Cyberspace Technological Standardization: An Institutional Theory Retrospective on the Generation Edge*

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Author's note – For a preliminary reading of this paper I would primarily recommend parts I, II and V.D.

ABSTRACT

The Clinton administration originally had made 'industry self-regulation' its guiding principle for standardizing cyberspace. So far, this principle has not been changed by the succeeding administration. This paper is a historical and conceptual assessment of that policy, examined through the prism of comparative institutional theory.

Historical analysis of the last two decades shows that industry 'self-regulation' was not always a coherent policy but partly a rhetorical device used to legitimize the government's own agendas, i.e. cyberspace's architecture and its infrastructure mandated design. Thus far, there are still far too many inconsistencies in its formal standardization policies. The intentions, actions and declarations aimed at further privatizing the net's funding and governance - on the one hand, as can be seen in the quasi-privatization of the Internet Corporation for Assigned Names and Numbers (ICANN) case study; On the other hand, the practice of offstage centralization of early infrastructure standardization policies.

Consideration of cyberspace's unique multi-layered architecture, will then attempt to answer the comparative institutional question of 'who should standardize the net?' This question would be subject to the distinctive production process of cyber standards. Thus, distinguishing between early infrastructure standardization on the one hand and complementing application standardization on the other. This is in reference to the FCC's incomplete legal category definitions.

This study will conclude with a set of comprehensive policy rules backed by a caveat; as with analogous IT standardization regimes, unless distinctive standardization categories and policies will be maintained en bloc and thus sequentially and context-based – cyberspace's present relatively successful institutional regulative reality may not always be preserved effectively also prospectively.

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I
INTRODUCTION

One of the most consequential ways to regulate cyberspace and shape its markets is by technological standard setting.[1] Seen too often as a gray and overly technical discipline, it is mistakenly, also a mostly neglected field of research on cyberspace regulation: That is, both as an independent field of regulation theory, and more specifically, as seen through the prism of institutional governance in cyberspace.

As with other technological fields of mass media standardization, i.e. broadcast, cable and satellite, TV and radio - cyberspace seems to have reached the degree of comprehensiveness, so as to be worthy of a wider perspective of comparative institutional analysis – wider than the one suggested by the U.S. government in its arguably nonexclusive category definitions.[2] Thus far, there is still too much ambiguity and inconsistency in its regulation (i.e., standardization) policies in cyberspace: intentions, actions and declarations aimed at further privatizing the net's funding and governance, on the one hand, as can be seen e.g., through the Internet Corporation for

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1 On the standardization discipline as an independent form of regulation, see, e.g., S. Breyer, *Regulation and Its Reform* (Harvard University Press, 1982) (for an economical perspective), p. 96 et al.; A. Ogus, *Regulation: Legal Form and Economic Theory* (Clarendon Press: Oxford, 1994), p. 150 et. al, and Fn. 1 & accompanying text; See, also, C. F. Cargill, *Open systems standardization: A business approach* (Prentice Hall PTR, 1997) (for an information technology perspective), pp. 26-29, 137-138; J. R. Reindenberg, *Lex Informatica*: *The Formulation of Information Policy Rules through Technology*, 76 Tex. L. Rev. 553, pp. 570-572 (for the cyberspace context) [Hereinafter, Lex Informatica]; J. R. Reindenberg, *Governing Networks and Rule-Making in Cyberspace*, 45 Emory L.J. 911 (concluding that standards in cyberspace embed policy choices, thus supplementing legal rules), pp. 918, 927-928.

2 On the need for technological comprehensiveness for standard setting, see, e.g., Martin C. Libicki, *Information Technology Standards: Quest for the Common Byte*, (Digital Press) (1995) (on the need for proper level of comprehensiveness in standard setting), pp. 16-18; T. M. Egyedi, *Institutional Dilemma in ICT Standardization: Coordinating the Diffusion of Technology*, 48, In Information Technology Standards and Standardization: A Global Perspective (K. Jakobs, ed.) (IDEA Group Publishing, 1999) (on the advanced need for implementation-dependent solutions for Internet standards, even more so than in other information technologies fields), p. 57; Ole Hanseth & Eric Monterio, *Participatory Standardization of Information Infrastructure, In International Perspectives on Information Systems: A Social and Organizational Dimension* (Savvas Katsikides & Graham Orange, eds.) (1998) ("The only general purpose information infrastructure in widespread use is Internet"), p. 174.

Assigned Names and Numbers (ICANN) self-regulation case study; And centralization and even natural monopolization of standard setting activities of *infrastructure* standardization, on the other.

With the commercialization of the net and the development of peripheral standardized software products, based on technological infrastructure platforms, the question of 'who should standardize the net?' can now be learned not only from experience of analogous technological fields, but ultimately also from within its own retrospective experience of mainly the last two decades.[3] This study attends this 'call of arms', while confronting the unique progress of what is, in essence, a technological standardization process.

As an institutional policy question, this study departs from Neil Komesar's comparative institutional theory insight: Acknowledging that all standardization institutions are subject to both internal and external imperfections - only a comparative approach vis-à-vis the identical assignments should arguably prevail.[4] Accordingly, whenever any institution may function inefficiently, alternative institutions may function even worse. By the same token, whenever the intrinsic worth of any institution might be apparent, alternative institutions may perform the same task even more effectively.[5] For example, upon examining market ability to self-standardize cyberspace, the operative question is not how well the market functions, but whether political institutions, i.e. government branches and/or other autonomous institutions e.g., industry standardization organizations, could produce a better outcome and should therefore prevail.

In doing so, this study will focus predominantly on the relationship between institutional analysis and standardization *production* policy as an ex-ante regulative mechanism. That is, instead of the more common concern about the ex-post antitrust and intellectual property legal implications of telecommunications regulation; or the traditional described relationship between commercial implementation of a new technology on *content* of legal (but even technological standards), as can also be viewed through the more general prism of regulation theory in cyberspace.[6] In the latter

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3 On the importance of precedents in designing standardization policies, see, e.g., S. Breyer, supra note 1, p. 99; Jason Oxman, *The FCC and the Unregulation of the Internet*, Counsel for Advanced Communications, (FCC OPP, Working Paper No. 31, 1999), at: <http://www.fcc.gov/Bureaus/OPP/working_papers/oppwp31> (last visited 28 August 2002) ("Where the distinction blurs between the regulated and the unregulated, between traditional categories of service and new methods of delivering traditional services…[T]he Commission should be guided by the last thirty years…"), p. 24; Kevin Werbach, *Digital Tornado: The Internet and Telecommunications Policy* (FCC OPP Working Paper Series 29, March 1997), at: <http://www.fcc.gov/Bureaus/OPP/working_papers/oppwp29.pdf> (last visited 28 August 2002), p. 26. In balance, Werbach warns us that there are reasons to believe that such analogies to familiar services may not be appropriate for the Internet due to real 'category' difficulties, id. Henceforth, any such analogy will derive from the proposition of contextual analysis, unless claimed otherwise.

4 Neil K. Komesar, *Imperfect Alternatives: Choosing Institutions in Law, Economics, and Public Policy* (1994), pp. 3-10.

5 Ibid, id.

6 So far, the latter prism is to be found in the core of the ongoing debate regarding application standards i.e. user-oriented software - as a regulative constraint, thus overshadowing the separate

forms of discourse, any institutional choice is mostly a reflection of an earlier pursued policy or defined 'rights', i.e. Lessig's constitutional urge for reducing 'code control', or Johnson and Post's freedom for regulative multiplicity.[7] From an institutional perspective, that discussion seems to be largely characterized by its placing of legal and other normative principles above the political *production* process and costs.

The Komesarian proposition, on the other hand, suggests that the mere reflection of any social goals and 'rights' on institutional choices are largely insufficient, as they tautologically imbed institutional choices of their own.[8] Accordingly, any social policy should become relevant only upon an earlier consideration of the proper institutional constraint.[9] In agreement with this line of thought, this study will suggest that any institutional choice should be seen, in essence, as an integral part of the general technological (and thus, social) goal and not solely its mere reflection. Indeed, the prevalence and form of IT standards are profoundly affected by the structure of cyberspace's regulative institutions.

Based on this proposition, this study will describe what ought to be viewed in future technological generations of cyberspace - a new multi-layered production process of technological standardization. Thus, offering an alternative synthesis to the existing top-bottom, bottom-up and industry standardization organization's single-layered regulation models[10]; that, as a general matter, seem all to fall short regarding the notable factor of *timing*.

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debate concerning system-oriented infrastructure standards. See, e.g., L. Lessig, *Code and Other Laws of Cyberspace*, (basic books, 1999) (explaining that his book and the present regulative discussion is (and should be) aimed at the standardized application layer), pp. 101-102; See, also, D. R. Johnson & D. G. Post, *Law and Borders--The Rise of Law in Cyberspace*, 48 Stan. L. Rev. 1367 (1996) (examining standardized applications e.g., copyright and trademark regimes as the point of reference in their regulative argument), pp. 1382-1391; Timothy Wu, *Application-Centered Internet Analysis*, 85 Va. L. Rev. 1163 (1999) ("[t]he whole Internet is rarely an appropriate level on which to generalize. Instead, legal thinking can better focus on where the variation that is apparent to the user is actually found: the application layer above the Internet's basic protocols"), p. 1164; Llewellyn J. Gibbons, *No Regulation, Government Regulation, or Self-Regulation: Social Enforcement or Social Contracting for Governance in Cyberspace*, 6 Cornell J. L. & Pub. Pol'y 475 (1997) (using the term cyberspace 'infrastructure' while focusing on 'application' standards instead e.g., email systems, World Wide Web, etc), pp. 481-487; Dan L. Burk, Federalism in Cyberspace, 28 Conn. L. R. 1095 (1996) (focusing on consumer protection applications and other public laws to police online behavior and commerce).

For a skeptical view of this trend, see, e.g., Carl Shapiro and Hal R. Varian, *Information Rules: A strategic guide to network economy* (Harvard business school press, 1999) (suggesting that "the Internet infrastructure is bound to become more regulated in the years ahead"), pp. 317-318.

7 L. Lessig, Ibid, id; D. R. Johnson & D. G. Post, Ibid, id, respectively.

8 Neil K. Komesar, supra note 4, ("calling something a 'right' is an institutional statement"), p. 43.

9 Ibid, (firmly suggesting that "the choice of social goals or values is insufficient to tell us anything about law and public policy either descriptively or prescriptively. One must seriously consider institutional choice in order to understand or reform law and public policy"), p. 271.

10 Neil K. Komesar, supra note 4 (suggesting that, originally, the available institutions are political institutions i.e. executive and legislative branches of government, market and the courts), e.g., p. 6. However, cyberspace technological environment embed, in practice, additional autonomous institutions i.e. industry, group consortias, etc, while minimizing the role of courts, as will be explained in § II.E, infra. For now, see generally, e.g., J. Farrell & G. Saloner, *Competition,*

As a reflection of the processional nature of this technological environment, the strength and weaknesses of one model versus another, will be measured in each sequential phase, as they may vary in both space, i.e. types of standards located on different layers of architecture, and from one production stage to another. Overall, the institutional choice between these different standard setters for each phase will be only a transitory choice among highly imperfect alternatives.

Lastly, with the purpose of comparing institutions, Komesar's position initially relies on a public choice legal process analysis:[11] That is, according to both the relative value of institutions, based on the levels of participation allowed by them, along side with their inherent participatory processes imperfections.[12] Nevertheless, for cyberspace's technological setting, this study will also confront the distinctive costs of standardization, which are to be found outside the partial scope of its institutional participatory process. Another presiding premise would, therefore, suggest that any institutional choice should be also subject to production costs that exist beyond the participatory process per se. That is, whenever strict legal process analysis falls short in supplying policy makers with a comprehensive result.[13] This study will, therefore, depart from the supported proposition that current law and economics, same as public choice and interest group theory, may be seen to share a joint objective and importance in standardizing cyberspace – as would be examined through the proper institutional analysis hereinafter. As a result, a preliminary cost-benefit analysis would be generally outlined in parts III-V, all in the following order.

Part II opens with a lead up description of the three technological benchmark criteria of the standardization realm. It upholds a conceptual definition of an IT standard, as a function of both technical maturity and commercial acceptance. Later on, this designation will also define the scope of the following discussion, as to exclude "non-standard" technology from the following policy discourse. Accordingly, a descriptive framework of the three standardization constrictions of: time, space and institutional identity - referring to the questions of 'when?', 'what?' and, ultimately - 'who?' can standardize, would be set up, respectively. In accumulation, all three define a triple scrutiny test bed for the competing standardization institutions in cyberspace. Methodologically, in the following parts both the criteria of space and institutional

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Compatibility and standards: The Economics of Horses, Penguins and Lemmings, Product standardization and Competitive Strategy 1 (H.L. Gabel ed., 1987), p. 1 et al.

11 Neil K. Komesar, supra note 4, pp. 53-58, 65-67, 128-138.

12 Ibid, id.

13 On the accumulative need for production costs, see, e.g., Edward L. Rubin, *The New Legal Process, the Synthesis of Discourse, and the Microanalysis of Institutions*, 109 Harv. L. Rev. 1393 (1996) (supporting a comprehensive synthesis to law and economics and the legal process movements for comparative institutional analysis), pp. 1394, 1411-1413, 1425-1437. See also, James G. March & Johan P. Olsen, *Rediscovering Institutions* (1989), pp. 1-2, 16-19; Paul J. DiMaggio & Walter W. Powell, *Introduction to The New Institutionalism in Organizational Analysis* 1 (Walter W. Powell & Paul J. DiMaggio eds., 1991), p. 11-15; Neil K. Komesar, *Exploring the Darkness: Law, Economics, and Institutional Choice*, Wis. L. Rev. 465 (1997), pp. 466-471.

identity would be dealt through the third prism of the different standardization phases, as follows.

Part III begins with the first among three – 'development' phase. In this early technological phase, new platform technology is typically introduced, beginning with it's generation from an idea to the development of a basic system product or process, thus creating the content of the first standardized core or infrastructure technology. In this early technological phase a theory of central political institutional inevitability i.e. mandated government intervention in infrastructure standardization will be upheld.

In retrospective, it will be suggested that apart from its self-regulation rhetoric - the U.S. government was justified in taking a dual regulative attitude towards what were two main distinctive purposes.[14] The first, as would be generally described through a broad cost-benefit analysis, was the central initiative to unify cyberspace's standardized infrastructure, namely - both the worldwide domination of the compatible TCP/IP set of protocols, along with the formal adoption of cyberspace's hierarchical multi-layered architecture.

Only, with what was a successful achievement of this early standardization goal, did the U.S. government continue to its second substantively different goal, namely - the gradual transfer of power over the Internet backbones into new market agents, namely - the predominant stakeholder interest groups of the traditional common carrier telecommunications and cable industries.[15] Conversely, for the latter objective, as will be critically evaluated through Olsen's 'collective choice' theory, the government rightly restrained itself into an indirect monitoring role to gradually encourage these interest groups into seizing control over growing larger backbone levels, in part or in full.

Part IV continues to the 'Modification' phase and explains how rapid innovative changes, through which cyber technology has undergone, was followed by extensive bargaining over technological change and later – commercial modifications as will be analyzed shortly. These changes are what, in essence, suggested to have led to the third and present commercial standardization phase.

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[14] For a description of secondary standardization policies, see, generally, e.g., Barry M. Leiner, Vinton G. Cerf , David D. Clark, Robert E. Kahn, Leonard Kleinrock, Daniel C. Lynch, Jon Postel, Lawrence G. Roberts, Stephen Wolff, *A Brief History of the Internet* (2000) <http://www.isoc.org/internet/history/brief.html> (last visited 28 August 2002) [Hereinafter, "Brief History"] , p. 8-9.

[15] The Telecommunications Act of 1996 adds the broad related category, "telecommunications" service, defined as follows: The term "telecommunications" mean the transmission, between or among points specified by the user, of information of the user's choosing, without change in the form or content of the information as sent and received. *47 U.S.C. §153(43).* [Hereinafter, "The Telecommunications Act"]. The term "telecommunications service" means the offering of telecommunications for a fee directly to the public, or to such classes of users as to be effectively available to the public, regardless of the facilities used. *47 U.S.C. §153(46).* As for the category difficulties this definition creates for Internet standardization purposes, see, also, the discussion at § II.D.2, infra.

Part V describes this concluding technological 'Implementation' phase. As it will be argued, whenever technology matures, the diffusion of new markets for both early core Internet telecommunications services and markets for application and conforming standardized products evolve – and should promote the raise of autonomous standard setting institutions. For that matter, four consecutive arguments will be raised. First, with the growing concerns about governmental 'technological bias' through cyberspace standardization policy-planning and 'code control', formal industry standardization is, arguably, the most efficient institution in chilling direct governmental incentives for intervention, beforehand or ex-post, as it is in chilling of anti-competitive market standard setters motivations. Upholding this comparative institutional argument - an updated cost-benefit analysis of the different commercial standardization costs i.e. administering, compliance and indirect costs for manufacturers and other agents, will be met.

Second, it will be further argued that apart from the limited *infrastructure* maintenance standard setting activity of the present phase, e.g. increase in bandwidth on the backbone transmissions links, better physical access from homes and businesses or even a more sophisticated network architecture - a government should restrain its former direct role from standardization activity, allowing Internet telecommunications providers and application standard setters to be constrained only ex-post by market forces, met by intellectual property and antitrust law.

Third, the *indirect* governmental standardization policy should then be promoted through two groups of proactive roles. The first, regulate supervision rules, which facilitate market production of standards by market agents. The second is to regulate procedural rules for the standardization process aiming at further confirming the legitimacy of both standardization decision-making and its outcomes. These technological policies will be examined, accordingly.

Fourth, it would be argued that one potential deviation from the supported general governmental policy for infrastructure standard setting may come in the form of the federal government involvement with the ICANN 'domain name system' (DNS) governance. Originally, the question of technological standardization was not raised properly as a policy question, thus undermining the need to decide on technological policy risks. In fact, it would be suggested that ICANN's technical mandate reaches potentially much further than might be literally understood from the varied formal documentation. Seen too narrowly as mere technological routine standard setting maintenance, it would be further argued that because no governmental guidelines were adequately established, the necessity for a visible and continuous technological standardization policy was potentially undermined (at least for infrastructure standardization as will be suggested beforehand, in part III.B) – as can be seen through the emerging institutional risk of self-standardizing the DNS.

Part VI will deduce several conclusions, which are suggested as policy rationales for future technological generations in cyberspace. The main conclusive proposition will be that the unprecedented development of cyberspace seems to provide theoreticians and decision-makers alike, i.e. FCC regulators, with a unique opportunity to develop a comprehensive, and thus chronological and context-based institutional standardization policy. This is in accordance with the different consecutive production phases and types of standards that result from this new technological realm vis-à-vis the U.S. government and FCC's existing legal framework.

Upon choosing the optimal standardization institution for each technological phase, the significance of this observation for the purpose of institutional theory in cyberspace, would arguably, be threefold. First, once different phases of technological development along with standardization institutions, which affect the market differently - are recognized, a rational standard setter would be also able to predict efficiently, the degree of compliance of each such standardized technology with a user-oriented competitive analysis, if at all. Second, the raise of different types of IT standards may then demand transitory regulatory conducts. Third, and ultimately, a comprehensive institutional framework could then be established for future technological generations in cyberspace. Establishing such framework is also the purpose of this study.

II
THE TECHNOLOGICAL TRIPLE SCRUTINY ANALYSIS

A. General

Trying to narrow the conceptual framework to cyber standardization - a preliminary description of IT standards, should be agreed upon. Based on that, the three facets of cyberspace's standard setting environment i.e. time – referring to the processional technological life cycle; space – referring to cyberspace architecture, established by different types of standards; and, finally, institutional identity – would be described hereinafter. In accumulation, all three would suggest a triple scrutiny analysis for the appropriate institutional choice in each of cyberspace's distinctive standardization phases (as will be implemented in the following III – V parts). Ultimately, as will be argued, these well-established technological criteria should then be acknowledged and processed into the FCC's incomplete legal category deliberations. Based on that, a contextual institutional standardization framework could then be finalized.

B. Information Technology (IT) standards – The methodological framework

Typically, the technical criteria used in defining an IT standard are in accumulation, twofold. First, technically, a technological standard is primarily viewed by the degree of its technical maturity. That maturity is most commonly viewed through the scope of a technological standardization process.[16]

Second, and as a reflection of the all-purpose standardization appraisal, i.e. institutional analysis, an IT standard is quantified as a function of its acceptance by the relevant

[16] For a practical industry perspective upholding this policy, see, e.g., at the Internet Engineering Task Force (IETF), a major IT cyber standardization organization, at S. Bradner, *The Internet Standards Process -- Revision 3*, RFC 2026 (Network Working Group) (Harvard University, October 1996) at: <http://www.ietf.org/rfc/rfc2026.txt> (last visited 28 August 2002) ("Specifications that are intended to become Internet Standards evolve through a set of maturity levels known as the "standards track"). Eventually, the IETF defined these maturity levels as -- "Proposed Standard", "Draft Standard", and "Standard", (The Internet standards track), at sec. 4 [Hereinafter, "the IETF"]. See, also, J. Postel (Ed.), *Internet Official Protocol Standards*, RFC 1800 (Network Working Group & Internet Architecture Board) (July 1995), at: <http://rfc.sunsite.dk/rfc/rfc1800.html> (last visited 28 August 2002) (for an earlier description of the maturity levels), at sec. 4;
For a supporting governmental perspective, see William J. Clinton & Albert Gore Jr., *A framework for Global Electronic Commerce* (1997), developed by the White House with the involvement of more than a dozen federal agencies, (concluding that "Premature standardization, however, can "lock in" outdated technology"), available at <http://www.ecommerce.gov/framewrk.htm> (last visited 28 August 2002), at § 9 [Hereinafter, "The Report"]; Stewart Crawford-Hines, *Formal Technical Reviews, Across All Maturities, Institute for Zero Defect Software*, at <http://www.izdsw.org/projects/FTR/maturity.html> (last visited 28 August 2002).
For a theoretical perspective, see, e.g., T. M. Egyedi, supra note 2, p. 49; See, more generally, Floyd Wilder, *A Guide to the TCP/IP Protocol Suite* (Second Ed., Artech House) (1998), pp. 368-370.

market, such as the cyber market.[17] Practically, this measurement is assessed through the intensity and the width of its recognition. Ultimately, this means real exercise by users. Naturally, that estimation typically derives from the recognition that the specified protocol or service used provides significant personal and social benefits to cyber participants and market, respectively.

Obviously, not every technological specification meets both criteria.[18] Any technological development that does not comply with both is generally regarded as a "non-standard" technology.[19] Usually it would be lacking the minimum degree of acceptance, based on the assumption that, originally, such technology was intended to be put on the standards track by its developers.[20] Another type of "non-standard" technology is found in specifications, which were previously defined as standards, until they were superseded by a more updated typical standard[21], or otherwise fell into abandonment or disuse by users.[22] In short, only specifications, which meet both criteria, are commonly regarded as IT standards. As potentially cohesive and stable technologies, these standardized specifications are found, justifiably, also at the focal point for cyberspace's institutional policy planning as a whole.

C. The technological life cycle: The criterion of time

In writings on information technology standardization, it is well accepted that the technical absorption of highly technological finished products (or routine product improvement processes[23]), into common usage, imbedding one standard or a more

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17 For a practical perspective, see IETF, which grants the strongest status, "Internet Standard", only to those specifications, which have already become widely adopted. See, IETF, supra note 16, § 4.1.3.
For a theoretical Information Technology perspective see, e.g., C. F. Cargill, *Information Technology Standards: Theory, Process, and Organization* (Digital Press, 1989), p. 42; Martin C. Libicki, supra note 2, pp. 18-19.
For an institutional analysis perspective, compare: e.g., G. March & J. P. Olsen, supra note 13, pp. 50-52.

18 Examples for standards that failed to congregate wide acceptance are most of the ISO standards for data communications, and the IEEE 802.6 standard for Distributed Queue Dual-Bus data communications, IETF, id.

19 The IETF, supra note 16, at § 4.2.1-4.2.4.

20 Ibid, ("Specifications that are not on the standards track are labeled with one of three "off-track" maturity levels: "Experimental", "Informational", or "Historic"), § 4.2.

21 Ibid, id.

22 Ibid, id.

23 On the difference between 'product standards' and 'process standards', see, Carl F. Cargill, supra note 15, pp. 59-61; Louis G. Tornatzky and Mitchell Fleischer, *The Processes of Technological Innovation* (1990), pp. 20-22; M. Blaug, *A survey of the theory of process-innovations*, Economica, *30, 13-22* (1963) (on the more wider context of 'product innovation' and 'process innovation'). Both of these IT definitions were finally adopted, separately, in The National Cooperative Production Amendments of 1993, Pub Law 103-42, 107 Stat. 117, June 10, 1993, 15 U.S.C.A. §§4301-4305) 15 U.S.C.A. § 4301(a)(6)(D) (regarding the definition of a term "joint venture") and accordingly in 15 U.S.C.A. § 4305(a)(3) (regarding the disclosure of the *purpose* of the joint venture) (For the Act, see also discussion at § III.C.2.b, infra). For a similar treatment, albeit in the distinct context of

complex group of standards[24], is neither immediate nor inclusive, but rather progressive.[25] Seen through a 'production stage model', there are, by and large, three consecutive independent technological phases, in the establishment of a standardized technology.[26] Jointly, all three are part of what is also known as a technological life cycle - a metaphor that typically describes the evolution of standardized technology from its emergence to its technological maturity and unavoidable decline.[27] In essence, a technological life cycle interacts with the standard process through the life of each standard or group of standards jointly.[28] As will be described hereinafter, each such production phase is technologically distinctive. As such, they will arguably require a separate policy approach, and also a separate institutional choice, as will be explained later on.

Broadly, in its early 'development' phase, a new technological innovation is introduced, beginning with idea generation to the development of a basic product or process, thus creating the content of the standard. In this phase, a standard is specified

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innovation, see, also, The 1995 IP Guidelines (defining "innovation markets" to consist of: ...the research and development directed to particular new or improved goods or processes…", id.

24 See, e.g., C. F. Cargill, supra note 1 ("usually quite a few standards will be invoked at once"), p. 142; A. Sloane, *The standards process: Tools and methods for standards tracking and implementations*, Computer Standards & Interface 22 (2000) 5-12, pp. 6-7; Bengt Hogberg, Lars Erik Norback and Thomas Stenberg, *Innovation in industrial Sectors – The cases of remote sensing and bioenergy* 157, In Organizing industrial development (Rolf Wolf, ed.) (1986) (upholding a broad definition of a 'life cycle' for the combination of software and hardware innovation process: "[t]he life cycle concept can be applied to different levels of analysis, i.e. to a technology, a product, or a branch of industry"), pp. 160-162.

25 See, e.g., J. Farrell & G. Saloner, supra note 10 (for the technological standardization perspective), p. 3; Louis G. Tornatzky and Mitchell Fleischer, supra note 23 (for the wider technological innovation perspective), pp. 27-3; and see Fn. 27, infra.

26 For the purpose of this study, only a production stage model will be discussed, in compliance with the public standardization production process perspective of this study. For one alternative model, see, e.g., Louis G. Tornatzky and Mitchell Fleischer, supra note 23 (discussing also a private user-oriented stage model and the interplay between both models), pp. 28-29.

27 In IT standardization literature, a variety of overlapping phases of this process were so far suggested. For several three-phased processes, see, e.g., R. Mansell & R. Hawkins, *Old Roads and New Signposts: Trade Policy objectives in Telecommunication Standards*. In F. Klaver & P. Slaa (Eds.) Telecommunication, New Signposts to Old Roads, p. 45 et al.; (IOS Press, 1992) (Suggesting the planning, negotiation and implementation phases); [*ISO80*], *General terms and their definitions concerning standardization and certification, ISO guide 2*, Geneva, 1980 (for a formal definition of 'standardization' as a three-phase process of formulating, issuing and implementing); T. M. Egyedi, supra note 2 (Suggesting the developing, inventing and diffusing phases), p. 49 et al.; M. J. Bonino & M. B. Spring, *Standards as change agents in the information Technology market, Computer Standards & Interfaces* (1991) 12, pp. 97-107; M. B. H. Weiss & M. B. Spring, *Selected Intellectual Property Issues in Standardization, at Information Technology Standards and Standardization: A Global Perspective* (Kai Jakobs, eds) (Idea Group Publishing 1999), p. 63 et al.
For a variety of analogous five-phased processional descriptions, see, e.g., Y. Y. Sivan, *Knowledge Age Standards: A brief introduction to their dimensions, at Information Technology Standards and Standardization: A Global Perspective* (Kai Jakobs, eds) (Idea Group Publishing 1999), p. 1 et al. (Suggesting the missing, emerging, existing, declining and dying phases); For an economical perspective, see, also, S. Breyer, supra note 1 (upholding an analogous five-phased standardization process), pp. 101-109.

28 See, e.g., C. F. Cargill, supra note 1, p. 142; A. Sloane, supra note 24, pp. 6-7; Bengt Hogberg, Lars Erik Norback and Thomas Stenberg, supra note 24, pp. 160-162.

also in its public form.[29] In this technologically oriented phase, any premature consumer-oriented price-based competition of technological knowledge is usually both technically premature and economically inefficient.[30] As a result, very little price-based competition transpires in this phase. In the development phase, radical innovations develop entirely new core standards.[31] As a whole, these standards are oriented toward increased technological performance, rather than an immediate market need. As a general rule, as in cyberspace, core or infrastructure standards usually establish a necessary technical platform for future standardized applications and any other complementary standardized technologies.[32]

In the second phase, the accepted technology generally undergoes rapid innovative changes. As competitors begin to challenge over consumer demands for enhanced complementing or application products and as extensive bargaining over modifications occur.[33] This arguably suggests a modification of the existing technical policies necessary for the emergence of new markets for core Internet telecommunications services and facilitating standardized applications. In the end of this phase the formal documentation of core-standardized technology is finally shared with the user community.[34] The modification phase also serves to enhance the creation of commercial products (or processes) that are to be finalized with the emergence of the following and last phase. In the intermediate modification phase no new type of standard is typically created.

In the last 'implementation' phase, due to technological and market limitations, technology matures, leading to the final diffusion of new markets for both core Internet telecommunications *services* and markets for application and conforming standardized *products*.[35] This activity typically propagates the unavoidable final decline of that same technology upon its standards, followed by the emergence of new product generations

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29 Hereinafter, regarded as the 'development' phase; See also, J.E.S. Parker, *The Economics of Innovation* 39 (1974), p. 48, Table 4.5; This dynamic correlation between the creation of innovations and standards is subject to a substantive change with the rise of standard commercialization, as will be described in § IV, infra.

30 See, e.g., J. Gregory Sidak, *An antitrust rule for software integration*, Yale J. on Reg. (winter 2001) 1 (suggesting that "in such a market, consumer knowledge is accumulating, and product demand is still immature and unstable"), p. 27; Michael Whinston, *Tying, Foreclosure, and Exclusion*, 80 Am. Econ Rev. 837 (1990) (suggesting that lack of technologic maturity leads to unclear ex-ante results and to ambiguous future welfare effects), pp. 855-856; Carl Shapiro, *Antitrust in Network Industries*, (1996) at: <http://www.usdoj.gov/atr/public/speeches/shapir.mar> (last visited 28 August 2002) (The key driver of consumer benefits in information industries is technological progress), at sec III.A; See also the discussion in part III.B.2.a, infra.

31 Hereinafter, referred as 'infrastructure' standards.

32 This technological incentive is particularly effective when it creates entirely new markets for standards. The difficulty in maintaining this incentive after the development phase will be discussed in part V, infra.

33 S. Breyer, supra note 1 (for a description of such bargains in various industries), pp. 107-108, 177-178.

34 Hereinafter, regarded as the 'modification' phase.

35 J. Gregory Sidak, supra note 30 ("In such a market, products are well-defined, both by the consumer demand that they satisfy and by the production technology through which firms supply them"), pp. 27, 28.

of a competitive nature (e.g., Internet Explorer (IE) generations).[36] In the third and last phase, complementary standards became largely oriented towards specific market needs of improving existing technology and further standardizing newer application and conforming standards.[37]

As implied, in addition to the procession dimension of time, potentially, these different technological phases, may ultimately imbed the creation of substantively different types of standards.[38] Accordingly, as a function of both technological and commercial needs, several *categories* of standards emerge, as part of the overall technological standardization endeavor, and as such serve as an additional independent regulative constraint, as will be described for cyberspace, hereinafter.

D. Cyberspace's architectural edifice: The criterion of 'space'

1. General

Subsequent to evaluating the function of *time*, a rational policy planner should continue in evaluating the more long-established question of '*space*', i.e. types of standards.[39] As will be described here, in cyberspace, that question would also be a function of architectural layer 'location'. However, even with technological standards the need for this criterion is, to some extent, less obvious. On the one hand, any overly strict definition of standards by type may lead to technological rigidity, as it might inhibit potential standard setters from developing additional and/or cheaper alternative standards.[40] On the other hand, identification of standards by type may potentially lower administrative costs and thus, also diminish both technological and economical uncertainty.[41] In balance, the latter notion upholding the criterion regarding types of standards has commonly prevailed, both in theory and in the FCC's practice.[42]

Thus, as early as 1966, the FCC opened the *Computer Inquiry* to study the interrelationship of computers and telecommunications technologies, and the use of computer-based services over telephone lines. The FCC Commission observed that "the growing convergence of computers and communications has given rise to a number of regulatory and policy questions within the purview of the Communications Act."[43]

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36 See, generally, supra note 27, id.

37 Hereinafter, referred as 'application' standards.

38 See, e.g., L. G. Tornatzky & M. Fleischer, supra note 23, p. 165 et al.

39 See, e.g., A. Ogus, supra note 1, pp. 165-168.

40 See, e.g., Ibid, p. 167.

41 Ibid, id. See, also, § III.B.2, infra.

42 However, due to the former argument's practical constraint, only the main distinctive types of standards in cyberspace would be examined independently, hereinafter.

43 See, *In the Matter of Regulatory and Policy Problems Presented by the Interdependence of Computer and Communication Services and Facilities*, 7 FCC 2d 11 (1966) (First Computer Inquiry), § 2 [Henceforth, "First computer inquiry"]. Overall, the three Computer Inquiries were a

These policy concerns still hold true today as they were more than three decades ago in the First Computer Inquiry.[44]

Later on, in the second Computer Inquiry, the Commission reaffirmed its essential regulatory approach to the provision of computer data services, but improved its analysis.[45] By distinguishing regulated telecommunications services from unregulated data services, the Commission created the categories of *basic* services (renamed telecommunications services)[46] and *enhanced* services (renamed information services).[47] The Commission also elaborated on the extent of structural separation required between the incumbent telephone provider and its enhanced services affiliate.[48]

Foreseeing that the future would bring the convergence and interdependence of computers and communications, the Commission was also aware of the difficulty of separating the two into discrete categories:[49] As described earlier, the Internet in its contemporary form did not exist at the time the FCC formed the basic/enhanced

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series of FCC regulatory proceedings that addressed the apparent convergence between telecommunications and computing. Although they partly influenced the Telecommunications Act, certain of their orders are still in effect, as will be described hereinafter.

44 Ibid, *First Computer Inquiry*, id.

45 This distinction was then formally adopted. See *Implementation of the Telecommunications Act of 1996: Telecommunications Carriers' Use of Customer Proprietary Network Information and Other Customer Information*, *Implementation of the Non-Accounting Safeguards of § 271 and 272 of the Communications Act of 1934*, as Amended, CC Docket No. 96-115, CC Docket No. 96-149, Second Report and Order and Further Notice of Proposed Rulemaking, FCC 98- 27 (released Feb. 28, 1998) ("Use of CPNI") at para. 46 (stating that telecommunications services and information services are "separate, non-overlapping categories, so that information services do not constitute 'telecommunications' within the meaning of the 1996 Act").

46 The Commission defined the term "basic" service, which referred to traditional common carrier telecommunications offerings as "the offering of transmission capacity for the movement of information." *Computer II, Final Decision*, (Computer II Final Decision), 77 FCC 2d 584, at para. 93 (1980). The Commission defined "enhanced services" as: "…services, offered over common carrier transmission facilities used in interstate communications, which employ computer processing applications that act on the format, content, code, protocol, or similar aspects of the subscriber's transmitted information; provide the subscriber additional, different or restructured information; or involve subscriber interaction with stored information", see, *46 C.F.R. § 64.702(a)*.

47 The Telecommunications Act broadly defines an "information service", but excludes "telecommunications services" as "the offering of a capability for generating, acquiring, storing, transforming, processing, retrieving, utilizing, or making available information via telecommunications, and includes electronic publishing, but specifically does not include any use of any such capability for the management, control, or operation of a telecommunications system or the management of a telecommunications service." See, *47 U.S.C. § 153(20)*.

48 *Computer II Final Decision*, 77 FCC 2d, at paras. 190-266; For a wider discussion about the three Computer Inquiries' genealogy, see, Barbara Esbin, *Internet Over Cable: Defining the Future In Terms of the Past*, (FCC OPP, Working Paper No. 30, 1998), at: <http://www.fcc.gov/Bureaus/OPP/working_papers/oppwp30.pdf> (last visited 28 August 2002), p. 25-26.

49 See, Jason Oxman, supra note 3, p. 7; Kevin Werbach, supra note 3 ("[e]ven the premise that Internet services should not be regulated requires a precise assessment of what constitutes an "Internet" service…With the increasing prevalence of hybrid services, joint ventures, and alternative technologies, such distinctions will always be difficult"), p. 46.

distinction and as a result is still (partly) subject to genuine category interpretive ambiguities in the cyberian context, at least: For a start, and broadly put, as the Commission acknowledged with respect to the line it drew between the two services: "[p]lausible arguments can be tendered for drawing it elsewhere. At the margin, some enhanced services are not dramatically dissimilar from basic services or dramatically different from communications as defined in the first Computer Inquiry."[50] For example, appreciative data processing, computer memory or storage, or some advanced switching techniques typically identified as enhanced services, can be components of a basic service if they are used solely to facilitate the movement of information.[51]

Second, this FCC's classification has focused entirely on the issue from a telecommunications perspective. That is, with no adequate consideration of cable-provided Internet services.[52] Instead, the Commission observed that because enhanced service was not explicitly reflected in the Telecommunications Act, there is no more a requirement to confront it with a specific traditional regulatory mechanism than there was for with cable television's formal elements of common carriage and broadcast television (then unregulated under the Act).[53]

Third, to date, "advanced telecommunications and information services" as those terms are used in section 254(h) to the Telecommunications Act, have been interpreted to include also "Internet services". Internet services, regardless of the identity of the entity providing them, could also fall under the section 706 definition of advanced telecommunications capability," which is defined "without regard to any transmission media or technology, as high-speed, switched, broadband telecommunications capability that enables users to originate and receive high-quality voice, data, graphics and video telecommunications using any technology."[54] Thus, even though the FCC has

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50 Computer II Final Decision, supra note 46, p. 434. In balance, the Commission avoided re-drawing the line at this margin due to its concerns that such action would potentially subject the issue to constant adjudication over the status of individual services offerings, id. However, as such distinctions are crucial for any institutional standardization analysis, such adjudication, is thus still necessary, and will be upheld in this chapter, hereinafter. See, also, Barbara Esbin, supra note 48 ("Regulators charged with implementing communications regulation find themselves unavoidably drawn into a process of determining the application or not, of existing rules whose terminology was established without regard to this new medium (The Internet, my emphasis, D.B.), for delivering communications services"), pp. i, 2.

51 *Computer II Final Decision*, supra note 46, p. 419-20.

52 Traditionally, cable service has been regulated as an integrated video, information content, and conduit service under Title VI to the Telecommunications Act. See, also, Barbara Esbin, supra note 48 (for an of integral cable-based analysis of Internet access services), pp. 3, 83-90, referring also to the *Report to Congress In the Matter of Federal-State Joint Board on Universal Service Under the Telecommunications Act of 1996*, CC Docket No. 96-45, FCC 98-67 (released April 10, 1998) ("Report to Congress"), where the FCC Commission expressly reserved for the future consideration of the "regulatory classification of Internet services provided over cable television facilities." Report to Congress, at para. 69 n.140, id.

53 Thus, the second Computer Inquiry states: "Precedent teaches that the Act is not so intractable as to require us to routinely bring new services within the provision of our Title II and III jurisdiction even though they may involve a component that is within our subject matter jurisdiction". See, *Computer II Final Decision*, supra note 46, p. 430.

54 Moreover, the use of "telecommunications" capability with no referral to any transmission media or specific technology raises the question of whether a new category of "broadband

repeatedly found that the old regulatory categories are integral to the 1996 Act's new "telecommunications" and "information" service categories, as already explained, section 706 still seems to give the FCC a new and flexible, but nevertheless an indefinite regulatory category of "advanced telecommunications capability".[55] Moreover, anticipating future technological developments, section 706(b) also directs the Commission (and each appropriate State commission) to periodically initiate and complete inquiries concerning the availability of advanced telecommunications capability. In essence, disguised as a facilitating interpretive tool - section 706 should also be seen as an additional obstacle in the search of Internet conceptual clarity.

Fourth, even while upholding the Commission's policy to regulating only the common carrier *basic* transmission service, while exempting *enhanced* services from common carrier regulation[56], there is still little or no guidance in answering the question about how the Commission *should* act towards Internet-based services.[57] For standardization purposes, there was also no adequate distinction between the question of regulating enhanced *services* and that of regulating (i.e. standardizing) their own production. Thus, implicitly leaving also the latter criterion to the competitive 'hands off' premise of Title II of the Telecommunications Act.[58] Moreover, the Commission even went on noticing that it still maintains regulative jurisdiction over enhanced services under the ancillary jurisdiction of Title I, on the grounds that the enhanced services under consideration "constitute the electronic transmission of writing, signs, signals, pictures, etc., over the interstate telecommunications network".[59]

Notwithstanding these interpretive difficulties, in the nowadays cyberspace these two dependent types of categories also give raise to two different types of standards. First, physical telephony infrastructure standards, supported by basic packet switching, transporting, addressing and routing standardized software (or protocols), which establish most of cyberspace's core or infrastructure standards. Originally, in the second Computer Inquiry and in subsequent orders, the Commission did come to address the implications of packet-switching technologies for this regulatory

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telecommunications" services that is different from either "telecommunications services" or "cable services" under the Act is therefore added to the above. That question, as well, albeit secondary in scope (potentially belonging to the basic services' carrying industries), still seems to add to the present categorical ambiguity.

55 See, e.g., Barbara Esbin, supra note 48 ("The new statutory category of "advanced telecommunications capability," itself, which speaks not in terms of services and service providers, but of "capabilities," may arguably be utilized to develop a new regulatory framework better suited to fluid the types of communications capabilities made possible by the Internet"), pp. vi, 116; S. M. Benjamin, D. G. Lichtman, H. A. Shelenski, *Telecommunications law and policy*, (Carolina Academic Press, 2001) (for a description of a variety of technological services and products derived from § 706), p. 867.

56 See, e.g., J. Scott Marcus, *The Potential Relevance to the United States of the European Union's Newly Adopted Regulatory Framework for Telecommunications*, at: <http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-224213A2.doc> (FCC OPP, Working Paper No. 32, 2000) (last visited 28 August 2002), p. 6.

57 See, e.g., Kevin Werbach, supra note 3, p. 29.

58 As mentioned earlier, the latter criterion of enhanced (i.e. application) standards' production will also be the focal point of the following III-V parts, infra.

59 *Computer II Final Decision*, supra note 46, p. 432.

framework.[60] It was legally admitted that the use of packet switching and error control techniques[61] "that facilitate the economical, reliable movement of [such] information [do] not alter the nature of the basic service".[62]

Second, computer software products, which establish most of cyberspace's following application standards and are to be found in the user-oriented 'application' layer of cyberspace's architecture. Here as well, these functions involve substantial computer processing and interaction with customer-supplied information, information-processing functions, such as authentication, email storage and retrieval, Web page hosting, and domain name server lookups - and therefore fall squarely within the definition of enhanced services.[63] Specific enhanced services also include protocol processing and electronic publishing, as well as the provision of access to data networks such as commercial online services and the Internet.[64]

Ultimately, both types of services upon their standards should, arguably, also pave the way for a more comprehensive and accurate multi-layered and standard-based understanding than the present one. That is, subject to the notion that the higher the layer and production phase are - the more specific the purposes of its standards become. Later on, with cleared categories, it will finally be possible to finalize the net's institutional regulative policy, at large (as will later be done in the following III-V parts).

2. Infrastructure Standards

In the face of the existing categorical ambiguity, technologically, cyberspace, and more distinctively, the Internet or the 'interconnected networks', are presently clearly and commonly defined by a unified architectural backbone structure and a unified set of core protocols, together known as the TCP/IP.[65] These refer to a large number of

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60 For further discussion concerning the applicability of the basic/enhanced distinction to Internet telecommunications services, see Kevin Werbach, supra note 3, p. 31, referring to Robert Cannon, "*What is the 'Enhanced Service Provider' Status of Internet Service Providers*?" FCBA News , February 1997.

61 *Computer II Final Order*, supra note 46, p. 420.

62 For example, in subsequent decisions the Commission has determined that packet-switched networks following X.25 protocols, and frame relay service offerings, provide a basic transport service. See, *Application of AT&T for Authority under Section 214 of the Communications Act of 1934, as amended, to Install and Operate Packet Switches at Specified Telephone Company Locations in the United States*, 94 FCC2d 48, 55-57 (1983); *Independent Data Communications Manufacturer's Association, Petition for Declaratory Ruling that AT&T's InterSpan Frame Relay Service is a Basic Service*, Memorandum Opinion and Order, DA 95-2190 (released October 18, 1995); See, also, Kevin Werbach, supra note 3, p. 32.

63 Ibid, pp. 32-33.

64 Ibid, id.

65 A "backbone" is basically a telecommunications line (either owned or leased) that links one or more locations together.

protocols that make part of the different levels of its standardized infrastructure technology. In general, the North American architecture, in connection with Europe through the EBONE communication supporter, consists of three autonomously managed levels of hierarchical standardized architecture, thus imbedding an independent data structure. Each of these levels represent a function performed when data is transferred between cooperating applications across the network, in the following hierarchical order: National Backbones (e.g., NSFNET)[66] which are attached among themselves, through (inter-) national network interconnections facilities, and down the line also to mid-level networks (E.G., Midnet), which are attached to local service providers (e.g., UCSD).[67]

The latter backbone level is also ramified into five additional infrastructure standardized levels, beginning with different IP networks (e.g., 132.287.n.m), which are attached to IP sub-networks (e.g., 132.287.51.n), which are attached to IP Host/end-systems (e.g., 132.287.51.6)[68], which are attached to end-users (persons), which are attached to networked applications (e.g., X-Windows).[69]

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[66] A 'national backbone' is one "maintaining a hub city in at least five different states, spanning both coasts, and peering at the major NAPs." *Boardwatch Magazine Directory of Internet Service Providers*, Vol. 2, Fall 1997, at 27.

[67] The FCC, which refers to cyberspace's 'lower' physical telephony infrastructure through four physical categories, formally suggested an analogous definition: backbone, middle mile, last mile and last 100 feet. (*FCC Inquiry concerning the development of advanced Telecommunications, second report, FCC 00-290, 2000 WL 1199533 (2000))*. Being aware of the need for future flexibility, the additional definition of "Advanced telecommunication capability" was widely defined in the Telecommunications Act, section 706(c)(1), as to include 'upper' broadband telecommunications capability "using any technology", i.e. cyberspace's physical telephony infrastructure. In essence, the FCC regulators left this accompanying definition dynamic, so to have it adjusted in the future, stating that "future reports will reconsider it in light of changing conditions of both supply and demand…we may change the definition…we emphasize that our definition of advanced telecommunications capability will evolve over time", ibid, § 14.

[68] A "host" is a computer directly connected to the Internet. Still, it does not accurately reflect the actual number of Internet users, and is usually shared by groups of users and is thus smaller than them in size.

[69] See, e.g., H.W Braun & K. C. Claffy, *Network Analysis for a Public Internet, In Public Access to the Internet* (B. Kahin & James Keller, eds.) (The MIT Press, 1995), pp. 353-356; Compare: Craig Hunt, TCP/IP: Network Administration (2nd Edition, O'reilly 1997) 1-22, 6, 8-9 (part 1) (for a functional-based description of the TCP/IP architecture in four levels only: "network access" (referring to the three backbone network levels); "Internet" (referring to the IP Networks and sub-networks levels); "host-to-host transport" (referring to the IP Host/end-systems) and the "application" level (referring to the end-users and the networked applications levels); For an analogous four-layer description, containing the Link, Network, Transport and Application layers, see ISO/OSI Network Model description, at: <http://www.uwsg.iu.edu/usail/network/nfs/network_layers.html> (last visited 28 August 2002). I will, hereinafter, suggest focusing on Hunt's four labels and referring to them as layers. Previously, the Federal Networking Council (FNC) has unanimously upheld the existence of a layered architecture, as part of the Internet's definition ("'Internet' refers to the global information system that…(iii) provides, uses or makes accessible, either publicly or privately, high level services layered on the communications and related infrastructure described herein") (October 24, 1995). See, also, RFC 1958, B. Carpenter, *Architectural Principles of the Internet*, at, <http://www.cis.ohio-state.edu/htbin/rfc/rfc1958.html> (last visited 28 August 2002), pp. 2-4. The concluding networked standards layer, i.e. the application layer and standards, will be discussed independently, infra.

Ultimately, the different layers also differ in their standardized system-oriented specifications. First, in the three backbone levels, consisting of the "network access" layer, very few protocols operate, as they handle relatively uncomplicated network interactions exclusively. This layer defines the network hardware and device drivers. As far as standardization matters, these 'non-consumer-oriented' levels include technologies for network management (e.g., the Simple Network Management Protocol (SNMP)[70], the Ethernet standard for local area networks[71] and the Frame Relay packet-switched data communication service[72]), standardized management interfaces for various classes of equipment (e.g., the Fiber Distributed Data Interface (FDDI) for the 100 Mbps local area networks[73]), and other operations issues.

Second, more protocols exist at the next two levels up – the IP networks and sub-networks layers, or the "Internet" layer, where the IP protocol prevails. As a general matter, they are both responsible for routed data interchange between hosts and across network links, through addressing and moving of packets (e.g., the IP Version 6 standard (IPv6)[74]), addressing-related issues (e.g., the Dynamic Host Configuration standardized Protocol (DHCP)[75]), Open Shortest Path First (OSPF)[76] or the border Gateway Protocol.[77]

Consecutively, the third and last infrastructure layer to follow is the "host-to-host transport" layer, referring to the IP Host/end-systems level. The function of this layer is to make the Internet more useful to its users and easier to use. This layer includes telecommunications and transport standardized protocols (e.g., the Transmission Control Protocol (TCP)[78]), and more general standards for providing sufficient quality of service.[79]

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70 Floyd Wilder, supra note 16, pp. 246-276.
71 Ibid, pp. 19-33.
72 Ibid, pp. 83-88.
73 Douglas E. Comer, *Interworking With TCP/IP* (vol. 1: Principles, Protocols, and Architecture) (3rd ed., Prentice Hall) (1995), pp. 32-33.
74 Floyd Wilder, supra note 16, pp. 155-164.
75 Ibid, pp. 199-208.
76 Ibid, pp. 213-226.
77 Ibid, pp. 227-235.
78 On the TCP protocol, see, Floyd Wilder, supra note 16, pp. 165-172; Carl Shapiro and Hal R. Varian, supra note 6, p. 237; See, also, the following Requests For Comments (RFC): *the standards "legislation" of the Internet*: RFC 793 (LAS) <http://www.faqs.org/rfcs/rfc793.html> (*TCP*) (last visited 28 August 2002); RFC 791 <http://www.faqs.org/rfcs/rfc791.html> (*IP*) (last visited 28 August 2002); RFC 894 <http://www.faqs.org/rfcs/rfc894.html> (*Ethernet and IP*) (last visited 28 August 2002); RFC 882 <http://www.faqs.org/rfcs/rfc882.html> (*Name servers*) (last visited 28 August 2002).
79 This layer is generally dominated by two different protocols: YCP and UDP, which are responsible for negotiating the flow of data between any two network hosts. See generally, Floyd Wilder, supra note 16, pp. 163-164; Douglas E. Comer, supra note 73, pp. 179-190.
For an industry perspective on these layers, See, e.g., The IETF internal division, at <http://www.ietf.org>. For a list of dozens of working Groups in the mentioned areas, see, e.g., <http://ietf.org/html.charters/wg-dir.html> (last visited 28 August 2002); For a U.S. governmental similar perspective, see: *The Report*, supra note 16, § 9.

As described, all of these three are breeding grounds for strict system-oriented standards, which together establish the net's infrastructure. As such they are also subject to separate standardization costs and as will be later argued - also a separate institutional choice.

3. Application Standards

On top of these three infrastructure layers comes the forth layer in hierarchy, namely the 'application' layer, referring to the end-users and the networked application levels of the Internet. The function of these standards is essentially twofold. For a start, as TCP/IP-compatible standards, they are developed in order to facilitate the operation of the infrastructure core standards. Such are the most familiar standardized network application protocols (e.g., the HTTP, FTP and SMTP, NFS, DNS, arp, rlogin, talk, ntp and traceroute).[80] These standards are also these that finally come to interact between clients (our personal computers) and the relevant data storage, namely the servers.[81] A second application of these standards carries an independent innovative nature - With the emergence of new markets and sub-markets, as part of the variety of Internet computer software products, the application layer has given rise to: browsers, operating systems, encryption modules, contract infrastructures, electronic payment systems and security equipment (e.g., the IP Security (IPSec) protocols[82] and XML Digital Signatures[83]), X-Windows, Java, e-mail systems, etc.[84] In essence, application standards are distinct from infrastructure standards in both specifications and function. As user-oriented standards application standards as well, embed unique standardization costs and as will be argued accordingly – they ultimately imbed a separate institutional choice.

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[80] Floyd Wilder, supra note 16, pp. 293-356; and see, also, Fn. 207 & accompanying text, infra.

[81] Of central importance to this interaction are: HTTP (Hyper Text Transfer Protocol), which is also the most widespread used protocol in this layer, and is a protocol to publish (and read) hypertext documents across the Web; FTP (File Transfer Protocol), is a protocol for transferring files; SMTP (Simple Mail Transport Protocol), is a protocol for transferring electronic mail. Douglas E. Comer, ibid, pp. 344-347, 299-304, 315-323, respectively.

[82] Ibid, pp. 471-488.

[83] See, e.g., *Extensible Markup Language (XML)* at: <http://www.w3.org/TR/2000/REC-xml-20001006> (last visited 28 August 2002).

[84] This same application layer lies also exclusively (and, arguably, only for the time being) in the core of the ongoing debate regarding application software as a regulative constrain. See, e.g., L. Lessig, supra note 6, pp. 101-102; D. R. Johnson & D. G. Post, supra note 6; D. G. Post, supra note 6; D. G. Post, supra note 6; Llewellyn J. Gibbons, supra note 6; Timothy Wu, supra note 6; Carl Shapiro & Hal R. Varian, supra note 6. Still, there are reasons to assume that this important debate will eventually expand, to the other infrastructure layers as well, only to follow the present cable and other telecommunications fields in and beyond the scope of software application standards, as will be upheld also in this study.

E. Standard setting institutions: The criterion of institutional identity

Finally, in the survey for the standard setting constituting criteria, lay its competing regulative regimes. Along with the criteria of timing of technological standard setting and space – referring to type of standards by function and location – this third criterion jointly suggests a three dimensional matrix of institutional choices, for policy makers to complete. Initially, institutions that regulate technological standards differ according to several variables. First, the degree of regulative formality, which evaluates the degree of legality and influence of its legitimate elective legislators. Turning to comparative institutional theory, March & Olsen address this question, while questioning both the primacy of such action and its outcomes.[85] Accordingly, the core task of political institutions is to confirm the legitimacy of choices made, by securing that relevant people are involved and by an appropriate control structure.[86] These same elements are arguably evident also in standardization 'ideology', as they define the role of formal standards bodies as guardians of the process.[87] Thus, standardization procedures should, eventually, serve also to legitimize the process of standardization. In all standardization bodies such specifications are just a starting point, and the ultimate test of a standard is whether it meets general acceptance, as suggested earlier. Functionally, standard setters carry also a role of checking the level of acceptance of their standards in relevant markets, i.e. cyber markets and sub-markets, through the intensity and width of their recognition and ultimately, through actual exercise by users. Measuring that acceptance typically derives from the recognition that the specified protocol or service used provides significant benefit to the cyber community and market.[88]

Second, these variables also include the degree and type of monopolistic power over the right to supply, vis-à-vis the regulated status of all suppliers in a given market, as will be analyzed accordingly.[89] Third, the degree of their legal status, while evaluating their binding force and enforcement efficiency of a given standard.[90] As a general matter, such performance, in any event, is more difficult to monitor for several reasons. For a start, legally - in the United States there is no official means test for ascertaining whether or not a standardization organization is a formal or informal standard developer.[91] Moreover, this differentiation is also blurred, empirically - there being no

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85 G. March & J. P. Olsen, supra note 13, pp. 50-52.

86 Ibid, id.

87 See, e.g., Louis G. Tornatzky and Mitchell Fleischer, supra note 23, pp. 41-42.

88 G. March & J. P. Olsen, supra note 13, id.

89 See, e.g., ibid, id; Louis G. Tornatzky and Mitchell Fleischer, supra note 23, p. 41 (and Fn. 4 & accompanying text).

90 Ibid, id.

91 In the United States alleged formal standards developers may request to be formally accredited by the American National Standards Institute (ANSI) (http://www.ansi.org) (last visited 28 August 2002). As part of both a non-binding and voluntary initiative, ANSI requires written procedures with strict requirements for openness, balance, consensus and other due process. Internationally, the situation is not substantively better off, as alleged formal standards developers may be created by declaration of treaty agreements between cooperative nations, such as the International Telecommunication Union (ITU) or by national policies which recognize a standards organization, such as the International Organization for *Standardization/International Electrotechnical*

experiments with competitive self-regulation, no real market for the *control* of standard setters; and no easy option of dismissal of ineffectual officials or even market standard setters by the principals (politicians and citizens).[92]

Nevertheless, in practice, submitting to these characteristics, different types of standardization regimes were eventually characterized and defined as such. In one of the seminal articles on standardization, Farrell and Saloner identify what became commonly regarded as five distinctive types of such regimes, typically as a function of their standardization endeavors.[93] The first, and less influential in cyberspace, is standardization activity generated by internal decisions of autonomous firms i.e. whenever there is only one vendor.[94] Closely related to that is the second type of standards emerging from a mutual agreement among several manufacturers, whether formal or informal, binding and/or voluntary – aiming at finding consolidating potential different interests among the parties to the agreement.[95] Third, market *de facto* and industry *gray* standards could be developed and then absorbed by consumers through historical accidents[96], and more so by strategic choice of consumers in a competitive natural selection process, later to be adopted and dominate the entire relevant market.[97] This is made possible after such a standard achieves a predominant market share over potential competitors. These three formats are commonly known as informal standards

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Commission (ISO/IEC) joint technical committee, ISO/IEC JTC 1 (http://www.jtc1.org/) (last visited 28 August 2002). Draft of 'International Standards' adopted by the joint technical committee are circulated to national bodies for voting. Publication as an International Standard requires approval by at least 75% of the national bodies casting a vote. On the activities of ISO/IEC JTC 1, see, also, C. F. Cargill, supra note 1, pp. 200-204, 269-270.

92 See, e.g., J. Farrell & G. Saloner, supra note 10, p. 5.

93 Ibid, pp. 2-5; A. Ogus, supra note 1, pp. 108-109; M. A. Lemley, *Antitrust and the Internet Standardization Problem*, 28 Conn. L. Rev. 1041, (1996) (focusing on the government, industry players and de facto standards); M. A. Lemley, *Standardizing Government Standard-Setting Policy for Electronic Commerce*, 14 Berkeley Tech. L. J. 745, 747; B. Toth, *Putting the U.S. Standardization System into perspective*, StandardView, 4(4) (for a review of the presiding organizations inside the U.S.), pp. 169-178.

94 J. Farrell & G. Saloner, supra note 10 (concluding, however, that a final analysis for both this regime and beyond is neither mutually exclusive nor independent), p. 2.

95 Ibid, (adding that this type of standard setters face all the problems of autonomous firms, and more), id; Carl Shapiro and Hal R. Varian supra note 6, pp. 236-237.

96 See, Brian W. Arthur, *Competing technologies and lock-in by historical small events: The dynamics of allocation under increasing returns*, Tech. Rep. 43 Center for Economic Research, Stanford University, Jan. (1985) (modeling technological choice under increasing returns by consumers as a random process); Paul A. David, *Clio and the economics of QWERTY*, Am. Economic Rev. 75, 2, May 332-337 (further explaining the development of the type writer keyboard from this approach); Paul A. David, *Some new standards for economics of standardization in the information age*, In Economic policy and technological performance (P. Dasgupta and P. Stoneman eds.) (Cambridge University Press, 1987) (Further confirming Arthur's study on historical lock-in under increasing returns).

97 See, L. M. Katz and C. Shapiro, *Network Externalities, competition and compatibility*, Am. Economic Rev. 73(3) June, 424-440; L. M. Katz and C. Shapiro, *Product compatibility choice in a market with technological progress*, Oxford Economic Papers 38 (Nov.) 145-165 (formalizing Arthur's notion (see Fn. 96 above) into a theoretical model describing consumer's choice of technological products as a strategic consideration).

(including *de facto, gray or ad hoc*[98] *standards*), and are produced by non-legally binding autonomous market forces (*de facto)* or even particular groups (e.g., non-profit organizations) or consortia (*gray*) standardizing autonomously.[99] Standards designed by de facto standard setters (but less so, gray standards) are typically driven by self-interested implementers and tend to be both proprietary and close. Consequently, they are especially interesting legally, for the reason that particularly in the implementation phase they tend to raise a variety of issues concerning the proper scope of antitrust and intellectual property law in influencing market outcomes.[100]

A fourth type of standardization institutions is government, usually through delegated regulatory agencies or organizations. The standards they produce are typically made to serve, and thus penetrate an entire industry. Finally, standards introduced by intra-national, and more so, international standardization organizations operating jointly, through special agencies.[101]

These last two regimes are commonly known as formal (*de jure*) standards and standard setters. They are processed by traditional political standard development organizations, such as the International Organization for Standardization (ISO), Internet Engineering Task Force (IETF) etc., scientific or professional societies, trade associations or other types of industrial standard organizations, which may operate in accordance with official formal regulative bodies.[102] Historically, in other fields of media, standardization used to be the prefecture of international industry standardization organizations e.g., the ITU, ISO and the International Electrotechnical Commission (IEC). With time, standardization activity expanded to the two additional institutions i.e. de facto and governmental standardization bodies.[103] As in the

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98 For a preliminary description of Ad Hoc standard setting activity and institutions, see, e.g., Martin C. Libicki, supra note 2, pp. 18-20.

99 In few cases, companies may operate outside the established standard-setting organizations in consortia to form standards. For a preliminary description of consortia, see, Roy Rada, *Consensus versus Speed*, In Information Technology Standards and Standardization: A Global Perspective (Kai Jakobs ed.) (2000) 19, pp. 30-31; For a description of gray standardization institutions, see, e.g., T. M. Egyedi, supra note 2, pp. 54-55; For one example of such activity, see, also, e.g., *the Bluetooth consortium*, a group of companies that has formed a "Special Interest Group" in order to develop standards for wireless connectivity for communications appliances, at: <www.bluetooth.com> (Last visited 28 August 2002).

100 As typical ex-post legal concerns, these legal aspects will, largely, remain outside the scope of this study, which as explained earlier – wishes to focus on the standardization production process, generally seen as an ex-ante regulative constraint.

101 J. Farrell & G. Saloner, supra note 10, p. 4; R. T Nimmer, *standards, antitrust and Intellectual Property, in PLI/Intellectual Property-Antitrust* (1997); K. Lee, *Global Telecommunications Regulation: A Political Economy Perspective* (London, 1995) (for a description of the telecommunications field main precedents: the International Telecommunications User Group (INTUG), Intelsat or Eutelsat), pp. 121-122; *Formal methods in standards: A report from the British Computer Society (BCS) working group* (C.L.N Ruggles ed.) (London, 1990) (for a broad description of the various early European and American-based International standardization organizations), pp. 7-8.

102 E.g., R. T Nimmer, Ibid, id.

103 P. Mähönen, *The Standardization Process in IT – Too Slow or Too Fast?, at Information Technology Standards and Standardization: A Global Perspective* (Kai Jakobs, eds) (Idea Group Publishing 1999) 35, p. 37.

telecommunications field, cyberspace is also subjected to all three, albeit not necessarily in that evolutionary order, as will be described in the following parts.

F. Conclusions

As shown, the absorption of high technology, through one or more standards, into ordinary usage in IT markets, i.e. cyberspace, is sequential. Generally, there are three consecutive independent technological phases, in the establishment of a standardized technology, beginning with the emergence of a technology in the development phase and ending in a full technological life cycle with the maturity and decline of the standardized technology in the termination of the implementation phase. Next to the conceptual variation in the technological phases, standards and thus, standard setting activity varies, accordingly, in space, with the partition of cyberspace's standardized architecture into four layers. Broadly, one can draw a clear distinction between the first three system-oriented layers on the one hand, and the fourth user-oriented layer on the other hand. These two groups of layers consist of substantively different technological standards, and in accordance also different regulative costs and concerns:

First, the three lower layers imbed infrastructure standards, made to maintain expensive lines[104], through data networking equipment[105], Internet backbone telecommunications and cable services, intended to carry traffic.[106] As seen, this type of standard is most common to the, typically, early development phase. Second, the latter application layer, which involves a substantively different type of standards: namely, application standards, which establish most of cyberspace's computer software products, and are to be found primarily in the following implementation phase of IT standardization activity, such as in cyberspace.

Once conceptual different phases of technological development, and in accordance, different technological standards are recognized - a rational policy-maker should be able to predict efficiently, the degree of regulative compliance of each such standardized technology with typical price based Kaldor-Hicksian efficiency, if at all. This in his or her way to establish a comprehensive regulative policy. Based on that, any optimal institutional choice will have to be met along the following three technological phases, upon their distinctive standardization activity.

[104] But lots of cheap routers that manage a limited number of (these expensive) lines. See, e.g., J. K. MacKie-Mason & H. R. Varian, *Pricing the Internet, In Public Access to the Internet* (B. Kahin & J. Keller eds.) (estimating that this conclusion is reflected in the rapid decline from expensive routers to expensive transmission links), p. 273.

[105] Both oriented at clients (modem, ISDN, cable) and servers (routers, modem pools, and call aggregators).

[106] E.g. hybrid fiber-coax to cable and digital cable for higher-speed PC Internet connections.

III
THE DEVELOPMENT PHASE: THE POLITICAL INSTITUTIONAL INEVITABILITY

A. General

The U.S. official policy regarding cyberspace standard setting never dealt appropriately with the difference between the infrastructure and application standard setting.[107] It has even largely ignored the existence of the standardization process itself. So far, the Report has largely focused its standardization policy on application standard setting. This part tries to evaluate the overshadowed infrastructure endeavor of the early 1990's development phase with a generalized view of infrastructure standardization for future technological generations. In doing so, a separate analysis of both the establishment the net's architecture and core standards themselves, and the backbone transit services, which followed, will be met.

B. Infrastructure telecommunications services: The collective choice analysis

As known, in its first twenty years the Internet started as a U.S. government military project. It was later transferred to the National Science Foundation (NSF), where it was operated for another decade.[108] Originally, it was the NSF who started the process that led to the comprehensive standardization of the nowadays cyberspace technological generation. Nonetheless, before evaluating this top-bottom standardization policy – the relevant factual background should be first upheld, as follows.

Historically, following the experience of other telecommunications industries, the NSF realized the need for unified wide area infrastructure to support the early NSFNET.[109] That realization immediately led to the adoption of two main *regulatory standardization* policies. The first was the decision taken in 1985 to unify the TCP/IP set of protocols as a worldwide mandatory infrastructure for the NSFNET program at large.[110] In time, that decision was what marginalized the other competitive computer

[107] The Report, supra note 16, § 9. As can be learned from the Report, the U.S. government applies its policy broadly, and made no distinction between infrastructure standards, such as 'high-speed network technologies' and application standards, such as 'electronic copyright management systems', id. This conclusion also derives from the earlier discussion regarding the FCC's category differentiation, see, § II.D.1, id.

[108] See, e.g., S. Bickerstaff, *Shackles on the Giant: How the Federal Government Created Microsoft, Personal Computers, and the Internet*, 78 Texas L. Rev. 1, (1999) (describing the major developments in these years while concluding that today's Internet market exists as a result of that government intervention rather than early free market competition), id.

[109] C. F. Cargill, supra note 17 (on coordinated *mandatory* policies, as *regulatory* standardization), pp. 64-65.

[110] See, *Brief History*, supra note 14 (Describing the transition of the ARPANET host protocol from NCP to TCP/IP as of January 1, 1983, requiring all hosts to convert simultaneously or be left having

network protocols and the dominance of the addressing IP system.[111] In addition, the NSF also decided to support DARPA's existing Internet organizational infrastructure hierarchy, assembled by the previous Internet Activities Board (IAB) in the decision known as the 'Request for Internet Gateways' (NFS network Technical Advisory Group of RFC 985).[112]

With this successful imposed domination of DARPA and the NSF's interoperable infrastructures, the federal government was ready to enlist the telecommunications and cable industries to further build the net's infrastructure and promote private investment.[113] The ultimate purpose for that initiative was to develop an independent network, from direct federal funding or governance.[114]

Early in this development phase, consumers with no or very little small extra expense could use distributed access rights to these backbone transit services. Infrastructure access was then a major part of the delivered service cost and to the extent that additional users accessing the net did not increase that basic cost.[115] This seeming governmental natural monopoly on access services was about to change, as cyberspace usage vastly expanded.[116] This massive growth started requiring larger lines and additional connections, as on-line crowding became increasingly notable. Here as with earlier telecommunications industries, it was clear that the marginal cost of serving that

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to communicate via rather ad-hoc mechanisms: "This transition was carefully planned within the community over several years before it actually took place and went surprisingly smoothly (but resulted in a distribution of buttons saying "I survived the TCP/IP transition")"), p. 8. Beforehand, the individual networks were largely not TCP/IP compatible, id.

111 Ibid, *Brief History*, p. 9.

112 RFC 985, *Request for Internet Gateways* (NFS network Technical Advisory Group of RFC 985), at: <ftp://ftp.isi.edu-notes/rfc985.txt> (last visited 28 August 2002), p. 8; The official document defining the areas of responsibility of the IAB is RFC 1160, at: <ftp://ftp.isi.edu-notes/rfc1160.txt> (last visited 28 August 2002); For more, see, Floyd Wilder, supra note 14, pp. 6, 366 (appendix A).

113 See, e.g., P. Mähönen, supra note 103 (agreeing that a "firm standard is needed for ensuring interoperability…before large investments are made"), p. 42;
For the U.S. government public policy concerns, see: *United States Dep't of Commerce, The National Information Infrastructure: Agenda for Action* (Dec. 21, 1993) at <http://metalab.unc.edu/nii/NII-Agenda-for-Action.html> (last visited 28 August 2002) [hereinafter, Agenda for action] (For the U.S. administration's National Information Infrastructure (NII) initiative to improve access to essential services, while encouraging private sector investment in the net's development through tax and regulatory policies that encourage innovation and promote long- term investment), § V.1.

114 *Brief History*, supra note 14, p. 9.

115 Michael Kende, *The Digital Handshake: Connecting Internet Backbones*, at: <http://www.fcc.gov/Bureaus/OPP/working_papers/oppwp32.pdf> (FCC OPP, Working Paper No. 32, 2000) (adding that "[g]iven the economies of scale inherent in the construction of the telecommunications network, natural monopoly regulation was necessary to ensure reasonable price and quality levels"), p. 11. Economies of scale arise when the cost per unit of providing service decreases as output increases.

116 Economic theory and practice suggests that a natural monopolist is likely to arise in network industries, such as telecommunications; It is considered efficient to the extent that then duplicative facilities are not installed. See, e.g., Robert S. Pindyck and Daniel L. Rubinfeld, *Microeconomics*, (Prentice Hall, 5th ed., 2001), pp. 350-351; Michael Kende, ibid, pp. 11-12.

additional user was becoming substantively higher than the average cost.[117] Consequently, it became obvious that these standardized infrastructure services could not be priced anymore at the marginal cost, because of the revenue that its developers could not cover of the government's costs, that is – with no adequate revision. In time, this same revision led to the privatization of the backbone providers.[118]

And thus, following the preliminary successful endeavor to unify the infrastructure standards, the NSF went on to the next step of its policy, to gradually privatize the Internet backbone providers.[119] It began with the local and regional networks and then expanded upon successful preservation of the compatible standardized infrastructure; its efforts eventually turned into the complete privatization of the net's transit infrastructure, through the final privatization of the national backbone pipes and the creation of simple economies of scale in the provision of a standardized transit service.[120] One of the main indications of this policy initiative came with the announcement of the National Science Foundation (NSF) on Dec. 23, 1992, regarding the cessation of funding to the ANS T3 Internet backbone.[121] This announcement catalyzed the transition from the government-funded engineered-oriented Internet, to the interest groups commercial one i.e. private providers of telecommunications services and business.

In the early beginning of this process, these efforts were aimed solely at the local and regional networks. Through its "Acceptable Use Policy" (AUP) the NSF prohibited backbone usage for purposes "not in support of research and education", intending at encouraging commercial network traffic at the local and regional levels, while temporarily denying access to the national scale transportation facilities.[122] It was only in 1995 that the NSF finally seized to refund the NSFNET backbone, thus allowing the

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[117] Until then, the marginal cost of supplying the new user could approach zero while the average cost of these infrastructure services to each user, that is, its total cost divided by the number of the users, stayed much higher. For the telephone network industries' similar experience, see, Amy Friedlander, *Natural Monopoly and Universal Service: Telephones and Telegraphs in the U.S. Communications Infrastructure* 1837-1940, at 54 (CNRI 1995); See, generally, also: Ingo Vogelsang and Bridger M. Mitchell, *Telecommunications Competition: The Last Ten Miles* (The MIT Press and The AEI Press, 1997); Gerald R. Brock, *Telecommunications Policy for the Information Age: from Monopoly to Competition* (Harvard University Press, 1994).

[118] Much later, in 1998, the FCC had finally suggested a market definition for this market of backbone transit services. See, *Application of WorldCom, Inc. and MCI Communications for Transfer of MCI communications corporation to WorldCom, Inc.*, 13 FCC Rcd. 18025 (1998); See also, C. K. Robinson, *Network Effects in Telecommunications Mergers MCI Worldcom Protecting the future of the Internet*, 1192 PLI/Corp 517, p. 539.

[119] Jay P. Kesan & Rajiv C. Shah, *Fool Us Once Shame on You – Fool Us Twice Shame on Us: What We Can Learn From the Privatizations of the Internet Backbone Network and the Domain Name System*, 79 Wash. U.L.Q. 89 (2001) (for a description of the privatization process of the NSFNET), pp. 111-117 & Fn. 6 (For a bibliographic list of short histories that discuss the privatization of the net); See, generally, also, Susan R. Harris & Elise Gerich, *Retiring the NSFNET Backbone Service: Chronicling the End of an Era*, ConneXions, April 1996.

[120] Jay P. Kesan & Rajiv C. Shah, ibid, p. 117.

[121] See, e.g., J. K. MacKie-Mason & H. R. Varian, supra note 104, p. 274.

[122] *Brief History*, supra note 14, p. 9.

full recovery off costs through competition on buying national-scale Internet telecommunications services by private networks.[123]

With the intention to privatize these services, and thus further encourage diverse infrastructure equipment providing, including data networking equipment, Internet connections, Internet service providers, telecommunications equipment providers and cable operators - to participate, the government also committed part of its effort in creating locations set up to facilitate the interconnection of different future private networks to exchange traffic i.e. Network Access Points ('NAP's).[124] Any company that wished to exchange traffic at a NAP, did so after negotiating the terms and conditions of that inter exchange through bilateral agreements.[125]

These developments were incapable of preventing the first signs of a free ride problem. Leading to that was the enormous growth of the Internet traffic, followed by a new problem of congestion of the NAPs. That led to the creation of the bottleneck of speed of the connection all over the net, followed by the typical telecommunications' loss of data and quality.[126] Acting as interest groups, the larger networks responded to this problem by investing in private dedicated connection points in which they had a monopoly on, given earlier by the government. That initiative was what then partly restored faster and more accurate connections.[127]

As individual networks grew, more actions were needed to combat the 'free ride' failure in the large nationwide backbone providers' extensive network investment. As a result, larger network providers began to create policies to restrict potential peer-to-peer arrangements between small and regional ISPs that had not invested in growing their networks.[128] These individual-to-individual peering agreements were then replaced by seller-customer transit agreements, where the national backbones charged the small networks or ISPs "Transit fees" for carrying and terminating their traffic, while further maintaining their inter-connectivity services monopoly.[129]

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123 Ibid, id.

124 C. K. Robinson, supra note 118, p. 530. See, also generally, Jim Winkleman, *Getting Connected: Now that Public Peering Isn't Viable for Hooking to the 'Big Five' Internet Backbones, What are the Best Approaches?*, America's Network (Aug. 15, 1998), available at <www.americasnetwork.com/issues/98issues/980815/980815_peer.html> (last visited 28 August 2002); Michael Dillon, *Inside Public Exchange Points*, *Internet World*, Aug. 1, 2000, at <www.Internetworld.com/080199/8.01infraexpert.jsp> (last visited 28 August 2002).

125 Ibid, C. K. Robinson , p. 531.

126 Ibid, id.

127 Ibid, p. 532.

128 Michael Kende, supra note 115 (describing the analogy between the Internet transit and peering arrangements and the bill-and-keep and sender-keeps-all arrangements in traditional telephony interconnection arrangements, respectively), pp. 4-9; S. M. Benjamin et al., supra note 55, pp. 915-917; *Intermedia Communications "Peering White Paper*," 1998, <http://www.intermedia.com> (last visited 28 August 2002) (Intermedia White Paper) at n.1.

129 M. Kende, ibid, id; S. M. Benjamin, et al., ibid, id. In contrast, telecommunications carriers interconnecting with one other for the exchange of telecommunications traffic, still do it pursuant to Title II of the Telecommunications Act of 1996, which obligates all carriers to interconnect pursuant to reasonable terms and conditions. See, *47 U.S.C. § 251*.

The ultimate establishment of public goods in users' access rights in the Internet backbone telecommunications services, and the minimization of the 'free ride' failure was eventually achieved as usage became essentially free to all authorized users. While most users are connected to a backbone through a "pipe" for which a fixed access fee is charged, the user's organization nearly always started covering the access fee as overhead without any direct charge to the user. As a result, to date, most users of the NSFNET backbone do not pay any pipeline fee to the service provider, but instead pay in order to get connected to their "regional" or mid-level network, and then are granted a connection to the NSFNET.[130]

In essence, this lubrication of infrastructure standards into public goods was achieved based on an inevitable governmental policy, which was aimed at minimizing only the negative externalities deriving from the risk of infrastructure multi-standardization. Conceptually, this policy can be identified as a *positive default approach* to standardization policy. That is, as opposed to a *negative default approach*, in which not even negative externalities of the inter-institutional technological arms race are handled ex-ante. For the development phase, when a unified infrastructure is presumed to be efficient, this latter extreme approach does not seem to be argued, for this phase, even by those who identify cyberspace as a state-free sphere complying only with alternative rule regimes under full consumer sovereignty.[131]

With time, the creation of these first suspected monopolies by primary interest groups resulted in their vast control over access to the net's telecommunications services.[132] Because such vast monopoly powers would become almost inevitable, they would later on demand counter-antitrust measures.[133]

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130 J. K. MacKie-Mason & H. R. Varian, supra note 104 (estimating that this conclusion is reflected in the rapid decline from expensive routers to expensive transmission links) p. 269 & Fn. 1. For two additional secondary reasons to why most Internet end-users do not pay usage charges: (1) residential local service tends to be flat-rated, and ISPs have located their POPs to maximize the number of subscribers who can reach them with a local call; and (2) ISPs typically connect to Local Exchange Carriers (LECs) networks through business lines that have no usage charges for receiving calls. See, Kevin Werbach, supra note 3, p. 50.

131 This is the analogous regulative doctrine to which Neil Netanel commonly referred as Cyberanarchism. See, N. Netanel, *Cyberspace Self-Governance: A Skeptical View from Liberal Democratic Theory*, 88 Cal. L. Rev. 395 (2000), at 433-435. See, also, Kevin Werbach, supra note 3, p. 29.

132 See, e.g., Jay P. Kesan & Rajiv C. Shah, supra note 119 (arguing that large backbone providers unfairly benefit from the lack of an interconnection policy, while treating smaller networks unjustly and limiting new competitors), pp. 148-159; That typically happens when the largest ones obtain the ability to dominate other backbones by threatening disconnection, degrading interconnection services, or charging monopoly prices for interconnection. See, also, Bickerstaff, S., supra note 108 (adding that "[I]f left to market forces, many of the subsidies that are critical to public use of the Internet would disappear as ILECs (ILEC refers to the independent existing local exchange monopoly companies, my emphasis, D.B.) would drive interconnection charges toward cost through usage- sensitive rates"), p.101.

133 M. A. Lemley, *Antitrust and the Internet Standardization Problem*, supra note 93, p. 1042 et al.; Compare: I. de Sola Pool, *Technologies of Freedom*, (Harvard University Press, 1983) (further adding that "such limited franchises have a way of being extended beyond their original rationale"), p. 245; Ronald Hirshhom, *Regulating quality in product markets*, In The regulation of quality (Donald N. Dewees, ed.) (Butterworths, 1983) 55-77, p. 77.

Conceptually, this governmental use of higher-quality telecommunications interest groups participation, seems to conform remarkably to Olsen's 'collective choice' theory.[134] According to this widely accepted theory, smaller influential self-interested groups will be better able to organize collectively and combine their resources, with a minimized 'free ride' problem.[135] Seemingly, that is not less true for early high technology research and development (R&D) standardization activities.[136] In cyberspace, in order to seek broad dispersed public goods, namely users' access rights to telecommunications services in the Internet backbone networks, that activity was dominated by small influential groups of individuals or firms that in the process of establishing the net's infrastructure were seeking to benefit themselves.[137] In theory, as here in practice, they were small groups in the form of pre-organized homogenous telecommunications transit providers, with high per capita stakes, as opposed to the relatively small per capita large heterogeneous potential customer groups in the form of dispersed customers.[138]

Thus, the easiest group to organize typically consists of a few market agents seeking government benefits for themselves, which will be financed at the general public expense, as was done in practice.[139] On an eliminative fashion, it is further argued, that for larger groups, each potential individual member has less incentive to participate in the group, due to those individuals' later option to ride freely on what will then be widely-accessible public goods. However, not like in the earlier telephone industry, the researchers working on the ARPA's internetworking program in the early 1970s did not follow the model of the telephone system upon its tightly integrated multiple networks into a centrally managed system, but rather built a loose confederation of independently

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[134] M. Olson, *The Logic of Collective Action* (2d ed. 1971). Among the few formalized theoretical models of institutional theory, Mancur Olsen's analysis is one that has profoundly shaped the debate, and will be used henceforth as a theoretical point of reference.

[135] More on the problem of 'Free Ride' see generally, Jonathan R. Macey, *Promoting Public-Regarding Legislation Trough Statutory Interpretation: An Interest Group Model*, 86 Colum. L. Rev. 223 (1986) at 231 et al.; D. Farber & P. P. Frickey, *Law and Public Choice* (1991) (concluding that "this 'Free Rider' problem suggests that it would be nearly impossible to organize large groups of individuals to seek broadly dispersed public goods"), p. 23.

[136] See, e.g., William J. Baumol & Janusz A. Ordover, *Antitrust: Source of Dynamic and Static Inefficiencies?*, in Antitrust, innovation, and competitiveness (Thomas M. Jorde & David J. Teece eds., 1992) 82 ("High technology industries, with their emphasis on investments in R&D that are characterized by imperfect appropriability and excludability, provide fertile ground for cooperation among potential competitors that may well prove socially beneficial…Research joint ventures contribute to dynamic efficiency by enabling the participating firms to reduce the free-rider problems that bedevil production of new knowledge"), p. 89.

[137] Compare: M. Olson, supra note 134, pp. 132-134, 162.

[138] For the theoretical perspective, see, e.g., R. G. Noll, *Economic Perspectives on the Politics of Regulation, in Handbook of Industrial Organization* (R. Schmalensee & R. D. Willig eds. 1989), p. 1265. For the practical (and technical) perspective, see, e.g., P. Mähönen, supra note 103 (suggesting that for IT standardization activity "the common belief is that the work can be done faster by the special interest groups than by a formal standardization organization"), p. 40; Ole Hanseth & Eric Monterio, supra note 2 (adding that the uniquely complex technological 'invisibility' of the Internet infrastructure serves, in fact, as a negative incentive for participation by private users), pp. 173-174.

[139] For a description of these governmental activities, see § V.C.3.b, infra.

managed networks.[140] Even so, it assumed that such large-scale producers will be able to organize better than diffused consumers with lesser ability to reach a stable coordinated consensus needed for such new industry.[141]

As a result, potential future consumers, such as the emerging Internet users community, would have justifiably found counter-organizing as over-costly, and thus substantively inefficient.[142] Accordingly, at this phase, legislators are generally biased in favor of these narrow economic interests, at the expense of the general public.[143] Therefore, it seems that at this stage, an additional degree of monopoly powers should have been legally admitted, as, in fact, it had been:[144]

Thus, not surprisingly, the interest groups enrolled in this political action came from among the leading telecommunications and cable service carriers such as AT&T, WorldCom, Sprint, etc.[145] It came to comply also with the early common realization of the government that only previously efficient organized groups should have been part of this preliminary commercial effort.[146] The rationale behind that policy was justifiably imported from previous experiences. It was acknowledged that organized groups, such which have already paid the fixed costs of formation, would have an

[140] See, Sharon Eisner Gillett & Mitchell Kapor, *The Self-governing Internet: Coordination by Design*, in Coordination of the Internet, edited by Brian Kahin and James Keller (MIT Press, 1997).

[141] For the theoretical perspective, see, M. Olsen, supra note 134, ("no one has an incentive to provide any more of the collective good, once the member with the largest F_i (group size, my emphasis, D.B.) has obtained the amount he wants."), p. 29; R. G. Noll, supra note 138, pp. 1264-1265; See, also, Neil W. Netanel, supra note 131 (emphasizing that "[I]n reality, however, Internet user autonomy of choice and mobility are both far more constrained than cyberanarchists suggest", p. 437; "[g]iven the wide diversity and sheer number of Internet users, coupled with innate human limitations in processing information and coordinating positions, collective action costs would remain significant, and would likely prevent any serious user challenge"), id & Fn. 161 and accompanying text.

[142] For the theoretical framework, see, generally, D. Farber & P. P. Frickey, supra note 135, p. 19; S. Rose-Ackerman, *Progressive Law and Economics – and the New Administrative Law*, 98 Yale L. J. 341 (1988); Cass R. Sunstein, *Interest Groups in American Public Law*, 38 Stan. L. Rev. 29 (1985); For cyberspace's application, see, e.g., Neil W. Netanel, supra note 131, ("[I]n addition, individual users would not enjoy the repeat player and other efficiency benefits that standard terms provide for many ISPs, web site operators, and other rule regime producers. As a result, rule shopping and drafting is generally more costly for users, both in absolute terms and relative to potential benefits, than for producers"), p. 438.

[143] See, generally, K. Schlozman & J. Tierney, *Organized Interests and American Democracy* (1986), p. 317; F. H. Easterbrook, *Forward: The Court and the Economic System*, 98 Harv. L. Rev. 4 (1985), p. 15; F. B. Cross, *The Judiciary and Public Choice*, 50 Hasting L. J. 355 (1999), p. 357.

[144] I. de Sola Pool, supra note 133 (suggesting that "Under this circumstances the best solution seemed to be to define a monopoly's turf narrowly"), p. 245.

[145] Jay P. Kesan & Rajiv C. Shah, supra note 119 (suggesting that although thousands of companies provide Internet connectivity, they are all dependent upon MCI WorldCom, Genuity (formerly GTE), AT&T, Sprint, and Cable & Wireless), p. 144; also referring to Neil Weinberg, Backbone Bullies, Forbes, Jun. 12, 2000, p. 236 (at Fn. 303), id.

[146] See, e.g., Cooney, Michael, Gaffin, Adam; Messmer, Ellen. "*Internet surge strains already shaky structure*." Network World v. 12, n14 (April 3, 1995) (anticipating that ultimately the management of the Internet transit services would occur by a few big self-interested backbone providers, cooperating bilaterally among themselves), p. 1 et al.

advantage over their unpaid counterparts.[147] This was especially important due to the anticipated susceptibility of these groups to the 'free ride' failure, when efficient interest group achieve an efficient outcome; with no ability to limit the beneficiaries to its members, who would have had to confront additional, sometimes fatal, costs of formation.[148]

In essence, in the development phase the government took a dual regulative attitude towards what were two main distinctive purposes. The first was the central initiative to coordinate a unified core standardized infrastructure, namely both the worldwide domination of the compatible TCP/IP set of protocols, along with the formal adoption of the hierarchical multi-layered architecture. Only, with what was a successful achievement of this early regulative goal, did the government continue on to its second substantively different goal, which was the transfer of power over the Internet infrastructure telecommunications services into new market agents, namely the predominant stakeholder interest groups of the telecommunications and cable carrying industries. Conversely, for the latter objective, the government justifiably restrained itself into an indirect monitored role to gradually encourage these interest groups into seizing control over growing larger backbone levels, in part or in full. In other words, while giving away much of its power over the market for transit *services*, the government deliberately avoided giving up hegemony over the infrastructure *production* process (and root zone).[149] Why was the latter infrastructure production policy set so? And was it institutionally justified for the development phase? – Should be the questions in discussion, hereinafter.

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[147] M. Olson, supra note 134 ("Large groups fail to provide themselves with any collective good at all"), p. 28; Compare: R. G. Noll, supra note 138, p. 1265.

[148] Ibid (suggesting that costs of formation are central to the ability to dominate the market), id; Cf. Julie E. Cohen, *Lochner in Cyberspace: The New Economic Orthodoxy of "Rights Management*", 97 Mich. L. Rev. 462, 529 (1998) (observing that whenever technology creates significant economies of scale, as in cyberspace, markets tend towards dominance by a few large players), p. 522; A key insight of Olson that goes even further than Noll's is that such organization costs (as initial fixed costs) required to realize collective benefits, are an increasing function of the size of the group. See, M. Olson, supra note 134, pp. 53-57. To date, there are still no sufficient empirical evidence to apply Olsen's claim to cyberspace. Furthermore, the costs of organizing groups that span international boundaries (i.e., cyberspace) are said to be decreasing in some respects due to communication technology and the Internet's radical ability to lower the significant costs associated with reproducing information and transmitting it over distance. Thus, even when Olson's application may have not yet been upheld adequately, the predictions of his theory can still serve as an early indicator in measuring cyberspace's institutional costs of formation: In fact, practice shows that, indeed, earlier than 1995 private companies were merely overseen by the NSF in developing early TCP/IP hardware and software products, e.g., private companies' participation in the advisory panel of scientists and engineers from academia and industry, including those involved in Computer Scientists Net (CSNET), to assist the Division of Networking and Communications Research and Infrastructure (NCRI) staff (The organization within the NSF specifically tasked with overseeing the NSFNET program) in designing the first TCP/IP products. See, e.g., Karen D. Frazer, *NSFNET: A Partnership for High-Speed Networking* (report on NSFNET backbone service from 1987-1995), at <www.merit.edu/merit/archive/nsfnet/final.report/> (last visited 28 August 2002), id.

[149] More on this suggested complexity, see generally, P. Mähönen, supra note 103, pp. 36-37; Michael A. Froomkin, *Wrong turn in cyberspace: Using ICANN to route around the APA and the constitution*, 50 Duke L. J. 17 (2000) (suggesting that for possessing control over the root zone the U.S. government had, in fact, only quasi-privatized the control over root server services), p. 169.

C. Infrastructure standardization: the cost-benefit analysis

1. General

Looking for the optimal institution for infrastructure production, a preliminary review of the subject matter activity in question should take place. The importance in doing so follows the premise that only the best standardization institution, which could best internalize the costs of its own activity, should be chosen. In an early seminal book on regulation, Stephen Breyer suggests the basic theoretical framework for assessing the efficiency of such standard setting activity.[150] As suggested by Breyer, a rational standard setter, operating with broad statutory authority, would first define the adverse effect which he or she seeks to control (e.g., defining the high transaction costs resulting in the adverse lack of compatibility among conflicting transfer protocols, without the design of the Dynamic Host Configuration Standardized Protocol of the second layer in the development phase; or acknowledging the lack of authentication, authorization, integrity, privacy and non-repudiation for XML Digital Signatures standards in the implementation phase).[151] The standard setter would then use a preliminary rough cost-benefit analysis to identify the specific part of the general problem, which he or she intends to minimize, while obtaining the greatest improvement at the lowest cost. In balance, the standardization plan must be set at the level in which the total benefits exceed the total costs by the greatest amount comparatively, and at which the marginal standardization benefits are equal to the marginal standardization costs.

Next, the standard setter would obtain information and design a standard which would most efficiently reduce the targeted adverse effects to an economically reasonable degree.[152] Later on, he or she would operate to enforce that standard through developed means that ensure compliance.[153] Finally, he or she would monitor enforcement, assuming that such can be efficiently gained, while evaluating the standard's effectiveness, through occasional revisions.[154]

Reflecting on the specific costs of infrastructure standard setting, this section will suggest that as for the institutional choice of the development phase, only an ex-ante governmental standard setting initiative delegated through its early federal agencies and monitored activity towards research institutions - would turn to be optimally efficient.[155] Left alone to market agents, a pre-commodified infrastructure environment

[150] S. Breyer, supra note 1, pp. 98-99, see, generally, also pp. 96-119 (part 5: Standard Setting).
[151] Ibid, p. 98 et al.
[152] Ibid, id.
[153] Ibid, id.
[154] Ibid, id.
[155] See, e.g., Ole Hanseth & Eric Monterio, supra note 2 (Upholding this argument for all-purpose information technology infrastructure standardization: "In recognition of the limits of both market forces and hierarchical control, formal standardization is a key strategy for developing an information infrastructure"), pp. 175 et al.; C. F. Cargill, supra note 1 (concluding that "the 'infratechnology' under consideration here was one that the private sector could not have established

bears high costs (and thus high risks of failing) to produce optimal core standards.[156] I would then conclude that for the development phase, a rationale planner should avoid any de facto or even industrial gray standardization independent coordination initiatives, hence primarily submitting to government standardization coordinative hegemony. As suggested earlier on, this policy rule should be regarded as a *positive default approach*, for minimizing the main predictable negative externalities deriving from multi-standardization of core infrastructure. Conceptually, this type of activity should be regarded as a preliminary rough benefit-cost analysis to identify only a specific part of the general problem of a basic lack of interoperability, which would be evaluated, hereinafter.

After identifying the fundamental lack of interoperability adverse effect in constructing cyber infrastructure products as public goods, a rational planner would then continue in categorizing the preliminary rough benefit-cost analysis for each specific parts of the general problem (e.g., the need for transferring, addressing and routing standards), which he or she wishes to minimize through possible standardization. Yet, bearing in mind the technological comprehensivity of the TCP/IP set of standards as the focal point in the infrastructure standardization activity, a more constrained evaluation of the general cost-benefit analysis could also be sampled referring to the TCP/IP specially. In providing a reasonable view of the adverse effect at stake i.e. the lack of interoperability and the inevitable expander of early balkanization of the net's architecture – such evolution would implicitly include the specific ingredients of the adverse problem i.e. the lack of addressing, routing and transferring of this former broader framework. I would, therefore, focus on the TCP/IP set of protocols production constraints at large:

The costs associated with technical standardization were initially subdivided by different scholars into three types of costs.[157] First, *administrative costs*, which are generally formed by its standard setters. Administrative costs are borne through several subsidiary activities. The first, costs of quality standardization, while overcoming numerous anti-competitive concerns of the development phase. The second is standardization development costs of research and development activity. The third, information costs or costs of conveying information about infrastructure standard formulation.

on its own. The government's participation was absolutely necessary to make the Internet come into being"), p. 176.

[156] As a general rule that would also mean that in few marginal cases, uniquely weak de jure infrastructure standards might be overcome by stronger self-regulated standards. One such example was the development of the TCP/IP infrastructure standardized set of protocols, which, jointly, quickly gained dominance over the OSI layer architecture. However, due to the coordination hegemonic role taken by the U.S. government in that case, only a unified TCP/IP was adopted. See, e.g., P. Mähönen, supra note 103, p. 43.

[157] See, e.g., A. Ogus, supra note 1, pp. 155-156; Compare, M. A. Lemley, *Antitrust and the Internet Standardization Problem*, supra note 62, §§ A-C; M. Maher, *An Analysis of Internet Standardization*, 3 Va. J.L. & Tech. 4, at § II-A.

Second, *compliance costs*, which consist of the requirement to coordinate standard interoperability (or compatibility) and espouse technological convergence with the three general constituents of media: mass media (broadcast, cable and satellite TV, and radio), telephony (wired and wireless), and interactive computer services. Accordingly, compliance costs also include transaction costs and the need to reduce inefficient variety.

Third, *indirect costs*, which consist of productive inefficiencies i.e. monopolies, the delay of technical change and external allocation inefficiencies due to negative network externalities, where resources are not being allocated most efficiently.[158] To date, all these major standardization concerns still necessitate further economical modeling, and for the purpose of this study would be broadly outlined, as follows.

2. Administrative costs

a. Quality standardization costs

In previous telecommunications infrastructure standardization primacy was given to technical performance-based efficiency over price-based efficiency.[159] This imperative quality rationale, is true for any IT standardization activity, but is arguably more acute for infrastructure standardization to the degree that it should imply a centralized and unified vision of the future of that technology.[160] As would be explained hereinafter, infrastructure quality assurances should be coordinated through delegated formal standard setters and monitored research institutions. This policy rule is based on several grounds.

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158 This group of costs will be dealt also in § V.C.2.c, infra.

159 Such policy was also embedded in the ITU rules and policies, regarding mobile telephony, HDTV, Radio Frequency Spectrum, etc. In accordance, since the restructuring of the ITU in 1947, up until the 80s' commercialization of telecommunications information, a separate federal structure was created for the 'technical' organs, including e.g., the Administrative Radio Conferences (ARC) and International Frequency Registration Board (IFRB). These institutions preside next to the more 'political' Plenipotentiary Conference (PC) and Administrative Council (AC), which came to maintain that technological qualitative primacy. See, K. Lee, supra note 101, pp. 131-133; See, also, Thomas M. Jorde & David J. Teece, *Product Market Definition in the Context of Innovation: An Explanation, Practicing Law Institute*, 1987 (suggesting that competition in such early technological phase of production advance is insensitive to price changes, but very sensitive to product feature changes), p. 236, (emphasizing that "Limiting new technology can bring an innovative development to an end – harming quality), ibid, p. 237.

160 See, e.g., C. F. Cargill, supra note 17 (Generally justifying the central 'regulatory style', "where quality programs mandate a single procedure in order to fabricate a product that must meet stringent quality standards"), p. 64.

First and foremost, under the alternative paradigm of price competition based on varying consumer demand[161] - the motivation of de facto standard setters would be to reduce marginal development costs: firms will ultimately end in reducing relatively high undervalued costs of socially desirable R&D quality benefits.[162] Moreover, the focus on quality assurances is not only intrinsic to the development process, but would be also guaranteed if a long-term unified infrastructure production were to be preserved. Thus, hegemony of de facto standard setters in infrastructure design may not only decrease quality assurances, but may accordingly create a technologically inefficient standard market. Such market may turn to be also over-costly to maintain as

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[161] See, e.g., Alan O. Sykes, *Product standards for internationally integrated goods markets* (The Brookings institution, 1995) (adding that, in general, not all potential customers will be willing to pay the same for particular attributes in quality due to differences in underlying tastes or to differences in wealth"), p. 38; Thus, in its recent report, the National Telecommunications and Information Administration (NTIA) of the Department of Commerce concluded that the use of computers and the Internet varies significantly according to income, race, and ethnicity, and that the gap is increasing for certain demographic categories. See *U.S. Dep't Of Commerce, Falling Through the Net: Defining the Digital Divide* <www.doc.gov> (last visited 28 August 2002).

[162] This core argument, limited here to the context of IT standardization, is part of a larger one, upheld by neoclassical economists, according to which average market agents tend to under-supply R&D activity (and thus benefits), resulting in these players' lack of incentive to explore different technological paths compared to their relatively lower worth. Eventually, market agents, left alone, will not generate the sufficient degree of variety of high-quality standards. See, generally, K. Arrow, *Economic Welfare and allocation of resources for inventions: The Rate and Direction of Invention Activity* (Princeton University Press, 1962), pp. 609-25; R. R. Nelson, *Recent Evolutionary Theorizing about Economic Change*, 33 J. of Econ. Literature, pp. 48-90; See, also, Elisha A. Pazner, *Quality choice and monopoly regulation*, In Regulating the product: Quality and variety (The Brookings institute, 1975), pp. 3-16 (Adding that, although the average quality-level introduced by firms is potentially equal to that of monopolies – firms will produce even wider variety in quality-levels of innovations, which for itself should demand central coordination, for high-quality assurances), p. 15 et al.;

Nevertheless, to date, there is still no theoretical or empirical consensus that reduced competition leads to less R&D and fewer new products. Economic theory is ambiguous on this point and only industry-specific findings e.g., Internet infrastructure standardization, should then be reviewed. See, Oliver E. Williamson, *Markets and Hierarchies: Analysis and antitrust implications* (1975) ("[t]he technological potential to innovate differs greatly across industries"), p. 180 referring also to D. Hamberg, *R&D: Essays on the economics of research and development* (New York: Random House, Inc., 1966) (concluding that "a case can be made for the hypothesis that research intensity... increases with size among the larger firms in but three industries"), p. 61. See, also, *Federal Trade Commission Hearings on Global and Innovation-Based competition October 25, 1995* (Day 7 AM and PM) Outline of Statement of Dennis A. Yao <http://www.ftc.gov/opp/global/yaotest.htm>, id; Dennis W. Carlton, *Antitrust policy toward mergers when firms innovate: Should antitrust recognize the doctrine of innovation markets?*, Testimony before the Federal Trade Commission Hearings on Global and Innovation-based Competition (1995), at: <http://www.ftc.gov/opp/global/carlton.htm>, id; John Lipczynski & John Wilson, *Industrial organization: An analysis of competitive markets* (Prentice Hall, 2001), p. 249.

Thus, for the IT standardization context see, Thomas M. Jorde & David J. Teece, *Rule of Reason analysis of horizontal arrangements: Agreements designed to advance innovation and commercialize technology* (1998), at: <http://www.ftc.gov/opp/global/jorde2.htm#5> ("Therefore, there are typically large positive spillovers from innovation, and a corresponding underinvestment in innovative activities"), at Sec. B, id; C. F. Cargill, supra note 17 (upholding formal standardization, while observing that "innovation for innovation's sake is not encouraged by the market"), p. 37.

seen with the formal OSI layer of architecture, which was finally replaced by the TCP/IP set of protocols.[163]

Second, and in accordance, the desire to propagate technology widely should also imply lowering potential price-based competition in developing unified infrastructure (as will be described also in the following § III.B.2.b, hereinafter). Initially, infrastructure standards as opposed to serial product applications e.g. operation systems or browsers might not be resourcefully exposed to premature price competition where infrastructure (and thus market-) boundaries are pre-defined.[164] Alternatively, any inducement in premature product interchangeability and cross elasticity of demand between its substitutes, will not lead to clear and simple differentiating of such outer boundaries.[165] Eventually, such early price competition will only come on the expense of quality assurances, which are needed in the early development phase.[166]

Third, lack of consumer qualitative judgment is even more acute with technological infrastructure, where potential customers would tend to overvalue the exterior *interface* of a standard on the expense of interior assurances and its development.[167] In practice, this observation is, as described, in part, what led the U.S. government to lower the independence and ultimately the *coordination* role of de facto standard setters in the development phase, while monitoring the latter development activity.

Fourth, subsequent to Akerlofs' 'market of lemons' insight, pooled with the common realization that architecture and protocol designing imbed future market preferences, a

[163] Probably one of the main reasons for the final collapse of OSI was its' vendors undervalued R&D investment policy and decline to invest in test suites on both quality assurances and compatibility. I thank Carl Cargill for this important remark.

[164] A. C. Hruska, Note, *A Broad Market Approach to Product Market Definition in Innovative Industries*, 102 Yale L. J. 305 (1992) (Explaining that because innovative industries are exposed to radical changes in the source of value, the analysis of potential price competition prevails in the early setting of boundaries on the scope of the market), p. 316. In essence, this use of the potential competition doctrine in the market for infrastructure standards might apply to application standards that do not now exist but will exist in the future with a high degree of certainty. See, also generally, *Horizontal Merger Guidelines (1992)* – Market definition, measurement and concentration, at: <http://www.ftc.gov/bc/docs/horizmer.htm> (last visited 28 August 2002) (for the original rule of defining market boundaries based on price competition), § 1.

[165] See, *Antitrust, Innovation and Competitiveness* (Thomas M. Jorde & David J. Teece Eds.) (Oxford University Press, 1992) (Defining the choice as "when competition proceeds primarily on the basis of features and performance, the pertinent question to ask is whether a change in the performance attributes of one commodity could induce substitution to or from another"), p. 9; A. C. Hruska, ibid ("[B]ecause product development begins years before the commercialization that would allow enforcing agencies to test claims of market power empirically, market definitions remain elusive"), p. 310.

[166] Michael J. Trebilcock, *Regulating service quality in professional markets*, pp. 83-108, In The regulation of quality (Donald N. Dewees, ed.) (Butterworths, 1983) (Emphasizing that consumer ignorance of serious risks embedded in the wrong choice may call for prescribed quality standards irrespective of the price or the access affects of such standards), pp. 86-87. Later on, in the implementation phase, quality standardization will serve to benefit price competition, as will be explained in § V.B, infra.

[167] For this unique technological rationale, see, e.g., C. F. Cargill, supra note 1, pp. 36-37.

supplementary conclusion should be upheld:[168] Arguably, high-quality infrastructure standardization, aimed at facilitating future transferability of information, will eventually lower the anticipated informing and advertising costs of application standards which would potentially be demanded by de facto standard setters in the implementation phase.[169] Acknowledging the role of core technology in establishing future consumer preferences, it may also minimize tendencies of producers and consumers to settle on lower quality, lower-price products in the subsequent implementation phase.[170] This argument is relevant to any standardization activity;[171] Still, it is more acute for infrastructure standardization where future market boundaries and motivations of de facto standard setting are imbedded into infrastructure definitions, its degree of compatibility and open access.[172] In that regard, de jure standard setting should be carrying a role of facilitating future competition and lowering these costs.[173]

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[168] For the proposition suggesting that de facto agents may embed (self-maximizing) preferences into their technological designs, see, e.g., Joel R. Reidenberg, *Governing Networks and Rule-Making in Cyberspace*, supra note 1 (arguing that technical standards set boundary rules and embed policy choices), pp. 918, 927-28; Joel R. Reidenberg, *Rules of the Road for Global Electronic Highways: Merging the Trade and Technical Paradigms*, 6 Harv. J.L. & Tech. 287, (1993) (arguing that technical considerations establish normative standards which, in turn, impact system practice), pp. 301-304; Lawrence Lessig, *Constitution and Code*, 27 Cumb. L. Rev. 1 (1997) ("the architecture is the product of private interests--whether the relatively open Internet Engineering Task Force or the absolutely closed Microsoft Corporation"), p. 14, ("[C]ode is political .... [T]he architectures that are established in cyberspace have normative significance, and ... choices can be made about the values that this architecture will embed"), ibid, pp. 14-15; Lawrence Lessig, *The Constitution of Code: Limitations on Choice-Based Critiques of Cyberspace Regulation*, 5 CommLaw Conspectus 181, (1997), p. 184; Niva Elkin-Koren, *Copyright in Cyberspace – Rights Without Laws?*, 73 Chi-Kent L. Rev., 1155 (1998) (emphasizing that "Information providers who are profit maximizers may act strategically to shape demand. Vulnerability to manipulation by power is particularly evident in a market for information because information is not an ordinary commodity."), p. 1186.

[169] Compare: G. A. Akerlof, *The Market for "Lemons": Quality Uncertainty and the Market Mechanism*, 84 Q. J. Econ. 488 (1970) (arguing that because quality is usually costly to produce, poor-quality products can outcompete high-quality products and the market equilibrium may entail the future production of suboptimally low-quality products exclusively, thus increasing informing and advertising costs), id.

[170] Compare: Ibid, id.

[171] See, e.g., James J. Anton & Dennis A. Yao, *Standard-Setting Consortia, Antitrust, and High-Technology Industries*, 64 Antitrust L.J. 247, 248 (1995) (suggesting, generally, that "Because standard setting is forward looking, it may involve a competitively sensitive information exchange about future technologies and products"), p. 264; C. F. Cargill, supra note 1 (on potential competition on future standardized technologies), p. 63; Carl Shapiro, supra note 30 (describing the components of the technological arms-race competition as including anticipating user needs and foreseeing and exploiting further hardware improvements); David A. Balto, *Standard Setting in a Network Economy, Cutting Edge Antitrust Law Seminars International* (February 17, 2000), at: <http://www.ftc.gov/speeches/other/standardsetting.htm#N_40_> (last visited 28 August 2002) ("Consumer expectations are critical to the success of networks, either existing or emerging ones"), at § I; ("Competition may be affected in complementary goods, or even in next generation goods"), at § II, id.

[172] See, e.g., T. M. Jorde & D. J. Teece, supra note 165 ("in the early (pre-paradigmatic) stage of the innovation/product life cycle, competition proceeds typically on the basis of product performance, not price. Competition in this phase of industry development is insensitive to price changes, but very sensitive to product feature changes"), p. 231, 236.

[173] A. C. Hruska, Note, supra note 164, p. 316.

b. Development costs

As all standards, infrastructure standards tend to freeze existing technology.[174] However, as explained, infrastructure standards tend to do so for longer periods. Thus, whenever de facto standard setters develop infrastructure they risk the loss of potential short-run market revenues. Ultimately, such risks are also reflected in the typical lack of sufficient firm funding, as will be observed from the derivative question of development funding:

Thus, next to the question of 'who should develop infrastructure standards?' lies also the derivative question of 'who should fund the development of infrastructure standards?' As necessary long-run standards, these standards involve high risk of harm through error.[175] That is, whenever their necessity may curtail the competitive motivation to develop them, whenever they are not cost-effective, or technologically inappropriate.[176] In any defected form – infrastructure standards would have to be reviewed and modified, if they are to become functional, in a process that in itself would impose additional development cost on standard setters, thus enlarging that same risk of error. Therefore, and in order to preserve these standards' advantage, there would be a need for central governments to fund that activity, and thus monitor its successful performance by standard setting research institutions i.e. autonomous standard setters.[177] In balance, as small and medium entrepreneurs with new applications in cyberspace are usually technically 'excused' from a pre-commitment to build infrastructure, more entrepreneurs can later on finance and design more applications.[178]

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[174] See, e.g., S. Breyer, supra note 1, pp. 103, 105, 115; P. Mähönen, supra note 103, p. 39.

[175] See, e.g., Sharon Eisner Gillett & Mitchell Kapor, supra note 140 (upholding also the opposite conclusion for application standardization errors), id; See, also, John Lipczynski & John Wilson, *Industrial organization: An analysis of competitive markets* (Prentice Hall, 2001), p. 226.

[176] S. Breyer, ibid, supra note 1 (concluding that overall "when a "should" in such a standard is changed to a "must", however, the risk of harm increases"), p. 102; For the U.S. government supportive perspective, see, *Agenda for Action*, supra note 113, § V.3.

[177] See, ibid, id; This explanation lies also as a conclusion given by the *Next Generation Internet (NGI) Report* ("Funding for long-term research and development is still a role best served by the federal government"), p. 5, at <http://www.cra.org/Policy/NGI/research_chall.pdf> (Last visited 28 August 2002) [Hereinafter, Next Generation Internet]. For a short description of the NGI, see FN 320, infra; C. Shapiro and H. R. Varian, supra note 6 (further estimating that "It is unlikely that the Internet would have achieved its current level of popularity without early subsidization by the government"), p. 314. See also § V.C.3.b, infra; For the U.S. government support of this policy, see: *Agenda for Action*, supra note 113 (Supporting the Administration's February 22, 1993 technology policy statement: "We are moving to accelerate the development of technologies critical for long-term growth but not receiving adequate support from private firms, either because the returns are too distant or because the level of funding required is too great for individual firms to bear"), § V.3.

[178] See, e.g., Sharon Eisner Gillett & Mitchell Kapor, supra note 140, id.

c. Convey information about standards

Obtaining accurate information about prospective standards is, probably, the most costly activity for political institutions.[179] Moreover, conveying information about performance-based infrastructure standards gets even harder, as it is primarily quality-based rather than price-based.[180] In essence, designers of infrastructure standards have varying preferences regarding quality and other value measurements (e.g., price, service, etc.) of these standards.[181] Thus, if de facto standard setters would have had perfect information on the characteristics of infrastructure and behaved rationally in accordance with these preferences, and if their R&D decisions would not have generated externalities – central intervention would not be vital. In cyberspace, that was far from being the case. Later on, even where sufficient information is made available, making decisions with the necessary degree of internalized social costs at that phase could have been underrated and later on, expensive to coordinate between diverse and self-interested de facto standard setters.

Alternatively, dominant and competitively neutral formal industrial standard setters, as repeat players (as opposed to governmental mostly one-time players) operating as constant and dynamic suppliers of information, originally hold a systematic advantage in conveying information about infrastructure standard setting activity.[182] They should, therefore, be advanced by a monitoring government mechanism, as done in practice.[183]

[179] S. Breyer, supra note 1 (describing information collection as the main set of costs in standard setting at large), pp. 103, 109, 112; Tim Sloane, Seema Phull, and Ketan Patel, *Efficient Business-to-Business Relationships: How Analytics and XML Can Help*, at <http://www.webtechniques.com/archives/2000/11/sloane/> (last visited 28 August 2002) (Suggesting that the biggest threat to the future of collaborative commerce is that collaborative commerce will be stalled by companies' inability to share information with trading partners), id; E. J. Iversen, *Standardization and Intellectual Property Rights: Conflicts between innovation and diffusion in new telecommunications systems*, In Information Technology Standardization and Standardization: A Global Perspective (ed. K. Jakobs) Idea Group Publishing, 1999) 80 (suggesting that cost-structure of manufacturers of IT standards involves high investments risks, i.e. R&D costs, regularly in excess of 10% of turnover, with low variable costs), pp. 85-86; M. B. Spring & M. B. Weiss, *Financing the Standards development Process*. In B. Kahin (ed.) Standards Development and Information Infrastructure (J.F. Kennedy School of Government, Harvard Univ., Cambridge MA, 1994) (Suggesting, e.g., that it has been estimated that the expenses of developing a single part of the Ethernet standards amount to approximately. $10,000,000, while the main development costs arise from the time, travel and salaries of the committee members), id.

[180] T. M. Jorde & D. J. Teece, supra note 165 ("Performance changes are more difficult to measure than price changes, because performance is multidimensional and may require various criteria of measurements"), p. 9.

[181] Ibid, id.

[182] C. F. Cargill, supra note 17 (on the industry consensus standardization process as a mean of promoting innovative market neutrality), p. 37; Tim Sloane, et al., supra note 179 ("To obtain the information required to make these decisions, it's crucial for companies to evaluate B2B operations through vendor- and market-neutral analytics"), (under section: "From Exclusive Club to Complex Web"), id.

[183] Trying not to repeat the mistakes that damaged the implementations of OSI in the development phase, as part of cyberspace's open systems movement, encouraged by the U.S. government, vendors have established consortia, e.g., X/OPEN, which as an important part of their effort to develop standards, focused on collecting information and testing the implementations of the POSIX

Overall, even with lesser commercial know-how than de facto agents[184], formal industry standard setters can usually better internalize information costs and risks embodied in infrastructure standardization.[185]

3. *Compliance costs*

It is commonly agreed that standardization coordinates technological developments efficiently.[186] Still, coordinating infrastructure is a complicated process, one that requires a great deal of interaction among the different phases of any comprehensive technology. Technologically, the ultimate goal of infrastructure standardization is to achieve complete integration, while minimizing congestion between and among the different technological ingredients of such a technology, namely infrastructure and application standards. At the same time, economically, the main difficulty is to overcome the self-motivations of de facto standard setters to bargain (subject to reimbursing transaction costs) as a method of dealing with potential non-cooperative (or even just over costly) technological compatibility of infrastructure. Compliance costs consist, therefore, of the requirement to coordinate standard compatibility (or interoperability), espouse technological convergence with other media, and reduce inefficient variety, taking account of existing transaction costs, as will be portrayed, hereinafter.

a. Coordination costs

In network environments, computer communications require complete and rigid compliance with basic interface specifications.[187] More specifically, in cyberspace, unified specifications are critical in designing both cheaper core protocols of computer

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1003.0 standard (ISO/IEC JTC 1 9945) (Test methods ISO/IEC JTC 1 13210, et al.) and other UNIX-like commands. See, C. F. Cargill, supra note 1, pp. 76, 221-222.

184 In their paper, Anton & Yao suggest that it may not require the exchange of much marketing information. See, J. J. Anton & D. A. Yao, supra note 171, p. 254. Eisner Gillett & Kapor further justify that early business environment twofold. First, unlike commercial protocols developed recently, such as IBM's SNA, Digital's DECNET, and Xerox's XNS, infrastructure standard setters did not have the marketing resources of a large company behind them; second, nor was their design oriented toward any particular vendor's hardware. See, e.g., Eisner Gillett & Kapor, supra note 140, id. Consequently, in most cases, such marketing will probably not involve personnel with much knowledge or authority in the marketing area, J. J. Anton & D. A. Yao, id.

185 A description of the funding mechanism will be made in § V.C.3.b, infra.

186 See, e.g., S. K. Schmidt & R Werle, *Co-ordinating Technology: Studies in the International Standardization of Telecommunication* (Cambridge Mass: MIT Press, 1998); J. Farrell & G. Saloner, *Installed Base and Compatibility: Innovation, Product reannouncements, and Predation,* 76 Am. Econ. Rev. 940 (1986), p. 942.

187 See, e.g., J. Farrell & G. Saloner, supra note 10, p. 1; Carl Shapiro & Robert Willig, *On the Antitrust Treatment of Production Joint Ventures*, 4 J. Econ. Persp. 113, (1990) (upholding the traditional rationale for joint ventures as a form of enterprise that can enable firms to attain economies of scale or scope that they could not otherwise achieve cheaply), p. 114.

communications and in achieving interoperability among its hierarchical layers.[188] Coordination costs also arise whenever standards are revised. When a network industry settles on a single standard, it may be expensive to move toward a new, superior technology even in the theoretical setting in which all users would be better off doing so. These costs are also commonly known as switching costs. In the development phase, switching costs, between technological ingredients are intended to be incompetently high.[189] Seen through the perspective of standard setters, this once again, results from the purposely-low level of effective price competitiveness of this phase.[190] Accordingly, potential price competition should not be able to efficiently motivate de facto standards setters to switch infrastructures, and de facto standard setters may not be able to establish monopoly power on infrastructure technology. Thus, they should not be even encouraged to be direct competitors on infrastructure production and coordination at large.[191] Thus, unless a monitored switch in infrastructure is centrally coordinated, it is highly expensive and typically not in the best interest of de facto standard setters to switch to uncoordinated platform-dependent standards.[192]

Thus, self-interested standard setters should not be left in charge of coordinating a new superior infrastructure - not only because of direct early coordination sunk costs, best absorbed by de jure standard setters, but because of late lost value from derivative negative network externalities.[193] Thus, once infrastructure technology is developed,

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188 See, e.g., A. L. Chapin, *The Internet standards process*, RFC 1310, March (1992) (referring to infrastructure standardization and suggesting, as early as 1992, that "Most IETF members agree that the greatest benefit for all members of the Internet community results from cooperative development of technically superior protocols and services"); David R. Johnson & David G. Post, *And How Shall the Net Be Governed?: A Meditation on the Relative Virtues of Decentralized, Emergent Law*, in Coordinating the Internet 62, (Brian Kahin & James H. Keller eds., 1997) (upholding that conclusion for the larger regulative perspective in cyberspace), p. 62, 68-69.

189 J. Farrell & G. Saloner, *Coordination Through Committees and Markets*, 19 Rand J. Econ. 235 (1988) (suggesting that the process of coordination tends to be slow, with very little chance of agreement between separate firms in the early development stages).

190 Ibid, (following the authors suggestion that when the value of coordination on a standard is large relative to the value a firm attaches to adopting its preferred standard, the standard setting committees are very likely to reach ultimate agreement on a standard but also vise verse), id.

191 See, e.g., Nicholas S. Vonortas, *Cooperative Research in R&D-intensive industries* (1991) ("In contrast [to 'maturing segments of R&D- intensive industries' and the case of 'declining industries'], multi-firm joint ventures for research are likely to be harmful in new, fluid technology industries… [C]ustomers of such industries are likely to lose from broad research cooperation since it will limit healthy competition in downstream markets."), p. 244.

192 See: e.g., J. K. Winn *Consumers and Standard Setting in Electronic Payments Regulation*, 5 Elec. Banking L. & Com. Rep. 11 (for an example of that later dilemma in application electronic payment standards: "whether to give up older systems that are cheap and efficient to operate and still meeting most of their needs, or to adopt newer systems that are expensive and risky"), p. 5.

193 J. Farrell & G. Saloner, supra note 10 (Emphasizing the positive correlation between the early coordination (sunk) costs hurdle and avoiding later motivation to overcome dependent switching costs: "once some costs are sunk, the firms have an incentive to fight hard for "their" standard to be adopted, even if objectively it may not be the best"), p. 4. One important mean of pre-committing de facto and even gray standard setters to a stable infrastructure would be to 'capture' their competitive motivations by enrolling them into infrastructure R&D by funding and subsidizing their early participation as was done in practice, as explained earlier.

infrastructure standards, will, in fact, become costly to change.[194] A monitoring policy regarding infrastructure developers will, therefore, be imperative in generating the indispensable infrastructure installed base.

The incentive of preserving a coordinated installed base, may be positively reflected also in the additional backbone telecommunications *services* market, as it may both encourage and facilitate early industrial initiatives to remain pre-committed to future infrastructure transit compatibility. An early example for that was given in the decision taken by eight subsidized industrial regional networks – BARRNet, CICnet, MIDnet, NEARnet, NorthWestNet, NYSERNet, SURAnet, and WestNet - to announce on May 27, 1993, the formation of the Corporation for Regional and Enterprise Networking (CoREN). This decision was eventually aimed to advance interconnection and blur the distinction between regional and backbone providers, thus choosing MCI (subsequently acquired by WorldCom) as their backbone provider.[195] By handling large amounts of Internet traffic, the CoREN backbone practically served to achieve wide installed base of infrastructure technology, and accordingly, to bill regional affiliates an efficient internal transfer prices for transport service provided.[196]

b. Reduce inefficient variety costs

By and large, one of the important standardization costs derives from inefficient variability of products, which standards come to reduce.[197] In the implementation phase, where potential consumer preferences might be based on product variability - consumer preferences are subject to become, most efficiently, heterogeneous, with some preferring one technology and others another. In that regard, a market of application standards might be better off with competing technologies than with a single standardized technology, subject to reducing inefficient variety so that economies of scale would become resourceful.[198] This is hardly the case with infrastructure standardization. Based on what has been described so far, such a scenario could lead to an inefficient outcome in the development phase. This heterogeneity is based on the subjective choice of consumers, which is not efficient or socially beneficial in the development phase. Instead, infrastructure standardization homogeneity, best achieved by central policy planning is efficient to a greater degree.[199]

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194 J. R. Reindenberg, *Lex Informatica*, supra note 1 (estimating that the cost of change at the local level will be imposed directly on individual users, while change at the network level will be borne by network operators), p. 583.

195 M. A. Eiinhorn, *Pricing and Competition Policies for the Internet*, In Public Access to the Internet (B. Kahin & J. Keller eds.), p. 344.

196 Ibid, id.

197 See, e.g., W. B. Arthur, *Competing technologies: An overview*, In Technical change and economic theory (G. Dosi et al, ed.) (Pinter Publishers: London 1988), id.

198 See, e.g., Jack E. Brown, *Technology Joint Ventures to Set Standards or Define Interfaces*, 61 Antitrust L. J. 921, (1990), pp. 922-923.

199 See, e.g., Sharon Eisner Gillett & Mitchell Kapor, supra note 140, id.

4. Indirect costs

As externalities, network effects positively benefit marginal participant-users, due to the effect of adding systems and the growing number of users of existing ones.[200] Typically, these effects suggest that network goods, priced by standard producers, and thus, also the derivative network access cost, valued by the network consumers, would be optimally fixed as cheaply as possible, thus facilitating the widespread adoption of a standard.

However, due to the existing differences in the two main types of standards in cyberspace - each type of standard is, arguably, subject to this externality differently. On the one hand, core standards seem to carry a positive network effect, due to the need for stable quality performance-based infrastructure. Here positive network effects are not merely a reflection of infrastructure interoperability, but rather the reason for their central adoption ex-ante. Moreover, due to the non competitive environment in which they are adopted their positive influence on the installed base is not direct by creating competitive incentives to produce additional infrastructure, but rather indirect as they end up leading to a derivative type of standards and markets[201]; namely - application standards in a later standardization phase.

Accordingly, a derivative advantage of infrastructure central coordination is the efficient default minimization of the - otherwise, typical costs of negative network externalities of multi-standardization, as explained earlier. Traditionally, in non-technological markets, these costs are argued to be present when persons other than the purchaser consume or use the product and some of the consequences of poor quality.[202] Conversely, in the early development phase, these costs are efficiently marginalized, based on the qualitative rational discussed earlier on. For these reasons, it is argued that central governments are best in achieving ex-ante critical mass of wide spread infrastructure standards, while most efficiently internalizing the costs of diffusing network effects, through funding industry organizations in research and ultimately, in endorsing and formally adopting infrastructure standards.[203]

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[200] For primary literature on 'network effect' externalities, see: M. L. Katz & C. Shapiro, *Network Externalities, competition and compatibility*, Am. Economic Rev. 73(3) June, supra note 59, id; J. Farrell and G. Saloner, *Standardization, Compatibility, and Innovation*, 16 Rand J. Econ. 70 (1985); J. Farrell & G. Saloner, *Installed Base and Compatibility: Innovation, Product renouncements, and Predation*, 76 Am. Econ. Rev. 940 (1986); M. A. Lemley & D. McGowan, *Legal Implications of Network Economic Effects*, 86 Cal. L. Rev. 479 (1998); C. Patterson, *Copyright Misuse and Modified Copyleft: New Solutions to the Challenges of Internet Standardization*, 98 Mich. L. Rev. 1351 (2000), pp. 1353 et al.; D. S. Evans and R. Schmalensee, *A Guide to the Antitrust Economics of Networks, Antitrust*, Vol. 10, No. 2 at p. 36 (Spring 1996); J. E. Cohen, supra note 148, pp. 543 et al.

[201] Jeffrey Church and Neil Gandal, *Network Effects, Software Provision, and Standardization*, Journal of Industrial Economics, Vol. 40, March 1992 (for a discussion on indirect network effects), at 85-104.

[202] R. Hirshhorn, supra note 133, at § 3.

[203] See, e.g., C. Shapiro and H. R. Varian, supra note 6 (on governments as cost-efficient in achieving critical mass of networks), pp. 313-315.

On the other hand, application standards are largely subjected to network effects in their traditional competitive form. Accordingly, they create the need for governmental intervention meant to minimize negative effects, largely, through ex-post antitrust law.[204] Here it is commonly agreed that in a competitive environment, new generations of standards will work at a significant disadvantage unless they are compatible with prior generations, so that the installed base of consumers could transfer data from one product to the next subject to productive competition between standards and their de facto developers.

[204] Ibid, p. 313.

IV
THE MODIFICATION PHASE: THE COMMERCIALIZATION OF CYBER STANDARDS

A. Overview

During the development phase, the U.S. government directly coordinated infrastructure design.[205] As explained earlier, infrastructure production had been primarily technically rather than commercially motivated. That policy eventually changed, with both technological and economical developments taking place. These central changes are what arguably led to the substantial commercialization of standard setting activity in cyberspace, followed by a substantive growth in the number and influence of de facto and gray standard setters. Empirically, it is yet to be proven whether these changes altogether, should be regarded as an independent technological phase in the technological standardization process, or merely an intermediate technological leap between two substantive phases of standardization. Even so, their central implications on the institutional choice are still worthy of a separate observation:

In 1995, soon after federal funding of the North American backbone had ceased, private companies began operating their own backbone networks and selling access to telecommunications services to their networks and the Internet. That privatization turned the Internet into a wide-ranging linkage of networks, turning it into a network of interconnected public and private computer networks joined by privately owned fiber telecommunications facilities. Once again, this development only came to follow the analogous case in the field of traditional telecommunications standardization. In the latter, a similar shift came in the mid-1980's, with the further growth of private-sector participation, supported by arguments that manufacturers, carriers and users should take part in formulating policies directly affecting them.[206]

One of the consequences of the vast growth of the early users community was a growing demand for additional facilitating standards.[207] Based on this largely platform-dependent approach, these software products came to facilitate the basic Internet data communication infrastructure.[208] One example for this technological development can

[205] In development, it was Dr. Vinton G. Cerf who led the design team at Stanford University that developed TCP/IP and managed the DARPA Internet project from 1976-1982. Along with Robert Kahn, both men are also generally accepted as the early inventors of the TCP/IP already in 1974. See, Vinton G. Cerf & Robert E. Kahn, *A Protocol for Packet Network Intercommunication*, 22 IEEE Transactions on Comm. 637 (1974).

[206] K. Lee, supra note 101, pp. 121-122.

[207] See, e.g., Kevin Werbach, supra note 3 ("Like a digital tornado, the vortex continues, as the new level of demand creates the need for additional capacity, and so forth"), p. 17.

[208] The derivative dependence of application standards on infrastructure is of central technological importance, as it explains the shift between the two first phases, as part of the processional argument, described earlier. For the various sources supporting this premise, see, e.g., *Brief History*, supra note 14, p. 12; Carl F. Cargill, supra note 17 (on 'implementation standards', using the

be examined through security technology, as it is embedded in both infrastructure and application standards. Thus, in its' infrastructure lies the Secure Socket Layer (SSL) infrastructure protocol that presides above the TCP layer and below application layer protocols such as HTTP, LDAP, IMAP, etc. SSL is designed to make use of TCP to provide a reliable end-to-end secure service. Because SSL is a channel security mechanism running on TCP, it can secure any protocol that can be carried by TCP. Thus, it is ideally suited for following secured-based applications such as SMTP, Telnet, FTP, through commercial software, such as NetSructure 7115 e-Commerce Accelerator, (an SSL offload device), SeeBeyond e*Xchange eBusiness Integration™ Suite (an interface for configuring security parameters), etc.[209] As with security technology, and soon after the uniformed TCP/IP infrastructure was in place, new commercial network effects gave incentive to vendors to build TCP/IP compatible products. This technological change seems to have been the main constraint leading to the commercialization of the net's standards.[210] Technologically, as advocated recently in a significant empirical study by Yochai Benkler, there were probably three major chronologically closed technological developments, which marked this technological shift to commercialization in cyberspace: The web server (World Wide Web); the first graphical user infrastructure (GUI), namely the Mosaic browser; and the first proprietary service provider, namely the America Online service provider ("AOL").[211]

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example of the IEEF 802.3 Ethernet infrastructure standard), pp. 28-31, 119; Floyd Wilder, supra note 16 (on the positive correlation between the Internet's layered-based architecture and the ease of developing future Internet protocols) p. 6 et al. ("When a new technology is invented that increases either processing power or transmission bandwidth, an application is developed to use it"), p. 357; P. Mähönen, supra note 103, p. 42.

Technically, the interchange between cyberspace's standardized infrastructure and applications is vertically coupled: network technology drives the applications, and applications drive the networks. This continuous feedback is also known as the "spiral design" process. For more, see: '*Research Challenges for the Next Generation Internet Report'*, produced by the NGI [Hereinafter, Next Generation Internet Report], at <http://www.cra.org/Policy/NGI/research_chall.pdf> (Last visited 28 August 2002).

209 See, respectively, *Packetized SSL Understanding the Advantage* (Andes Networks, Inc. white paper) (March 1, 2001), at <http://yahoo.bitpipe.com/data/detail?id=984686824_161&type=RES&x=1281472939> (last visited 28 August 2002); The Tolly Group, "*Intel Corp. Intel NetStructure 7115 e-Commerce Accelerator Server Performance Evaluation*" (white paper) (December 1, 2000), at <http://yahoo.bitpipe.com/data/detail?id=978117309_640&type=RES&x=1200891898> (last visited 28 August 2002); SeeBeyond Technology Corporation, "*Internet Security for eBusiness*" (white paper) (September 1, 2000), at <http://yahoo.bitpipe.com/data/detail?id=1008622485_295&type=RES&x=920655897> (last visited 28 August 2002).

210 Jay P. Kesan & Rajiv C. Shah, supra note 119 (suggesting that the first use of the term "commercial use" was made by Stephen Wolff, Director of the NSF Division for Networking and Communications Research and Infrastructure, who had laid the term in the backdrop of his formal statement). See, *Memorandum from Brian Kahin Director*, Information Infrastructure Project, Science, Technology & Public Program, John F. Kennedy School of Government, Harvard University, RFC 1192: *Commercialization of the Internet Summary Report* (Nov. 1990), at <www.ietf.org/rfc/rfc1192.txt> (last visited 28 August 2002)), p. 111, Fn. 93.

211 Y. Benkler, *Net Regulation: Taking Stock and Looking Forward*, 71 U. Colo. L. Rev. 1203, (2000) (on regulating in the closed-system pre-commodified era), p. 1206 (further arguing that "[those three changes] changed it all. It turned out that the net was not in the future; it was here…in what suddenly became the new popular (not to say mass) medium"); Compare, also: M. A. Lemley,

Soon after, the Internet became highly commercial in nature. According to the FCC, the Internet has grown from ten million users in 1995 to over 40 million less than five years later.[212] A similar pattern evolved with the growth in Internet services purchased, from $6.2 billion to over $300 billion in trade per year in the year 2002.[213]

Ultimately, this shift to platform-dependent compatibility was also met by consumer-oriented price competition.[214] Accordingly, this shift was ultimately followed by the commercialization of code writing of application software.[215] Eventually, as will be described, cyber standardization ended up becoming very closely related to the commercial decision-making done in industrial companies with products.[216]

Thus, central to the standardization process was a regulative change that is regarded as a shift from anticipated standardization planning to short-term gray and de facto standardization. Traditionally, industrial-age innovation followed the linear sequence from scientific discovery to applied research and development, followed by production and marketing. The standardization process is time consuming, particularly if the number of participants is high having divergent preferences. When a market exhibits rapid technological growth, as the cyber market has, the time required to develop an IT standard is typically longer than the product life cycle.[217] To cope with this, standards bodies begun, in the development phase, to act in anticipation of the technology, developing standards before products were being produced.[218] In the development phase

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Antitrust and the Internet Standardization Problem, supra note 93, p. 1052; L. Lessig, *The Limits in Open Code: Regulatory Standards and the Future of the Net*, 14 Berkeley Tech. L.J. 759, pp. 760-761; *Brief History*, supra note 14, p. 13; R. Caillian, *A little History of World Wide Web: From 1945-1995*, p. 2, at: <http://www.w3.org/history.html> (last visited 28 August 2002).

212 See, e.g., for FCC's policy records, in: *Connecting the Globe: A Regular s guide to building A Global Information Community,* Federal Communications Commission (1999), at <http://www.fcc.gov/connectglobe/sec9.html> (last visited 28 August 2002).

213 Ibid, id.

214 See, e.g., J. Farrell & G. Saloner, supra note 10 ("when competing products are compatible, they compete more on price and less on design. That makes the market more of a "commodity market"), p. 5; Manford M. Fisher & Börje Johanson, supra note 23 ("In finished standardized product (or mature products) markets, which serve for mass production – price competition prevails, as a quantitive measurement, is the main criterion for the decision making of buyers"), p. 264. For a similar governmental description of that transfer, although not necessarily assuming this paper's present multi-phase argument, see, also, United States Dep't of Commerce, *The Emerging Digital Economy II*, § 1 Secretariat on Electronic Commerce, U.S. Department of Commerce, April 15, 1998. This report is part of the *Clinton Administration's initiative on global electronic commerce*, described in the July 1997 Report [hereinafter, "The emerging digital economy"], at <http://www.ecommerce.gov/ede/part1.html> (last visited 28 August 2002).

215 L. Lessig, supra note 6, p. 52; Y. Benkler, supra note 210, p. 1233.

216 See, e.g., M. A. Lemley & D. McGowan, *Could Java Change Everything? The Competitive Propriety of a Proprietary Standard?,*: 520 PLI/Pat 453, p. 471.

217 In fact, this has been suggested as one of the characteristics of the present 'Knowledge Age' standards, as opposed to the previous 'Industrial Age' standards. See, e.g., the international Standardization Organization (ISO), in its report *'A vision of the Future: Standards Needs for Emerging Technologies'* (1990), id.

218 C. F. Cargill, supra note 1, pp. 45-46; P. Mähönen, supra note 103 (concluding that "the place for innovations is outside the formal standards meeting – standards just agree on the solution"), p. 38.

there were known as anticipatory standards.[219]

This means that while in the industrial age one first created a product and then standardized it, in the knowledge age one often needed standards before products, with compatibility to existing standards being a preliminary condition to enter into the market.[220]

In practice, this standardization work, even at the technical committee level, was not related to R&D work or innovations. Innovations were submitted to the standards process, wherein state of the art technology 'froze' to standards. Accordingly, in the development phase, standards were typically designed to include high technology specifications available, but did not drive towards new innovations within the standardization process itself.

Yet, with the growing shift to commercialization of application standards in the implementation phase, there has been an erosion of the anticipatory standards effectiveness, as the unified vision of the future became growing privatized, noticed by the rise of informal standardization. Thus, in practice, gray and de facto activity was to be initiated and driven by commercial implementers.[221] Eventually, with less efficient incentives towards strategic social planning, and as a result of rapidly increasing consumer demand for application standards, the development and implementation of standards became decreasingly less anticipated.[222]

For the most part, the risk of such rapid market-oriented standard-setting activity is that the standards will curtail innovation prematurely.[223] It may produce design standardization too early in the technological life cycle. A technology may thus be forced into "early maturity" not because of technological limitations but rather the will of competitor collusion.[224] Consequently, with the growth of application

[219] In fact, Bonino and Spring argue that anticipatory standards act as mechanisms for collective planning i.e. they are an embodiment of a central industrial policy. Accordingly, their prevalence serves as an additional rationale favoring central standardization of the developmental phase. See, M. J. Bonino & M.B. Spring, supra note 27, p. 99 et al.

[220] *International Standards Organization (ISO),* supra note 215, id.

[221] See, e.g., T. M. Egyedi, supra note 2, p. 55.

[222] Ibid (suggesting that, in fact, application standards development has began to occur in parallel), pp. 54-55; In a conversation with Carl Cargill, he further suggested that anticipatory standard-setting activity (as in the early phase of cyberspace standardization), is now practically 'dead', followed by the shift to standardize 'existing practice'. E.g., ECMAScript, which was standardized by ECMA - based on the Javascript programming language, established earlier by Netscape.

[223] Carl F. Cargill, supra note 17 (concluding that "if standards, voluntary or otherwise, are introduced, they will fail, since standards act to stabilize a market"), p. 118; P. Mähönen, supra note 103, p. 38; Martin C. Libicki, supra note 2 (alternatively suggesting that the optimal moment for standardizing should be "if the technology matures before the market takes off standardization can occur smoothly in between"), pp. 14-16; A. Sloane, supra note 24 (exemplifying the HTML protocol), p. 8.

[224] Frederick Betz, *Managing Technology* 75 (1987), see figure 2; See also, M. A. Lemley & D. McGowan, supra note 199 (focusing on the need for interoperability and defining this (growing) difficulty, as "whether the market can transition to a common standard allowing vertical and horizontal interoperation, and thus capturing positive externalities, without the standard itself becoming a force limiting competition"), p. 471. In the following part the resulting institutional

standardization, a new institutional balance had to be struck. Such balance was finally established in the implementation phase, hereinafter.

consequences of this change will be examined.

V
THE IMPLEMENTATION PHASE: THE RISE OF AUTONOMOUS INSTITUTIONS

A. General

As cyberspace budged into a substantive new phase of commercialization new commercial network effects gave incentive to vendors to build TCP/IP-compatible products. Ultimately, commercial decision-making in industrial companies with products of the real world became a second nature to cyberspace's standardization reality. Thus, while the path has neither always been clear, nor followed one direction, the narration of governmental interpretation of the public interest in the United States exhibits a definite pattern of decreasing intervention. That is, in the face of an increasing number of standard setting institutions i.e. de facto or gray standard setters.[225]

Arguably, in the implementation phase, only self-restrained political institutions, in the face of the government upon its delegated agencies, and particularly the FCC, will come close to optimize competition among autonomous standard setters. However, due to new risks of ex-ante technological stagnation and/or ex-post anti-competitive effects, (assimilated mainly with deliberate lack of compatibility or convergence between standards), on the one hand; and the need to sustain private competition, on the other hand - a role for an industry voluntary regulative approach to formalize de facto or gray standardization will turn to be essential. By the same token, due to growing concerns about governmental 'technological bias' through 'code control' - the formal industry organizations will be, arguably, the most efficient institution in chilling direct governmental incentives for mandated intervention, beforehand or ex-post.

Upholding this comparative institutional argument, an updated cost-benefit analysis of the different standardization costs i.e. administering, compliance and indirect costs for manufacturers and other agents, would be broadly outlined, as follows.

B. Application standardization: the cost-benefit analysis

The design of application standards should be primarily a product of competition, subject to the widespread need to develop, approve and compatibly adapt applications to infrastructures and other complementing applications. These production constraints suggest a new and delicate balance, as they are the result of two seemingly contradictory processes of commercial innovation: the creation of innovative product variety (when n actors bilaterally agree to a set of standards, then n*(n-1)/2 rules must

[225] See, e.g., C. F. Cargill, supra note 1, pp. 102-103.

be defined) and its successive reduction through user-based qualitative selection. Any effective technological acceptance will then require that these two processes be kept in balance.[226] In the highly competitive environment of cyberspace, this balance is not always maintained, due to genuine risks of inefficient production: As far as development per se is concerned, this balance derives from the common threat that rapid commercial activity will curtail innovation prematurely and will lead technology into early maturity in the face of inefficient standards. Thus, if a leading standard is set before a technology reaches maturity, innovative activity that is bent on more radical improvements may be economically inefficient. With the decline of anticipatory standardization that risk seems to have only grown.

Moreover, as far as adaptation and approval (or formalizing) are concerned, compatibility should be promoted optimally, so to create and maintain new and competitive economies of scale in application standards. Thus, the need to diminish the basic cost of both early maturity, due to will of competitor anti-competitive collusion and inefficient incompatibility, should, arguably necessitate a role for formal industry policy planners to optimize efficient de facto and gray standardization, as follows.

1. Administrative costs

a. Eliminating duplicative efforts

As with infrastructure standards, the central problem of the standard-setting process, and the most pressing task facing de facto and gray standard-setting organizations is gathering the information needed to write a sensible commercial standard.[227]

Ultimately, standardization authorities and organizations should involve cooperation and prevention of R&D overlapping.[228] Following this premise, already back in 1984 Congress passed legislation aimed at indirectly facilitating autonomous commercial innovative initiatives, through the National Cooperative Research Act, and later in 1993 also the National Cooperative Research and Production Act.[229]

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[226] See, e.g., Carl Shapiro and Hal R. Varian, supra note 6, p. 233 et al.; B. Carlsonn & R. Stankiewicz, *On the nature, function and composition of technological systems*, J. of Evolutionary Economics, 1, 93-118.

[227] E. J. Iversen, supra note 179 (suggesting that cost-structure of manufacturers of IT standards involves high investments risks, i.e. R&D costs, regularly in excess of 10% of turnover, with low variable costs), pp. 85-86; S. Breyer, supra note 1, pp. 103, 109, 112.

[228] See, e.g., Carl F. Cargill, supra note 15, pp. 131-138; A. L. Chapin, supra note 188, id; Thomas M. Jorde & David J. Teece, *Acceptable Cooperation Among Competitors in the Face of Growing International Competition*, 58 Antitrust L.J. 529, n. 28 (1989), p. 538;

[229] *15 U.S.C. §§ 4301-4306 (1983 & Supp.1995)* [Hereinafter, the NCRPA]. In fact, by enactment of the NCRPA congress seem to have reinforced the existing tolerance expressed for joint ventures engaged in legitimate research and development and standard-setting projects, mandating application of the rule of reason in cases brought against registered ventures. See, Jack E. Brown, supra note 197, pp. 933 & Fn. 55 and accompanying text. (Adding that the congressional interest in furthering joint activities was also reflected in the repeated legislative attempts to extend the NCRA's

Designed to accelerate the existing pro-competitive policy in mind, the National Cooperative Research and Production Act (NCRPA), 15 U.S.C. §§ 4301-4306, clarified the substantive application of the U.S. antitrust laws to joint research and development activities and joint production activities. Initially drafted to promote R&D activity by providing a special antitrust regime for such joint ventures, the NCRPA requires U.S. courts to judge the competitive effects of a challenged joint R&D or joint production venture, or a combination of the two, in properly defined relevant markets and under a 'rule-of-reason' antitrust law standard. Such conduct was to be evaluated as "shall be judged on the basis of its reasonableness, taking into account all relevant factors affecting competition, including, but not limited to, effects on competition in properly defined, relevant research, development, product, process, and service markets". The NCRPA also instituted a voluntary procedure pursuant to which the Attorney General and the FTC may be notified of a joint R&D or production venture. Accordingly, numerous US consortia have already filed under the National Cooperative Research and Production Act of 1993;[230] That is, in order to limit their penalties and liabilities for costs for standardization activities.[231] However, overall, the NCRPA has not been widely practiced by standard setters since its enactment.[232]

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protections to joint production and manufacturing, as well as research ventures. See, e.g., *H.R. 1604, 102d Cong., 1st Sess. (1991)),* id.

230 See, e.g., Dennis W. Carlton & Jeffrey M. Perloff, *Modern Industrial Organization* (3rd ed., Addison-Wesley) (2000), p. 522.

231 This 'Rule of Reason' analysis was earlier on adopted in the Research and Development Joint Ventures and Antitrust Concerns embedded in the Department of Justice early *Guidelines on Research Joint Ventures, 1980*. Focusing on the justifications for joint projects, these Guidelines indicate three considerations: the capability and compliance of the participants to carry out similar research individually; the existence and degree of entry barriers; and the reach and length of the venture, id. See, also, John Lipczynski & John Wilson, *Industrial organization: An analysis of competitive markets* (Prentice Hall, 2001) (for evidence to suggest that dominant firms may protect their existing market shares and status que by either keeping new ideas secret or denying entry to firms with a newer technology), p. 229, referring also to W. R. Maclaurin, *The process of technological innovation: the launching of a new scientific industry*, Am. Econ. Rev., 40, 90-112 (1950).

Another central case study of this policy, one which was uphold already back in 1987, came with the International Organization for Standardization (ISO) telecommunication-oriented organization and the International Electrotechnical Commission (IEC) information technology-oriented organization - agreement to cooperate in the *ISO/IEC Joint Technical Committee 1 (JTC1).* The internal structure of the three standards bodies is similar, although the names of organizational entities differ; each has an overarching forum in which standards policy is decided upon. The purpose of this cooperation was to eliminate the serious overlap between ISO and IEC in their standardization activity. See, Informal guide for IDO/IEC JTC1 and CCITT cooperation, *ISO/IEC/JTC1 N303*, Geneva, 1988 (formalizing open-sharing and common good will as the basis for cooperation); See, also, K. Lee, supra note 101, pp. 44-45.

232 See, e.g., Joseph Kattan, *Contemporary Antitrust Analysis of Joint Ventures: Why It Makes Sense to Stay the Course*, Presented at the Federal Trade Commission's Hearings on Joint Venture Project Washington, D.C. June 5, 1997.

That is the case, most likely because of the notable gap between the protections offered by the Act and what Congress evidently believed it to be when it enacted the statute:[233] Designed primarily to enhance early innovative research and development activity, the adapted 1994 Act still suffers from certain limitations that result from the limited view of the technological standardization process. Firstly, the Act does not extend to joint production and marketing or even to certain applied research. The Act's distinction between "pure" research and its following applications in both time and space is thus potentially artificial.[234] In order to commercialize a product effectively, development engineers must receive feedback from the production and marketing stages.[235] Moreover, especially in the later implementation phase, when standard setting committees seize to be engaged in anticipatory standardization – the production of application standards gets a new commercialization and marketing emphasis instead of the more R&D one of the early infrastructure standardization phase. Indeed, innovation in manufacturing processes may be just as important for the success of a new product as the design innovations conceived in the early development phase.[236] Secondly, as Jorde and Teece rightly point out, many types of production ventures, however, would not be covered by the new law, as in order to be protected by the Act, a production joint venture must have its principal production facilities in the United States. Furthermore, according to the Act the parties to the venture must be United States companies or must be incorporated in nations that treat United States companies fairly under their own antitrust laws governing production joint ventures.[237] Being aware of the internationalized growing nature of formal industry standard setters, gray standard setters consortia and Ad Hoc standard setters, the Act now necessitates further conformity.

Another indirect mean of preventing overlapping is achieved through the expanding voluntary promotion of electronic publishing of research materials. For a start, increasing the efficiency of information flows to users, trying to improve productivity seems to diminish inefficiency associated with protracted trial and error processes in manufacturing.[238] In balance, it is important for manufacturers in this environment of increasing competition to protect their R&D investments against misuse in other markets.[239] In practice, there is a notable growth in common R&D joint ventures,

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[233] Ibid, id.

[234] See, Anthony L. Clapes, *Blinded by the Light: Antitrust Analysis of Computer Industry Alliances*, 61 Antitrust L.J., 899, 916 (1993).

[235] See, Thomas M. Jorde & David J. Teece, supra note 162, at 582, 589.

[236] Ibid, id.

[237] *H.R. 1313* passed the House of Representatives on May 18, 1993. House Passes Bill Easing Antitrust Law for Parties Involved in Joint Ventures, 64 Antitrust & Trade Reg.Rep. (BNA) No. 1615, at 600 (May 20, 1993).

[238] See, e.g., P.A. David & S. Greenstein, *The Economics of Compatibility Standards: An Introduction to Recent Research, Economics of Innovation and New Technology*, 1(1) & 2, Fall 3-42.

[239] Thus, industry standard setters may try to use the information they control to influence market trends, also against the public's interest, while raising bargaining threat costs of standardization activities to a non-cooperative level, and beyond the NCRPA antitrust 'rule of reason'. In 'unreasonable' situations there will be a need for governmental intervention. Moreover, if certain de facto standard setters are excluded from such a joint venture, they may be competitively disadvantaged because they could not conduct research on the same scale as the members of the

embraced to tackle high R&D costs and uncertainty about market developments. And so, several industry standardization organizations, e.g. IETF, make their standards (or parts of them) called Request-For Comments (RFCs), available electronically, and waive all publishing or use fees.[240]

b. Reduce search costs

In markets of application standards, information regarding the different measurements (i.e. cost, quality, services, etc.) whenever it is the consequence of self-regulation should be communicated to consumers in a way that is easily comprehended and used as the basis for comparison. In markets of applications it is notably difficult to measure the quality value of these products for consumers. As demonstrated by Arrow, this intrinsic tension is true for information markets at large.[241] It is thus, also true for consumer-oriented markets of applications.

As a result, and due to the fact that information as to quality is more costly to supply and process than information as to price - public agents which hold sufficient information so to make appropriate quality judgments and then certify them, were needed to act as a monitoring proxy for average consumers approaching application standard markets.[242] In cyberspace, it being a standard-oriented industry, such formal monitoring standard setting activity was largely achieved by attaching a consensus around individual technologies. While the government is best suited for subsidizing costs of such activity (as will be explained in § V.C.3.b) – it was competitively-neutral formal industry organizations, that took charge of diminishing these search costs necessary to ensure the adoption of adequately efficient standards. In so doing, these monitoring proxies should too bypass the situation in which the market either does not pick up momentum because of too much variety, or it malfunctions. In the latter extreme cases, the industry is also most efficient in mitigating the technological 'orphan' problem i.e. when a market left with an abandoned technology (by producing backward compatibility) and is subject to the risk of choosing the 'wrong technology' i.e. bandwagon effect and remaining inefficiently locked-in.[243] Alternatively, government acting proactively in the same monitoring role will not reach such optimal

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venture. See, e.g., Lawrence A. Sullivan, *Handbook of the law of antitrust* 298-303 (1977) and Fn. 167-70 & accompanying text (discussing the anticompetitive effects of membership restrictions).

[240] This practice is also reflected in the common argument in cyberspace's infrastructure research community, according to which such policy may have, in the past, cheapen adoption of standards, such as the TCP/IP, in attaining a significant share of the market. As to the TCP/IP, the argument was that since university researches could obtain a significant standard at no (direct) cost in electronic form, they elected to choose these standards over CCITT or ISO standards.

[241] K. Arrow, supra note 162, p. 615.

[242] More on certification mechanisms, see: G. A. Akerlof, supra note 169, id; Kip W. Viscusi, *A note on "Lemons": Markets and quality certification*, Bell Journal of Economics 9 (1978) 277; Michael J. Trebilcock, supra note 166, pp. 92-95.

[243] See, Joseph Farrell & Garth Saloner, supra note 10, p. 8; Paul A. David, *Narrow Windows, Blind Giants and Angry Orphans: The Dynamics of Systems Rivalries and Dilemmas of Technology Policy* (Center for Economic Policy Research, TIP Working Paper No. 10, Palo Altp, Cali.: Stanford University, 1996).

results. According to a seminal study set by Paul David, whenever a government is basing its policy on insufficient information (i.e., high search costs) and acts proactively to push de facto standard setters to convergence i.e. proceeded with standards development even faster, it acts like a blind giant.[244] In unclear situations a government should, instead, only operate by default to slow up market convergence so to prevent premature lock-in. On average, that way a government is said to promote the demand for market compatibility, thus easing the ultimate risk of backing wrong standards.[245]

Overall, standard development best contributes to the collective R&D learning process whenever inefficient sources of variety in design are reduced by minimizing information costs through formal industry intervention. At the same time, the choice of industry naturally adds to the costs of the system, since according to this suggested institutional mechanism - rule making remains within the firms i.e. de facto standard setters. In balance, in order to preserve the latter competitive benefits, while upholding the Report's self-regulatory paradigm for application standardization, formal industry standardization organizations should be limited only to a secondary role of monitoring and certifying de facto production in the implementation phase.[246]

2. Compliance costs

In order for infrastructure to be effective, the system infrastructure of the future must be designed to be dominant and hegemonic, as suggested earlier. A different type of compliance is required for application standards. Here, this need for a unified vision for anticipatory standard setting activity (for both internalizing and ultimately reducing existing costs, through formal institutions) is typically smaller. In application standard setting compliance became a regulatory preference, not a must.

However, even in this commercial environment, too great a departure from unvarying standards by de facto standard setters may still generate significant compliance inefficiencies, based the present incentive of firms to overstate their compliance costs with other developers. Thus, raising their pre-bargaining threat costs of that desired competition.[247] Such strategic behavior from the part of self-interested standard setters takes place whenever firms close-source their standards and turn them to be proprietary, and thus typically less compatible. On the other hand, imposition of more inflexible standards on 'newer' firms may create inefficient barriers to entry and thus protect 'older' firms from competition. Reducing such compliance costs should therefore be sustained within the framework of the immanent regulative paradox: the more de facto activity is encouraged by formal agents, the more independent and thus, potentially non-compliant de facto standards are made possible.

244 See, Paul A. David, ibid, id.
245 Ibid, id; Martin C. Libicki, supra note 2, pp. 25-27; J. Farrell & G. Saloner, supra note 10, p. 8.
246 Compare: A. Ogus, supra note 1, p. 110.
247 E.g., A. Ogus, supra note 1, p. 155.

The idea that compliance costs diminish with application standards also complies with transaction costs, generated in cooperative production of standards. In the world outside cyberspace, subsequent to Rakoff's significant insight, it is agreed that when transaction terms are standardized, thus lubricating bargaining conditions - transactions costs (but also enforcement costs and adjudication costs) of producers (and users) are reduced.[248] This premise is also part of the general criterion of compliance costs, especially so in the implementation phase, where bargaining as a means of coordinating standards becomes feasible.[249] Indeed, one of the primary purposes of standardization is to eliminate bargaining over details of individual transactions when bargaining costs and unpredictable customized bargains would deter producers from making valuable products i.e. application software available. This is for the following reasons. First, application standards imbed an ex-ante constraining nature, as automated, self-adapting and self-executing regulative subject-matters: standards, as independent technological policies, can therefore, be encouraged to impose, prevent or permit transactions from occurring while defining the level of access to both its source code and interface, before, during and after application standards are produced.[250] Second, in cyberspace, direct signaling options increase in both quality and number.[251] Thus, based on software design, technological standards give greater regulative control to users that get to have a clearer say about their preferences.[252] As advanced signaling options, production based on future consumer preferences is also likely to simplify and potentially cheapen transactions among producers and users alike. Third, based on consensual practices of fair competition, users of application standards may lower enforcement costs against non-compliant standard setters through monitoring and compliance technologies e.g. blocking and filtering technology or even censorship software against uncooperative

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[248] See, T. Rakoff, *Contracts of Adhesion: An Essay in Reconstruction*, 96 Harv. L. Rev. 1174 (1983) pp. 1222-1224.

[249] More on the importance of promulgating common terms of trade in cyberspace e.g., for the XML standardized languages market, see, e.g., C. P. Gillette, *Intervention and Standardization in Electronic Sales Contracts*, 53 SMU L. Rev. 1431, p. 1435; E. L. Rubin, *Computer Languages as Networks and Power Structures: Governing the Development of XML*, 53 SMU L. Rev., 1475 (2000), p. 1455.

[250] The IETF is a good example of this front. All standard proposals and main standards are available at their web site (www.ietf.org). See also *GII Virtual Roundtable* (www.globalcollaboration.org) - an organization-neutral online forum that includes a large set of standardization organizations such as IEC, IrDA, ISO, JTC1, POSI, VESA, ETSI, DAVIC, etc. Its goal is to provide a common forum for users and consumers alike for voicing their opinions on various active standardization processes. Moreover, the principle that insures that implementers of a standard should have open access to intellectual property rights and would be required to meet the standard on a non-discriminatory, fair and reasonable basis - was adopted by many standards developing organizations, e.g. ANSI, ISO, IEC, ITU and the IETF; See, also, P. Mähönen, supra note 103, p. 44, referring also to H. J. F. Ryan, *ISO/IEC JTC 1 Directions in Multimedia and GII standards*, IEEE Comm. Magazine, (September 1998) pp. 108-114; see also, Roy Rada, supra note 99, pp. 29-30, 32.

[250] K. Lee, supra note 101 (using the example of the wireless phone industry and suggesting that their joint interoperable failure has been neither on consensual nor on technical grounds, but because of ability, given CCI rules, of core groups to dominate the standard setting process), pp. 128-129.

[251] See, e,g., J. R. Reindenberg, *Lex Informatica*, supra note 1 (generally suggesting that signaling options for completing transactions in technological products increase), p. 570.

[252] Ibid, id.

behavior from the part of such non-complying standard setters. In essence, these technological constraints can be designed to increase the ability of users to lubricate demand for application standards in the face of the growing need for advanced widespread applications.[253] In essence, the expansion in consumer diversity on demand still remains a seeming paradox. On the one hand, cyberspace allowed a growth in consumer regulative involvement in designing his or her preferences of standards. At the same time, the need to coordinate both production efforts and compatibility, aimed to meet diverse preference – has well increased, as more application standards became more complex and expensive to coordinate. Thus, with such regulative tension unresolved, a role for industry formalizing of de facto and gray standards will still remain essential.[254]

The second general justification for the role of industry formalizing de facto and gray standards is based on a procedural ground. Procedurally, formal industry has an effective ability to maintain and reproduce such compliance through rules of membership and procedure. Formal industry standardization is, arguably, the most efficient mediator of hegemony within the overall institutional framework, as they are more likely to remain competitively neutral and thus serve universal interests in the face of growing self-interested competition.[255]

In summary, changes in application standards made by de facto standard setters, can be mostly facilitated through the intervention of formal industrial groups that both possess

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[253] To date, filtering software for data and documents on the Internet are mostly related to two main standard applications, namely: email and the World Wide Web. Broadly, filters can facilitate individual choice at the browser or even the server level. See, generally, Paul Resnick & James Miller, *PICS: Internet Access Controls Without Censorship*, 39 Communications of the ACM 87 (1996) <http://www.w3.org/PICS/iacwcv2.htm> (last visited 28 August 2002); R. Polk Wagner, *Filters and the First Amendment*, 83 Minn. L. Rev. 755, 759- 69 (1999); Jonathan Weinberg, *Rating the Net*, 19 Hastings Comm. & Ent. L.J. 453 (1997).

[254] J. R. Reindenberg, *Lex Informatica*, supra note 1, p. 587; R. Rada, supra note 99, p. 33.

[255] The procedure of IT standardization rule making, will remain outside the scope of this study. Analogously, in the telecommunications field, the nature of consensus in the ITU organization has been hegemonic rather than pluralistic. Pluralistic consensus suggests equal, open and voluntary participation in decision-making. Hegemonic consensus, in contrast, may overtly appear as the same process but is characterized by the underlying dominant-subordinate relations. This hegemonic consensus was eventually adopted also for cyberspace standards, e.g. in the IETF standardization organization, where the standardization process depends on "rough consensus and working code". "Rough consensus" is used in all decisions of IETF working groups (and IESG). This regime means that a majority of the participants support a proposal, and that any strongly dissenting voices belong to a small minority. Nevertheless, as explained beforehand, this policy rule is ultimately subjected to the test of not whether a standard body accepts it, but whether it is accepted in general use. For the telecommunications experience, see generally, R. W. Cox, *Gramsci, hegemony and international relations: an essay in method*, Millennium 12(3) 162-75; R. W. Cox, *Production, Power and World Order: Social Forces in the Making Method*, (Columbia University Press, 1987). For cyberspace's analogous experience, see, e.g., G. T. Willingmyre, P.E., *Consortia or Consensus? Current Issues in Industrial Standards Policy* (October, 1996) at: <http://www.gtwassociates.com/answers/micros64.html> (last visited 28 August 2002); E. L. Rubin, supra note 239, pp. 1455-1461; IETF's home page: <http://www.ietf.org>; S. Brander, *The Internet Standards Process—Revision 3*, RFC 2026 <http://www.ietf.org.rfc/rfc2026.txt> (last visited 28 August 2002).

the authority to articulate and promulgate standards of their own, but more so, formalize de facto standards and promulgate common terms of trade. In addition, as centralized adopters of standards, formal industry organizations are looked upon to publicize and advertise content and procedures of cooperative standardization practices. Ultimately, in all of these roles they are then the most effective institutional choice.

3. Indirect costs

As seen, coordination of technologies required by new standards and innovative products may, because of economies of scale, be cheaper for larger and well-organized agents than for smaller firms. However, this also means that the real winners in a system are de facto standard setters that would be supple enough to identify opportunities to capture an architecture and powerful enough to sustain control over it. Often, one or more such de facto agents might be pushed towards delaying a final innovative outcome hoping that technological or commercial developments will overtake an undesirable result. Beyond an efficient result, there is a risk that this process will produce an answer that will end in isolating vendors and fractionating the market. That may result whenever duplicative production is made, rather than uniting vendors behind a standard that would be well accepted by users.[256]

With inefficient monopoly being a market failure best minimized through governmental regulation, formal industry standardization organizations are not a natural proxy for such regulative activity.[257] Nonetheless, as a policy matter, they may still serve to minimize the potential need for such governmental intervention already ex-ante.

Thus such industry intervention could be achieved through a coordinated approach towards the right to supply itself: Trying to avoid self-regulating firms to have monopolistic control over the right to supply standards, it may be a supporting role of the industry to channel it to competition for that right, each competing self-regulatory firm being required, as part of its bid, to submit its proposed regulatory rules. A second-tier formal public agency, acting as proxy for consumers in the manner described above, might then be able to determine the right to supply, which could be contingent on the suppliers meeting the approved regulatory rules. In cyberspace, this more theoretical approach may have not yet reached its potential, leaving the industry with the more limited role of ex-ante coordination of production. That is, as opposed to the right to supply itself, which in return would admit even additional market control to

[256] For an example, see, K. M. H. Wallman, *The Role of the Government in Telecommunications Standard-Setting,* 8 CommLaw Conspectus 235, (suggesting that this was the case with the wireless network standards situation that has ended up producing one set of prevailing standards for the U.S. market (Time Division Multiple Access and Code Division Multiple Access) and another for most of the rest of the world (Global System for Mobile Communications)), pp. 239-240.

[257] K. Lee, supra note 101 (following the example of the wireless phone industry and suggesting that their joint interoperable failure has been neither on consensual nor on technical grounds, but because of ability, given CCI rules, of core groups to dominate the standard setting process), pp. 128-129.

industry organizations.[258]

C. Government intervention

1. General

The question of the appropriate function of governments in producing IT standards is still largely over-shadowed by its confusing counterpart question of content regulation (i.e., standardization), as argued also in part I above. As such, it has also become an overly sensitive question, which often appears to be deduced to more abstract questions of theory, bearing to some extent, extreme conclusions against central intervention. In this comparative setting, this section will depart from a different, more practical line of argument, and will assume as a fundamental proposition that the U.S. federal government (and state governments) is already substantively involved in the standardization of the net and will continue to be, as will be described henceforth.[259] In accordance, any decision to disfavor any governmental intervention in cyber standard setting should not be seen merely as a function of these standards content but also of its production costs per se, as suggested earlier. Therefore, the questions which will be set forth would be not simply whether governments should be involved in standard production - but rather when? Where? and then also how could that involvement be optimally sustained?

Generally, for the implementation phase, this study wishes to join the suggestion that the role of the government should largely diminish. The agreed assumption is that whenever corrective actions that the political institution, i.e. a government, can take to

[258] See, e.g., A. Ogus, supra note 1 (acknowledging that, to date, such a system is already used for the allocation of public franchises, for example in broadcasting services or airline routes), p. 110; This environment in which industries might control the market for the right to supply will also be subjected to antitrust law limitations. For suggestions regarding joint ventures' admitted market-share, see, e.g., E. Gellhorn & W. T. Miller, *Joint Ventures and Standard- Setting: Problems in the Current Framework*, paper presented to the Federal Trade Commission in the hearings on the Changing Nature of Competition in a Global and Innovation-Driven Age, October 26, 1995 (Suggesting that cooperation among industry participants with a collective market share of less than merely 35 percent create few risks, especially in dynamic high-technology markets, and thus should be immune from antitrust challenges); See, also, William F. Baxter, *The Definition and Measurement of Market Power in Industries Characterized by Rapidly Developing and Changing Technologies*, 53 Antitrust L.J. 717, 723 (1984) (proposing that R&D joint ventures possessing market shares of lower than 20 percent be considered benign); Joseph F. Brodley, *Joint Ventures and Antitrust Policy*, 95 Harv. L. Rev. 1523, 1541 (1982) (proposing a restriction of 40 percent); Robert F. Bork, *The Rule of Reason and the Per Se Concept: Price-Fixing and Market Division*, 75 Yale L.J. 373, 397 (1966) (suggesting a restriction of 25 percent), id.

[259] Thus, under the Invention Secrecy Act of 1951, the United States still blocks patents from being issued, and in the case of nearly 6,000 inventions - still prohibits the inventors from selling or licensing their technology to anyone except the government. That is, whenever an alleged threat national security is suggested. Thus, next to technologies concerning advanced ceramic materials, laser materials, etc. – there are also computer hardware and other Internet technologies. See, e.g., Dennis W. Carlton & Jeffrey M. Perloff, supra note 230, p. 512.

minimize market failures, could be efficiently, or at least as well, achieved through the private sector standard setting activity, there is no reason to divert government resources away from functions that a government alone is qualified or empowered to do. Thus, under section 401 of the 1996 Act, the Commission must refrain if regulation would not be necessary to prevent anti-competitive practices and to protect consumers, and forbearance would be consistent with the public interest.[260] More specifically, in response to the standard setting framework, the U.S. government justifiably followed with this clear comparative institutional guideline: "Even where collective agreements or standards are necessary, private entities should, where possible, take the lead in organizing them".[261]

In this part I will argue that apart from the indirect support for routine and limited *infrastructure* standard setting activity of the present phase, aimed at preserving its central quality rationale, e.g. increase in bandwidth on the backbone transmissions links, better physical access from homes and businesses or even a more sophisticated network architecture - a government should stick to a restrained indirect role in application standard setting activity, due to what are its institutional barriers on efficient participation.

2. Direct intervention: The problem of efficiency

Upon examining governmental efficiency through direct application standardization activity in the market, there are broadly three main rationales for why governments tend to be inefficient in standard setting innovations in the *implementation* phase. First, and most importantly, from a view of an overall standardization process, rapid technological developments generally outpace the rate of slow ex-post bureaucratic decision-making evolution.[262] Moreover, once production patterns are adopted, they acquire a taken-for-granted quality and are not easily dismissed or changed.[263] The latter proposition is even more acute regarding IT standardization. As a general matter, when standards are developed or ordered by governments, they tend to be designed for particular needs (especially, the Department of Defense's programs), which are largely less commercially-oriented or desirable for smaller commercial programs with fast response times.[264] Eventually, while the market may replace an inefficient standard by

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[260] *47 U.S.C. §160*. On a more declarative level, the 1996 Act concludes that "[t]he Internet … [has] flourished, to the benefit of all Americans, with a minimum of government regulation."; "[it] is the policy of the United States to preserve the vibrant and competitive free market that presently exists for the Internet…." *47 U.S.C. § 230 (a)(4), (b)(2)*. In essence, this premise is also what led to the deregulation movement in telecommunications services. See, e.g., Kevin Werbach, supra note 3, p. 29. See, also, discussion infra.

[261] *The Report*, supra note 16, § 9.

[262] M. C. Libicki, supra note 2, p. 354; S. Eisner Gillett & M. Kapor, supra note 140, id; S. Breyer, supra note 1 (generalizing a rule for technological standard setting, while observing: "the agency is in the dark. It cannot know in advance whether the industry will or will not be able to comply"), p. 106.

[263] G. March & J. P. Olsen, supra note 13, p. 52.

[264] M. C. Libicki, supra note 2, pp. 354-355.

competitive technological "leapfrogging", there are, typically, fewer guarantees that the government will or could do the same.

Furthermore, except for the competitive self-standardization practice (backed by a governmental monitoring role), there is no market for *control* of standard setters; and thus, the principals (politicians and citizens) could not easily dismiss ineffectual officials if the latter are to control such activity directly.[265] Moreover, government agencies are generally composed of career public servants, not market participants, and as a result, they often do not involve the most qualified and yet industrially impartial individuals in the industry for the standard-setting process. This is the inherent danger of bureaucracy, particularly when it attempts to standardize such a fast-moving area of commerce as the Internet.

Second, today's technology may limit the ability of governments to be in even terms with direct and substantive standardization. For a start, in a market economy, such as that of the implementation phase, where the market is the chief determinant of what is in fact efficient, it is not even apparent that the government will be on familiar terms with an inefficient standard, in practice. While formal terms of production provide product differentiation with a more certain and open to scrutiny environment, it also turns autonomous incentives for necessary change more scarce and subject to delay. That is, in case governments adopt them directly. Ultimately, the need to write standards with an eye towards enforcement raises difficulties that may potentially compel the agency to write standards that do not meet an efficient policy primary objective.[266]

Third, information flows may be impermeable to the action of a single government. Accordingly, government standard-setting agencies may be slow in gathering information, and may not always have access to the best information.[267] As explained,

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[265] G. March & J. P. Olsen, supra note 13, p. 52; A. Ogus, supra note 1, p. 112.
[266] S. Breyer, supra note 1, p. 112; A. Ogus, supra note 1, p. 170.

[267] See, e.g., R. A. Posner, *Antitrust in the New Economy*, Antitrust Law Journal 2001, 925 (arguing that in the new innovative economy the real legal problem lays on the institutional side: the enforcement agencies and the courts do not have adequate technical resources, and do not move fast enough, to cope effectively with a very complex business sector that changes very rapidly), p. 25; J. J. Anton & D. A. Yao, supra note 171 ("Technical judgments are also critical to assessing whether the benefits of the standard outweigh the costs, but most courts and agency officials lack a technical background"), p. 252; Bazelon, *Coping with Technology Through the Legal Process*, 62 Cornell L. Rev. 817 (1977) (Suggesting that in cases of great technological complexity, the best way for courts to guard against unreasonable or erroneous administrative decisions is to establish a decision-making process which assures a reasoned decision that can be held up to the scrutiny of the scientific community and the public); H. Shelanski, *Regulating at the Technological Edge: New Challenges for the F.C.C*, 2000 L. Rev. Mich. St. U. Det. C. L. 3; H. Shelanski, *Competition and Deployment of New Technology in US Telecommunications*, 68 U. Chi. L. Rev. 1 (generally supporting an on-going repeated-play policy in establishing the right equilibrium to the telecommunications industry in the FCC, in the face of the present technological change); Harry S. Gerla, *Federal Antitrust Law and Trade and Professional Association Standards and Certification*, 19 Dayton L. Rev. 471, 503 (1994) (examining how eventually "antitrust courts generally have been favorably disposed toward trade and professional association standards").

this problem exists also in the earlier development phase. However, as suggested earlier, in that former pre-commodified phase, competition was scarcer than it is in the present phase and the U.S. government successfully monitored such information flows. Thus, even with the best of objectives, a government standard-setting agency may simply pick what is impartially a reduced standard, leading to stagnation of robust standards, even when technologically they may be evidently ill conceived. Alternatively, government agents may not always have the ability or will to perform such best intentions. As it has been adequately noted in the literature on public choice, government agencies in a position to influence the outcomes of market competition are highly susceptible to "capture" by private entities with an interest in the outcome. Thus, there is much less guarantee that a governmental standard-setting body will act efficiently in the public interest through direct standardization activity, even when it is possible for a government agency to discern what in fact that interest is.[268]

Fourth, as a derivative conclusion from the former explanations (albeit an independent institutional rationale) - lays the advancing globalization trend, which is reflected also in IT regulation and thus more specifically also in cyberspace's standardization today. As suggested above, institutional analysis refers narrowly to "collective action" and "interest groups" at the national level. These paradigms were generalized before new global regulative realms (i.e., cyberspace) were upheld as such. These institutional paradigms narrowly assume a homogeneous national institutional structure, based on the US or some hypothetical Western liberal democracy rather than the borderless global arena. In accordance, we might not even have so far a good understanding of the relationship between national and international standardization, or even how important and useful this distinction is. Indeed, fundamental to the developments affecting the standardization institutional debate is the emergence of a global economy in which the United States, as other national governments, might not always play the predominant role in IT and cyberspace standardization.[269] That role is increasingly more internationalized through international standardization organizations. In the future, it might even have the potential of changing the present institutional balance, described in this study – with the possible domination of international standardization organizations in both application, but also infrastructure standard setting.[270] From what can be seen

[268] See, M. A. Lemley, supra note 93 (experimenting the HDTV example: "This almost happened in the case of the United States HDTV standard. Only by an accident of timing did the government adopt a digital HDTV standard, rather than an analog standard which would have been immediately obsolete"), p. 1063 at Fn. 76; See, also, J. Farrell & C. Shapiro, *Standard Setting in High Definition Television*, 8 Brookings Papers on Econ. Activity 1 (1992); N. Negroponte, Being Digital 37-40 (1995).

[269] See, e.g., U.S. Congressional Office of Technological Assessment (OTA), in its report: *Global Standards: Building Blocks for the Future (1992)* (The report discusses, among other things, the growth of international standardization efforts and the effect of multinational organizations); Martin C. Libicki, supra note 2 (on the weakening of governments role in the midst of globalization of IT standard setting activities), pp. 19, 341-342.

[270] See, e.g., Linda Garcia, *A new role for government in standard setting?*, StandardView vol. 1, No. 2, December/1993 2 (suggesting that the United States may also have considerably less influence than in the past in determining the character of international standards institutions), p. 5.

today, this development already serves as yet another justification for the shift in the role of government indirect role, acknowledged through constant retreating national involvement.[271] Nevertheless, as opposed to arguing for a complete restrained standardization policy, there are more than sufficient reasons to suggest that indirect standardization activity might be beneficial, as will be explained hereinafter.[272]

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3. Indirect intervention: Roles of government regulation

a. General

Generally, there is a broad range of regulative approaches to promote the production of standards. Largely, they differ in extent and directness vis-à-vis the type of each technological standard. As to extent, government intervention can be promoted narrowly, e.g. through specific preexisting regulations such as network non-bundling of the services and facilities involved in providing advanced capability. Alternatively, government intervention could be designed widely to promote completely new regulations designed to increase competition and investment in superior services. As to directness, government intervention can be made indirectly, thus letting markets to operate without any new specific regulation, typically with the verification of a "reasonable" procedure made in deployment. Alternatively, a government can engage in deregulating services from broad regulation, thus improving investments incentives and technological development. Then, as mentioned earlier, there is also the remaining alternative, namely - direct technological standardization, which would be less efficient, and is generally, strictly limited due to the constrictions discussed above.

An even more extreme scenario, is the risk of a government - acting on its own or in concert with other national governments or industry members - might try taking over the standard-setting process itself. It could then convene federal advisory committees for the purpose of obtaining organized industry and user input, as did the U.S.

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[271] See, e.g., David C. Wood, *European standardization policy*, StandardView vol. 3. September/1995 112 (further suggesting e.g., that "Concerned economic players should participate directly in the standardization process, without national coordination or representation"), p. 114.

[272] For a supporting opinion, see, e.g., J. R. Reindenberg, *Lex Informatica*, supra note 1 (similarly concluding that effective channeling of Lex Informatica requires a shift in the focus of government action away from direct regulation and towards indirect influence), pp. 589-592.

government in the sensitive case of security standards.[273] Still, for the reasons mentioned so far, and beyond the issue of security standardization, government standard setting intervention of this nature is routinely seen in recent years by both the U.S. government and its critics, as the ultimate inefficient bottleneck.[274] Thus far, the Clinton administration policy against such government intervention in application standard setting is still valid and has not been replaced.[275]

Accordingly, the Report contains strong language concerning the proper de facto production of technological standards for electronic commerce.[276] Albeit overly broad, so to refer to both infrastructure and application standards alike, including no adequate processional perspective and consistent with its general anti government tenor, the Report takes a strong position against government direct standard-setting in its section on technical standards.[277] Industry groups, rather than individual companies, it is said there, should set standards.[278] In support, the First Annual Report of the U.S. government's Working Group on Electronic Commerce publicized, as a major accomplishment, a resolution pushed at the Global Standards Conference in 1997, in which government participants agreed to let the private sector lead in standard-

273 See, e.g., M. A. Lemley, *Standardizing Government Standard-Setting Policy for Electronic Commerce*, supra note 93 (criticizing the U.S. government for dictating an encryption policy: “The government has for many years tried every means at its disposal, short of an outright ban, to prevent industry from coalescing around a strong encryption standard”), p. 478; L. Lessig, supra note 6 (criticizing governmental code control of the use of encryption in cyberspace), pp. 35-36; A. M. Froomkin, *The Metaphor Is the Key: Cryptography, the Clipper Chip, and the Constitution*, 143 U. Pa. L. Rev. 709, 712, 718-35 (1995) (describing analogous government access and regulation possibilities), pp. 755-575.

274 Referring generally to the ‘Internet’ at large, the 1996 Act states that it is the policy of the United States "to preserve the vibrant and competitive free market that presently exists for the Internet and other interactive computer services, unfettered by Federal or State regulation," and the FCC has a responsibility to implement that statute. See, Tele*communications Act of 1996, Pub. L. No. 104-104, 110 Stat. 56,* to be codified at *47 U.S.C. §§ 151* et. seq; see, also, For the derivative context of standardization, e.g., W. E. Bijker, T. Hughes & Pinch, ibid, id; E. L. Rubin, supra note 239 (concluding that at present, the government does not want to undertake the task, private groups do not want government intrusion, and no one thinks government will develop the optimal standards), p. 1455; The Report, supra note 16 ("The United States believes that the marketplace, not governments, should determine technical standards and other mechanisms for interoperability") § 9, p. 20; see, also, *The Emerging Digital Economy*, supra note 213, id.

275 Ibid, *the Report*, id.

276 Ibid, id.

277 Ibid, ("The United States considers it unwise and unnecessary for governments to mandate standards for electronic commerce. Rather, we urge industry driven multilateral fora to consider technical standards in this area"), see, also, ibid (referring to governmental control over standards development as a "potential area ... of problematic regulation"), id.

278 Ibid, ("We urge industry driven multilateral fora to consider technical standards in this area."), id. Eventually, the Report also endorses the standards model of the IETF, see id; see also, infra Part III. On the other hand, the Report does note, once again, too broadly that "in some cases, multiple standards will compete for marketplace acceptance", id.

setting.[279]

Hence, up until now, the FCC has largely avoided direct standardization of both Internet telecommunications services (through interconnection between Internet backbone infrastructure) or of application standards. In practice, Internet telecommunications services and application standard setting are largely constrained by market forces, backed by general intellectual property and antitrust law.[280]

Practically, this policy should leave the government with only indirect means of standardization. Broadly, they can be viewed through two groups of roles a government could efficiently carry in application standard setting. First, regulate supervision rules, which facilitate market production of standards by market agents. Second, regulate processes of standardization aimed at further legitimizing both decision-making and its outcomes.

b. Regulate production supervision rules

In order to facilitate market production and funding, a government should engage in three main activities. First, encourage R&D activities of autonomous institutions and preferably through better-coordinated industries rather than de facto agents. However, funds should also be made accessible for people from academic institutions and even SMEs (small and medium size enterprises).[281] That is, whenever that might make it more productive for the latter to participate in socially undervalued research activities at large.

In the backdrop of shortened technological life cycles, left alone - autonomous self-interested standard setters are typically less willing to risk potential exposure to failure. This reality is what arguably makes governments best suitable for R&D funding made to internalize some of these development-sunk costs.[282]

This largely supported rationale was originally not restricted to application standards only. Already in 1993, in what was the development phase, the NSF practically funded the operation of the NSFNET and provided grants to help operate and develop the regional networks.[283] NSF grants also helped colleagues and universities connect to the

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279 U.S. Gov't Working Group on Elec. Commerce, *First Annual Report IV* (Nov. 1998), available at <http://www.doc.gov/ecommerce/E-comm.pdf> (last visited 28 August 2002).

280 See, e.g., S. M. Benjamin et al., supra note 55, p. 915.

281 E.g., it is commonly agreed that the World Wide Web and the Netscape browser were successfully developed in government-funded research facilities – CERN and the University of Illinois, respectively.

282 See e.g, S. Breyer, supra note 1, p. 102. This explanation lies also as a conclusion given by the *Next Generation Internet Report* ("Funding for long-term research and development is still a role best served by the federal government"), p. 5, at <http://www.cra.org/Policy/NGI/research_chall.pdf> (Last visited 28 August 2002). See, also Fn. 176 and accompanying text.

283 J. K. Mackie-Mason & H. R. Varian, supra note 104, pp. 272-273. See also, *Next Generation Internet Report*, 177 (Arguing for an additional need for government intervention in subsidizing

NSFNET.[284] As explained earlier, in trying to spread these costs, the NSF also encouraged the regional networks of the NSFNET to seek for commercial, non-academic customers, and expand their facilities to serve the latter in order to eventually lower subscription costs for all, exploiting the emerging telecommunications services economies of scale.[285]

As much as funding is concerned, an analogous policy prevails also in Europe, through the European Committee for Standardization (CEN), and one of the three official European Standards Organizations under European law.[286] As in the American case, CEN's mission is to promote voluntary technical harmonization in Europe in conjunction with worldwide bodies and its partners in Europe. Accordingly, the European Commission, acting according to the European Union's communal policy, provides about half the R&D budget of the Central Secretariat of CEN and members' fees pay most the remainder.[287]

A second production supervision rule is of encouraging and maintaining multi-industrial competition through antitrust law against potential anti-competitive strategic behavior. Thus, applying the general antitrust rule for anti-competitive research or production co-ventures whenever new innovations are prevented from entering the market due to entry barriers - antitrust law should make collaborative standard-setting bodies liable based on Section 1 of the Sherman Act and Section 7 of the Clayton Act.[288]

However, in order to find a proper balance, §§ 4301-4306 to the NCRPA established a voluntary procedure pursuant to which the Attorney General and the FTC may be notified of a joint R&D or production venture. Accordingly, many U.S. consortia file under the Act in order to limit their penalties and liabilities for costs for standards activities. In practice, it is the Department of Commerce's National Institute of Standards and Technology (NIST), which is in charge of coordinating standards and

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bandwidth growth, as a basic infrastructure for future performance-sensitive applications as real-time video and audio transmission), p. 277

284 It was under similar apprehensions that the High Definition Television Competitiveness Act of 1989 was introduced to encourage 'U.S. companies to compete in the development of HDTV by providing tax incentives for companies that produce and develop HDTV products. See, *H.R. 1267, 101st Cong., 1st Sess. (1989)*, id.

285 *Brief History*, supra note 14, p. 8.

286 See, generally, *Directive 98/34/EC of the European Parliament and of the Council*, laying down a procedure for the provision of information in the field of technical standards and regulations and of rules on information society services, at: <http://www.etsi.org/public-interest/Documents/Directives/Standardization/Directive_98_34amended.doc> (last visited 28 August 2002) (recognizing the activity of CEN); Vaclava Horakova, *Technical Harmonization - condition for integration of the CR into the EU Internal Market*, at <http://www.mpo.cz/gc/0597/page0010.htm> (last visited 28 August 2002); ETSI – Telecom standards, at <http://www.etsi.org/frameset/home.htm?/public-interest/New_Approach.htm> (last visited 28 August 2002).

287 Ibid, Vaclava Horakova, id.

288 See, e.g., S. P. Gates, *Standards, Innovation, and Antitrust: Integrating Innovation Concerns into the Analysis of Collaborative Standard-setting*, 47 Emory L.J. 583, pp. 654-655.

conformity assessment activities between the public and private standardization agents.[289]

A third production supervision rule could be seen through indirect price regulation, whenever market competition curtails socially desirable variety of standards.[290] For a start, such subsidies should legitimately be used to lower prices of undervalued social welfare benefits.[291] In cyberspace, such initiatives included real-world analogous non-profit activities as research and education.[292] In some cases such valuable benefits can be practically technologically inefficient. Such is in the case of governments benefiting low performance-sensitive applications, which benefit clients that otherwise might lose their incentive to reveal their preferences or use them. Such inefficiency might result in the erosion of the qualitative rationale of standardization over-evaluating narrow performance-sensitive applications.[293] This important supervision rule should not be limited only to confronting strict economic productivity, but potentially technological efficiency alike. As explained, industry standard setters are not necessarily *technologically* neutral – making government intervention in the latter probably important, but ultimately irreplaceable.

c. Regulate the processes of standardization

Inherent to any commercial production is the permanent tension of balancing efficient outcomes with procedures. With application standards, this difficulty is primarily the result of constant outside commercial pressure. As a result, even formal standard bodies

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[289] See, generally, <http://www.nist.gov/> (last visited 28 August 2002); See, also, J. J. Anton & D. A. Yao, supra note 171 (Basing the need for governmental control over procedural rules whenever "good" decision making would be manipulated through "fair" procedural means”), pp. 255-258. For critical public choice literature, see, ibid, Fn. 33-37 and accompanying text, id.

[290] For the U.S. government declarative support of this policy, see: *Agenda for Action*, supra note 81 (“We will support further NII-related research and technology development through research partnerships and other mechanisms to accelerate technologies where market mechanisms do not adequately reflect the nation's return on investment. In particular, these government research and funding programs will focus on the development of beneficial public applications in the fields of education, health care, manufacturing, and provision of government services”), id.

[291] See, e.g., A. Ogus, supra note 1, p. 153.

[292] Accordingly, during its first seven months, the Clinton-Gore Administration followed this policy. Initially, the President's FY 1994 budget included a $100 million program to develop applications in areas such as education, manufacturing, health, and digital libraries. In addition, the U.S. government allocated $50 million for National Telecommunications & Information Administration (NTIA) grants to demonstrate the applications of the NII for non-profit institutions such as schools, hospitals, and libraries. See, *Administration NII Accomplishments* <http://www.ibiblio.org/nii/NII-Accomplishments.html> (last visited 28 August 2002), at § 3; For some U.S. regulatory initiatives, see, also, *H.R. 5759, 102d Cong. (1992)*; *S. 2937, 102d Cong. (1992)* (introduced by then Senator Gore, sought to develop high-speed technological infrastructure for schools, libraries, medicine etc.); *H.R. 5983, 102d Cong. (1992); S. 2813, 102d Cong. (1992)* (sought to facilitate public access to federal electronic information).

[293] S. Shenker, *Service Models and Pricing Policies for an Integrated Services Internet,* In Public Access to the Internet (Eds. B. Kahin & J. Keller), p. 326 et al.

tend to focus on outcomes, as opposed to processes.[294] Thus, as a comparative conclusion, March and Olsen see the main role of fairly elected political institutions i.e. governments, as formal standardization institutions – as those who will be most able to confirm to the legitimacy of these same undervalued procedural decisions.[295]

Translating this conclusion into practice, governments should then put emphasis in regulating standardization processes instead of technically standardizing products.[296] As the ultimate guardians of the process of producing standards, governments would thus promote the dynamics that are likely to satisfy the demand of fairness by the *process* used in their creation.[297]

As indirect players, this role of governments may be achieved in different ways. First, by supervising formal industry initiatives. Beyond economic efficiency, governments would thus impose and encourage formal industries to maintain a democratic layer between the fields of forces i.e., autonomous standardization institutions and their participants, and the standards that they design.[298] In essence, as guardians of the process, standardization procedures would then serve, indirectly, to legitimize that same process.[299] Second, by defining its own alternative procedures.[300] In either way, most participants in designing a standard should be made to benefit from the result.[301]

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[294] T. M. Egyedi, supra note 2 ("The formal standards bodies are, however, inclined to stress 'outcome' rather than 'process' results because of outside pressure"), p. 52; Joel West, *Institutional Constraints in the Initial Deployment of Cellular Telephone Service on Three Continents*, In Information Technology Standards and Standardization: A Global Perspective (K. Jakobs, ed.) (IDEA Group Publishing, 1999) (For a comparative empirical study on such external institutional pressures in the deployment of analog cellular Telephone Service standards, as experienced in the United States, Japan and Europe), pp. 198-221; Such outside pressure is already argued to stand in the way of ICANN, see, e.g., D. Post, *Governing Cyberspace* (1999) at: <http://icannwatch/archives/essays/930604982.shtml> (Last visited 28 August 2002) ("Any entity exercising control over the DNS will be subject to immense pressure to do more than mere 'technical management'), id.

[295] G. March & J. P. Olsen, supra note 13, pp. 50-52. See also Fn. 17 & accompanying text.

[296] E. L. Rubin, supra note 239, p. 1473, referring also to J. Freeman, *Collaborative Governance in the Administrative State*, 45 UCLA L. Rev. 1 (1997); J. J. Anton & D. A. Yao, supra note 171 ("While informed judgments about such procedures will still be necessary, technical judgments will be avoided"), p. 248;

[297] See, e.g., *The FTC Bureau of consumer protection, standards and certification – Final staff report (1983)* (For a discussion on elements important in determining reasonableness of procedures in the face of potential anti-competitive effects of standard setting (e.g., record of proceedings, interests of decision makers, following procedures, opportunity for challenge of evidence); See, also, Michael C. McCarey, Associate Director, FTC Bureau of Consumer Protection, *Industry Standards and Certification: Three Current Issues, Remarks Before the 26th Annual Symposium of the Trade Ass'n and Antitrust Law Comm. of the D.C. Bar*, Washington, D.C. (Feb. 1990) (suggesting that such "quality" of the decision-making process includes whether particular concerns were even considered and whether analysis was systematic or based on speculation), id.

[298] Ibid, id.

[299] *Final staff report*, Ibid, id, & Fn. 17 and accompanying text, id.

[300] Ibid, id.

[301] T. M. Egyedi, supra note 2, p. 52.

This role of governments may than encourage the level of competitive participation in standardization itself.[302] That is, especially participation of marginal participants.[303] This important regulative goal was also pursued by U.S. federal legislation. In the National Technology Transfer and Advancement Act of 1995, federal agencies are directed to use standards developed by voluntary consensus bodies (§12(d)), with the exception of when that would be inconsistent with applicable law or when it would be otherwise impractical.[304] This legislation adds credence to the earlier U.S. government policy codified in the President's Office of Management and Budget (OMB) Circular A-119 "Federal Participation in the Development and Use of Voluntary Standards".[305] The OMB Circular A-119 interprets the language of the National Technology Transfer and Advancement Act of 1995. In addition, proposed revisions to OMB Circular No. A-119, "Federal Participation in the Development and Use of Voluntary Consensus Standards and in Conformity Assessment Activities", characterize the nature of standards that government agencies are constrained to consider ahead of developing their own procurement or technological standards.[306] Accordingly, agencies will be submitted to an administrative burden of proof to justify why they did not use any such relevant "Voluntary Consensus Standard" prior to proceeding to design such new government standards.[307]

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302 David A. Balto, supra note 171 (adding that in practice, "the antitrust jurisprudence on standard setting focuses almost entirely on collective standard setting and the process used to determine the standards"), § 2 and Fn. 13-19 & accompanying text, id.

303 C. F. Cargill, supra note 17 (on the diversity of participants in autonomous standardization institutions both as an advantage and as a problem in reaching consensus), pp. 233-234; See, also, Fn. 256 infra & accompanying text.

304 For a derivative suggestion, see, E. L. Rubin, supra note 239 (Suggesting that it would be possible for a federal statute to declare that the use of a computer language in interstate commerce that was not designed through a sufficiently cooperative process is an unfair trade practice under 15 U.S.C § 45(A)(1)), p. 1473 & Fn. 106, id. So far, however, this suggestion has not been adopted.

305 The OMB has been the guardian of the previous policy and is responsible for the more detailed regulations that all agencies will have to follow to meet the new law.

306 See L. E. Panetta, *Circular Number A-119*, (Last visited 28 August 2002). <http://www.whitehouse.gov/wh/eop/omb/html/circulars/a119/a119.html> (Last visited 28 August 2002); <http://www.gtwassociates.com/answers/omb.html> (Last visited 28 August 2002)

307 With the decrease in the governmental role in cyber standard setting, there is some criticism on this policy as an overly national-based in nature, in the midst of a global standardization trend. See, e.g., David C. Wood, supra note 271 ("Concerned economic players should participate directly in the standardization process, without national coordination or representation"), p. 114; *Standards, conformity, assessment, and trade into the 21st century*, A report of the board of science, technology, and economic policy in the national research council, 1995, StandardView vol. 5 No. 3 September/1995 98 (suggesting a list of ten operative recommendations for further improving of the (OMB) Circular A-119 coordinative policy); Linda Garcia, supra note 270 (for a critical analysis of Circular A-119 policy, as insufficiently coordinating), id.

D. A potential deviation: The ICANN case study

One potential deviation from the supported general policy for infrastructure standard setting came in the form of the federal government's involvement with the Internet Corporation for Assigned Names and Numbers (ICANN) 'domain name system' - the naming hierarchy that in essence tells connected computers where to find particular web sites. Eventually, the government did transfer a mandate on managing the authority to a private nonprofit (California) corporation. ICANN was appointed to oversee the operation of the root server system. In this capacity it was delegated to support existing protocols and telecommunications services used to implement domain name facilities.[308] For that purpose, ICANN board of directors received two different functions. The first, taking steps towards introducing competition into the Domain Name registration system. The second was to uphold a policy against cyber squatting through its Uniform Dispute Resolution Policy (the UDRP) and arbitration Panel.

As such, ICANN's establishment suggested two types of standardization concerns. The first lie in its potentially problematic institutional identity; with the second being its wide technical mandate as a standardization organization, as follows.

For a start, as a technical standardization institution, ICANN was initially constructed as a private interest group, as is evident from its structure, its insider consensus mechanism and its politically fractioned secretarial character.[309] Thus, as a private entity it exercises direct and central control – with the U.S. government choice to remain merely in the background.[310]

As suggested earlier through public choice analysis – left alone, such competitive interest group might establish genuine public policy inefficiency. In addition, it might even create a monopoly on the allocation of the DNS's IP names and numbers.[311] These latter challenges are not merely structural as they often interplay with ICANN's unique technological mandate:

Thus, the standardization concern is a function of ICANN's technical responsibilities. Arguably, ICANN was made responsible for potentially too broadly defined technical

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308 On these facilities, see, generally, *Domain Name Concepts and Facilities*, Network Working Group, RFC 882, supra note 78, id; *Domain Name- Implementation and specification*, Network Working Group, RFC 883 at: <ftp://ftp.isi.edu-notes/rfc883.txt> (Last visited 28 August 2002).

309 For critical literature on these governance policy issues, see, e.g., Michael A. Froomkin, supra note 149, pp. 160-165; Neil W. Netanel, supra note 131, pp. 484-487; Jonathan Weinberg, *ICANN and the problem of legitimacy*, 50 Duke L. J. 187.

310 See, e.g., S. M. Benjamin et al., supra note 55, p. 825.

311 See, generally, A. Michael Froomkin & Mark A. Lemley, *ICANN and Antitrust* (published on-line as a working paper) <http://www.law.berkeley.edu/institutes/bclt/pubs/wp/202.pdf> (last visited 28 August 2002) (Addressing the various potentially anti-competitive effects of ICANN), id; Michael A. Froomkin, supra note 149 (suggesting that the analyses of the privatization of the DNS and TCP/IP, highlight some of the reasons why the bottom-up process has failed), p. 216 et al.; J. P. Kesan & R. C. Shah, supra note 119 (suggesting that the Internet community was not able to resolve the uniformity problem through a bottom-up process, and, as a result, the U.S Government has begun to intervene), p. 214.

discretion, being it ICANN's blurry mandate on code writing i.e. technological standardization. Such as, the maintenance of the bit size of data packets, the architecture of the root services, i.e. assigning of IP numbers and the number and top-level domains that can safely be added to the Root, the preservation of unique protocol numbers for other various Internet functions, etc.

Originally, it was informally declared that: "the U.S. government should end its role in the Internet number and name address system".[312] Instead the Department of Commerce initiated the White paper, which is a non-binding report statement of policy.[313] Like the 'Green Paper' statement of policy before it, the White paper has conformed to the already existing vague and basic governmental "Principles for a New System" as "stability[314], competition, private bottom-up coordination, and representation", with no clear separation between a technical standardization policy and non-technical (or even technical coordination) governance responsibilities.[315] Accordingly, also the DoC characterized ICANN's technical responsibility in blurred terms. This new corporation was made responsible only for "technical management of the DNS", which was most likely undermined as the "narrow of management and administration of Internet names and numbers on an ongoing basis". Overall, most commentators still agree that the U.S. government still holds de facto control of the root zone.[316] However, it is also clear that the U.S. Government has chosen not to have direct control over the Root server.[317]

Thus far, the main controversy over ICANN's governance mandate was mostly limited to the question of its democratic decision-making accountability. Consequently, the question of its technological standardization i.e. code writing mandate has still not been raised properly, as a separate policy question, thus undermining the need to decide on future technological risks, e.g. fragmentation of the network layer and the ultimate risk of Root splitting.[318] To date, both ICANN and DoC deny that ICANN is engaged in

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[312] See, *Management of Internet Names and Addresses*, 63 Fed. Reg. 31,741 (1998) [Hereinafter, the White Paper], at <http://www.ntia.doc.gov/ntiahome/domainname/6_5_98dns.htm> (Last visited 28 August 2002), at 31, 749.

[313] Ibid, id.

[314] Ibid, "…During the transition and thereinafter, the stability of the Internet should be the first priority of any DNS management system…" at 31,743.

[315] Compare: Michael A. Froomkin, supra note 149 (further suggesting that the DoC draws one henceforth), p. 171 et al.

[316] Ibid (suggesting that "there is no dispute that the U.S. government, through the Department of Commerce, currently enjoys de facto control of the DNS"), p. 166; (adding that "Nor is there any dispute that DoC has at least temporarily ceded to ICANN, through a variety of contractual and quasi-contractual agreements, almost all the control the United States enjoys"), p. id; Steve Kettmann, *Will U.S. Release Grip on ICANN?* <http://www.wired.com/news/infostructure/0,1377,49836,00.html> (last visited 28 August 2002) (emphasizing that post September 11 the gradual process by which ICANN will gain autonomy from the government has been slowed), id.

[317] Michael A. Froomkin, supra note 149 (suggesting that for that reason the U.S. government had, in fact, only quasi-privatized the control on the root server), p. 169

[318] This "Split DNS" (or "two faced DNS"), is also a corollary of this same fragmentation, followed by the loss in communication between a particular FQDN and an IPv4 address, whenever it seizes to be universal and steady.

either regulation or governance. Instead they hold out the general observation suggesting that ICANN is practically engaged in nothing more than routine standard setting or presumably 'technical coordination' or 'maintenance'.[319] Nevertheless, the need to confront these technological risks is not merely theoretical. Present infrastructure transparency concerns are already a good case in point for that:

Broadly, infrastructure transparency was referred to as the original Internet concept of a single universal logical addressing scheme and the mechanisms by which packets may flow from source to destination essentially unaltered. Regrettably, much of this traditional end-to-end transparency infrastructure standard mechanism has been lost in the current Internet.[320] That adds up to complexity in applications design and inhibits the deployment of new applications.[321] Overall, there are multiple causes for the loss of transparency i.e. the deployment of network address translation devices, the use of private addresses, firewalls and application level gateways, proxies and caches, etc.[322] In recent years, as part of ICANN's appropriate concern with preserving end-to-end transparency, it became notably involved with the various issues surrounding internationalized domain name (IDN) standardization. Thus, ICANN's Board has begun to promote inquiries about that role and views with regard to the various efforts to use non-ASCII characters to design international domain names supported by the domain name system at large. Eventually, on 25 September 2000, the ICANN Board approved a set of resolutions (00.77 to 00.80) (formally relating to the 22 August Verisign Global Registry Services announcement about its introduction of the multilingual test bed), in which the Board recognized the importance of the Internet evolving to be more accessible to those who do not use the ASCII character set.[323] Ultimately, ICANN recognized a need to specify an adequate standards track protocol based on supporting test bed findings and requirements. Upon final adoption IDNs would probably become fully operational in a standards-based way.[324] Consistent with ICANN's policy, the accepted standard would then have to be fully compatible with the Internet's existing end-to-end model, and 'preserve globally unique naming in a universally resolvable public name space'.[325]

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319 *The white paper*, supra note 312, at 31,744.

320 IETF Network Working Group, at M. Kaat, *Overview of 1999 IAB Network Layer Workshop*, Network Working Group, RFC 2956 (October 2000), at: <ftp://ftp.ietf.org/rfc/rfc2956.txt> (Last visited 28 August 2002) ("Specifically the assumption that IPv4 addresses are globally unique or invariant is no longer true"), p. 2, § 2.1.

321 Ibid ("It was however concluded that end-to-end transparency is desirable and is an important issue to pursue"), p. 3 § 2.1.

322 Ibid, id.

323 See, *Internet Corporation for Assigned Names and Numbers Minutes of Special Meeting* (25 September 2000) <http://www.icann.org/minutes/minutes-25sep00.htm#MultilingualDomainNames> (Last visited 28 August 2002), upheld also at: *Internationalized Domain Names Internal Working Group (of the Board)*, <http://www.icann.org/committees/idn/iwg-15nov01.htm> (last visited 28 August 2002).

324 Thus, de facto designers of browsers or other Internet software would then be able to program their software to convert any foreign-character domains typed in or linked to into the appropriately coded string, which could then be resolved using normal DNS queries.

325 See, *Internet Corporation for Assigned Names and Numbers Minutes of Special Meeting*, supra note 323, upheld also at: *Internationalized Domain Names Internal Working Group* (of the Board), id.

As the specially designed Internationalized Domain Names Committee has suggested, any TLD expansion should occur in a careful and controlled fashion, with regard for the overall stability of the DNS.[326] In balance, as long as the DNS is subject to the present pre-designed scarcity policy, that stability will be achieved within the limit of the total number of TLDs eligible for delegation to a given geographic unit.[327] IDNs should, therefore be carefully and agreeably set at a number equal to the number of its official languages. In part, this technological challenge was met successfully. However, it took more than a quasi-privatized ICANN to do so, as ICANN asked for the legitimacy and intervention of ISO. Technically, the ISO-3166-1 IDS table developers at ISO, appointed earlier by ICANN, already solved the problem of what is and is not a recognized geographic unit (country or geographically distinct territory).[328] However, it being a sensitive politically oriented decision, the table only provides two- and three-letter ASCII codes for each such geographic unit. Thus, ISO's table does *not* solve the multi-facet problem of what non-ASCII names (or abbreviations) should be assigned to

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326 On the fundamental importance for DNS stability, see, e.g., *Internationalized Domain Names (IDN) Committee Discussion Paper on Non-ASCII Top-Level Domain Policy Issues* <http://www.icann.org/committees/idn/non-ascii-tld-paper.htm> (Last visited 28 August 2002) (warning that "(2) the sudden introduction of a massive number of new TLDs would be a bad idea"); See, also, IETF Network Working Group, at M. Kaat, supra note 320 ("Operational stability of DNS is paramount... It is therefore recommended to the IETF that, except for those changes that are already in progress and will support easier renumbering of networks and improved security, no fundamental changes or additions to the DNS be made for the foreseeable future"), p.10.

327 In regulation analysis, any definition of a regulative realm as scarce is of meaningful consequences. Such is, arguably the case with the DNS (and IDNs) infrastructure, described above. For an institutional rather than technical explanation of DNS scarcity, see, e.g., S. Eisner Gillett & M. Kapor, supra note 140 ("Scarcity is a key characteristic that distinguishes administrative from political processes…The IETF process has produced many proposals for change, but few (if any) have been implemented because of the perceived need for consensus, which is highly valued but notoriously slow to achieve"); See, also, David Randy Conard, *Personal communication with Randy Conrad of APNIC*, September 1996 ("The current mechanisms by which addresses are allocated fundamentally [rely] on trust...[T]he allocation authorities must trust the requesters to provide an accurate and honest assessment of their requirements in order for appropriate amounts of address space to be allocated and the requesters must trust the allocation authorities to be fair and even handed….[H]owever, with the rapid ascendancy of commercial networks on the Internet, the trust model for resource allocation is under severe pressure"), id.

For a more technical explanation, see, S. Eisner Gillett & M. Kapor, ibid, (concluding that "The bottom line is that uncertainty in the future growth rate combines with uncertain user adoption of technical changes make it impossible to predict whether there are enough IPv4 addresses to satisfy demand"), id.; See, also, David Randy Conard, ibid, ("The bottom line is that successful address allocation requires administrators with strong technical skills, not just political or legal expertise"), id. In practice, as Einer Gillett describes, DNS allocation is subject to two types of policies: First, "based on extrapolation of past growth rates, the registries feel compelled to allocate remaining IPv4 address space conservatively", id. Second, acknowledging that allocation authorities are trying to simplify the Internet routing system, "registries prefer to allocate larger contiguous blocks of addresses, which are of course less plentiful than smaller blocks", id. Consequently, this section's argument will depart from the assumption of DNS scarcity regulation, upon its institutional implications, infra.

328 For most users of ISO 3166-1 the standard is the list of country names and codes. For background on *ISO 3166*, see: <http://www.iso.org/iso/en/prods-services/iso3166ma/04background-on-iso-3166/index.html>(last visited 28 August 2002), id.

each recognized geographic unit, and who should be in charge of assigning them. That politically oriented question is now still open.

In essence, the current ICANN/IANA policy permits the delegation of ASCII ccTLDs only when a given geographic unit and its associated specific 2-letter ASCII codes appear on the ISO 3166-1 list. Due to the heavy political nature of this question, ICANN/IANA's policy has so far failed to authorize so with non-ASCII characters, leaving ICANN without a given reference point for IDNs.

With the risk of overly-decentralizing the responsibility for the latter, there is still a potential peril that the ICANN Board would decide to delegate to each self-interested proposer the task of identifying the desired TLD string for each non-ASCII script and justify it subjectively. However, while enabling users to easily type domain names in familiar non-ASCII scripts - that decision might then curtail ICANN's new main goal of privatizing today's DNS universal uniqueness.

An additional derivative political problem is of identifying and achieving consensus among the stakeholders of a given set of language communities. Left to the 'market of nations', ICANN/IANA's hegemony might be facing self-interested competing claims backed by different stakeholders, or, worse, different national governments. Left alone, national registries would have an incentive to benefit their own customers on the expense of the DNS stability at large. Thus, maintaining such stability, in the face of growing self-interested commercial intervention, would be potentially a task poorly suited for a technical coordinating organization such as ICANN. Arguably, the quasi-privatized ICANN is now facing a set of political concerns for which it might not be well suited. Ultimately, ICANN might misuse its mandate of deciding when and to what neutral and authoritative arbiter should this problem be referred, thus risking potential DNS instability, both politically and ultimately technologically.

Alternatively, as the broadly agreed lowest common denominator rule, ICANN should attempt to enforce mandated policies only when there is a clear need for uniformity based on a substantive consensus among those who must implement such policies and are impacted by them.[329] But should have ICANN be faced with the challenge in the first place? With potentially little future agreement on the need for DNS uniformity, as in the case of IDNs, ICANN might be arguably approaching here its own institutional limits: Even assuming that in the longer run both economically and technically multiple language domain names are favorable – in the short-run, ICANN may still have to coordinate ad hoc undesired fragmentation that might weaken the stability of the DNS, and even destructive collusion between name owners. Inevitably, as a policy rule ICANN's Board may then have to be backed by more authoritative agents, namely formal industry standardization organization as with the case of ISO's 3166

[329] See, e.g., David R. Johnson and Susan P. Crawford, *The Idea of ICANN* <http://www.icannwatch.org/archive/the_idea_of_icann.htm> (last Visited 28 August 2002), id.

Maintenance Agency[330]; and in extreme scenarios of loss of DNS hegemony, even more notably by the DoC, and the U.S. government at large.

Here, as potentially elsewhere, seen narrowly as mere technological customary standard setting activity, no governmental guidelines were adequately established for ICANN, thus undermining the necessity for a visible and continuous technological standardization policy, at least when infrastructure standardization is directly concerned. Left as a technologically independent quasi-privatized standard setting organization, yet carrying public responsibility - an unmonitored ICANN may embed an underrated potential of designing or adapting standards unproductively.

[330] As described earlier, so far, such partial intervention in ICANN's own mandate has already been made by the International Organization for Standardization (ISO) and its ISO 3166 Maintenance Agency.

VI
CONCLUSIONS

In the future, cyberspace's change pattern is presumed to bring about new innovative developments, potentially as part of new technological generations.[331] Both the TCP/IP and the Internet, as a whole, will continue to be standardized, and standard setting will continue to shape new and existing cyber markets, at large. New protocols will be designed and old ones will be revised. As with analogous standardization regimes, there is the risk that unless the distinctive standardization policies will be seen en bloc, and thus sequential and context-based, cyberspace's largely successful institutional practice might not be preserved also prospectively.

With the growth in both the community of users and the demand for sophisticated applications - a more advanced standardized architecture is already needed. In part, new standardization challenges are already here - e.g., the ISO's new conceptual model and set of network protocols, known as the ISO/OSI (open system interconnected) protocols, which are potentially in line to replace part of the existing infrastructure, currently in use on the Internet;[332] or the IP Version 6 (IPv6) which is designed to expand address space.[333] Similarly, several external trends and influences are argued to have a large impact on the status of the infrastructure network layer, i.e. the deployment of wireless network technologies, mobile-networked devices and special purpose IP devices.[334] Leaving aside the question of whether these specific developments will lead

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[331] See, e.g., the *Next Generation Internet (NGI)* U.S. federal initiative including experts from business, government and academia, trying to anticipate the next generation of Internet standardized applications. It was a three-year program, which started in 1996 with a $300M that were divided among several government agencies (with the lead role going to DARPA). The program involved a test network with 100 sites that were linked at a speed 1,000 times greater than today for the design of revolutionary applications: at <http://www.ngi.gov/> (last visited 28 August 2002); and see especially the *Research Challenges for the Next Generation Internet Report*, produced by the NGI, at <http://www.cra.org/Policy/NGI/research_chall.pdf> (last visited 28 August 2002);
See, also, the *Internet2 consortia* initiative, which is being led by over 200 universities working in partnership with industry and government to develop an advanced network and applications. Together with the NGI initiative these are two private networks that may be integrated into the present Internet or remain separate. See, <http://www.internet2.edu> (last visited 28 August 2002) (For the Internet2 initiative); For earlier IETF Network Working Group RFC's recommending various next generation revisions, see, e.g., *The recommendation for the IP next generation protocol*, RFC 1752, January 1995 at <http://www.ietf.org/rfc/rfc1752.txt > (last visited 28 August 2002); *Technical criteria for choosing IP: The next generation (Ipng)*, RFC 1726, Dec. 1994, at <http://www.ietf.org/rfc/rfc1726.txt > (Last visited 28 August 2002), id.

[332] See, Ole Hanseth & Eric Monterio, supra note 2 (further explaining that new generations of infrastructure evolve by combining, extending and aligning existing infrastructure), p. 174 et al.

[333] IPv6 was designed to replace the IPv4, as a long-term solution to limited 32-bit address space, which are 'only' more than 4 billion addresses. The address space of IPv6 is designed by 128 bits, so to include approximately $8*10^{28}$ times bigger than the entire 32-bit address space. Floyd Wilder, supra note 14, pp. 155-164.

[334] See, e.g., Peter Brockmann, *User Demand for Internet Services: Is the Infrastructure Ready?*, Computer Standards and Interfaces 20 (1998) 117-121 (for a broader perspective on potential infrastructure trends); M. Kaat, supra note 320, § 1; See, also, *Programming Considerations for Developing Next-Generation Wireless Embedded Applications (white paper)* (January, 2002), at

to a generation leap or less – it is argued that any adoption of such central technologies, should follow this past two decades, by and large, positive experience of cyber standardization.

As for infrastructure standards, and notwithstanding strong governmental rhetoric concerning the need for regulative restrain and ICANN's potential inconsistency, this study generally supports the rationalization of the early central institutional adoption of a unified infrastructure set of standards for inter-connective transmission i.e. TCP/IP. Justifiably, this early endeavor was not followed by private initiatives of creating a market for infrastructure standards for inter-connectivity. Instead, only a market of telecommunications basic services evolved, with the involvement of diverse infrastructure equipment providers including data networking equipment, Internet connections, telecommunications equipment providers, cable operators, etc. As described, mostly later on, a market for application standards was developed as well. In essence, even with the later creation of the market for backbone telecommunications services, a common stable denominator in the face of a governmental inter-connective TCP/IP naturally monopolized standard and the consensual architecture were preserved. Hence, efficiently overshadowing the potential inter-institutional infrastructure standardization arms race.

In retrospective, in this early development phase, only an ex-ante governmental standard setting initiative, delegated through its early federal agencies and followed by monitored activity regarding research institutions is inherently efficient. In this environment of poorly complied price-competition, the only exception, which should be gradually maintained is in giving away much of the government's power over the early market for carrying and access services, as was mostly done in the early 1990's. In essence, these infrastructure standard-setting activities had been primarily technically rather than commercially motivated. That policy eventually changed with its face towards commercialization of application and complementary standardized products. These central changes are what arguably led, among other things, to substantial competition in standard setting activity in cyberspace. In the future, such further changes could be expected to come, whenever such technological and economical developments take place, as part of future intermediate 'modification' phases.

Later in the process, that existing institutional choice should, once again, change towards future 'implementation' phases. In this phase of application and complementary standardization, apart from the limited indirect support for infrastructure routine standard setting activity of the present phase, e.g. increase in bandwidth on the backbone transmissions links, better physical access from homes and businesses etc. - political institutions i.e. the U.S. governments through its delegated

<http://www.itpapers.com/cgi/PSummaryIT.pl?paperid=29639&scid=421> (Last visited 28 August 2002) (describing compatibility challenges of future generation (2.5G and 3G) wireless systems); *OMAP: Enabling Multimedia Applications in 3G Wireless Terminals (white paper)* (December, 2000), at <http://www.itpapers.com/cgi/PSummaryIT.pl?paperid=29634&scid=421> (last visited 28 August 2002) (describing multimedia applications in third-generation (3G) wireless appliances), id.

agencies, and particularly the FCC, should stick to a restrained indirect role in its standardization activity, due to what are its institutional barriers on efficient participation. As a general matter, such policy should also facilitate essential competition among autonomous standard setting institutions.

In practice, while the conduit has neither at all times been lucid, nor followed one route, the telling of governmental understanding of the public interest in the United States revealed a positive and definite prototype of declining interference, notwithstanding an increasing number of such institutional sources.

Of special importance for this commercial environment is the role of autonomous industry institutions. As explained, due to new risks of ex-ante technological stagnation and/or ex-post anti-competitive effects, assimilated mainly with the lack of compatibility or convergence, on the one hand, and the need to sustain private competition on the other hand - a role for an industry voluntary regulative approach in formalizing gray and de facto standardization will turn to be essential.

By the same token, in future technological implementation phases, an industry is, arguably, the most efficient in chilling direct governmental incentives for intervention beforehand or ex-post. This is subject only to indirect governmental supervision rules, which facilitate market production of standards and procedural regulative intervention.

Although much of these policies are, and were, upheld in practice - so far the U.S. government or the FCC drew no sufficiently clear or comprehensive policy on the matter;[335] leaving institutional choice in the net's standardization subject to overly general principles of marketplace competition, made to assure 'reliability, interoperability, ease of use and scalability'[336], dependable of its general anti-government tone.

Even for specific infrastructure standardization, where the unspecified governmental rhetoric is erroneously king, potential risks of deviation from its justified pro-active practices, already suggests policy conformity. One important case study for such potential digression came in the form of federal governmental involvement with the ICANN Internet Corporation for Assigned Names and Numbers. Here as well, the question of technological standardization was not raised properly ex-ante as a policy question, thus undermining the need to confront upcoming technological threats, e.g. fragmentation of the network layer and even Root splitting. In addition, such policy made no adequate division between infrastructure standards and application standards

[335] For a relevant early U.S Federal warning about such a possibility, see, the Ba*yh-Dole Patent Act of 1980, 15 U.S.C.A. (Commerce and Trade part 63—Technology innovations) § 3701(8) (Main volume 1997)* (Declaring "No comprehensive national policy exists to enhance technological innovation for commercial and public purposes. There is a need for such a policy, including a strong national policy supporting domestic technology transfer and utilization of the science and technology resources of the Federal Government"), id

[336] For the specific context of standard setting, see, *The Report*, supra note 14, § 9. For all-Internet purposes, see, Ibid, the *Bayh-Dole Patent Act of 1980, § 3701(2), (9)-(11).*

for matters of regulative intervention, hence providing ICANN, as a potentially self-interested interest group, overly broad control over both, but especially over the former.

Indeed, ICANN's technical mandate reaches potentially much further than is literally understood from existing formal declarations. Seen narrowly as mere technological routine standard setting through technological 'maintenance', no adequate governmental guidelines were put in place, thus undermining the necessity for a comprehensive technological policy already for the present ICANN and ultimately for the future.

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