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The politics of public safety communication interoperability regulation

Viktor Mayer-Schönberger

Kennedy School of Government, Harvard University, Cambridge, MA 02138, USA

Abstract

This article examines an understudied area of telecommunication policy, namely the regulation of public safety radio communication to bring about communication interoperability. Commonality and funding are the two intertwined policy challenges need to be overcome to achieve this interoperability. Addressing these challenges separately, US federal policy has struggled to establish communication interoperability. By contrast, the integrated approach of the Europeans has resulted in a relatively successful outcome. It is argued that this integrated approach may even permit the transplantation of a more general telecommunication policy thread—competition—to the public safety radio communication field. However, whether interoperability is established may also be linked to intra-agency fears of a potential re-direction of hierarchical communication flows brought about by new (and configurable) communication infrastructure. If this is the case, policy-makers regulating for interoperability will need to take into account inter- and intra-agency organizational dynamics as well.

Keywords: Public safety; Radio; Communication; Interoperability; Regulation

1. Introduction

Over the last decade, two policies have shaped the regulatory landscape of information and telecommunication networks. Governments around the globe, including those in the United States and the European Union, have "de-regulated" the telecommunication sector. As a result, the prices of telecommunication services have come down drastically and telecommunication infrastructure investment skyrocketed, at least for a period of time. The ideologically convenient catchword, "de-regulation," is a misnomer though. What did take place was not the simple abolition of a stifling regulatory regime, but rather the successful replacement of regulations accepting of a (more or less) monopolistic provider with a sophisticated regulatory framework geared to creating competitive markets (Lazer & Mayer-Schönberger, 2002; Vogel, 1996). At the same time, policy-makers have felt compelled to regulate networks, especially the Internet, in order to protect the safety and security of citizens (Benkler, 2001; Hazlett & Sosa, 1997, pp. 35–39; Rappaport, 1998, pp. 765–785).

E-mail address: Viktor_MS@harvard.edu.

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On the surface, these two central policy threads appear to have little in common. One cherishes choice and freedom while the other seems to limit these values. Yet they are not as different as they may seem. From an outcome perspective, both telecommunication liberalization and Internet regulation, including US congressional attempts that courts later held unconstitutional,[1] are regulatory measures that have shaped the policy environment in which information and communication markets operate. Fundamentally, telecommunication liberalization and Internet regulation reflect an ideological commitment of policy-makers: competition is good and markets are superior to non-market structures though functioning markets necessitate that some information flows need to be restricted (indecency in the US, neo-Nazism in Europe, and child pornography in both).

The relative importance of these two policy threads has oscillated. In the 1990s, there may have been a stronger emphasis on telecommunication liberalization and a weaker one on Internet safety and security regulation. A combination of the telecom bust and the post-9/11 emphasis on security may have tipped the balance the other way. Fundamentally, though, the two policy threads have co-existed and continue to do so. One need to only remember the intense debates concerning encryption control during the first Clinton administration (Diffie & Landau, 1998; Levy, 2001), and the almost continuous stream of federal laws regulating the Internet, from the Communication Decency Act (CDA)[2] to the Child Online Protection Act (COPA),[3] to the Children's Internet Protection Act (CIPA)[4] and beyond.

This article is concerned with a relatively neglected area of telecommunication policy making—enabling public safety personnel to communicate wirelessly with each other across agencies in real time—and the extent to which US and EU policy making in this area reflects the two regulatory threads discussed above. The establishment of a regulatory framework for such communication interoperability has advanced in the EU but so far has lagged behind in the US. Instead of harnessing the core regulatory principles of competition and safety, US policy-makers have shown deference to vested interests (Mayer-Schönberger, 2003). Failure to establish communication interoperability has had grave consequences. Numerous reports on disasters and terrorist attacks have identified the lack of radio interoperability as a major shortcoming in the rescue operations, from the first World Trade Center bombing to the shoot out at Columbine High School. Yet the impact of these reports has been limited (Falkenrath, 2001; Public Safety Wireless Network (PSWN), 1999, pp. 19–23). Thus on September 11, 2001, perhaps hundreds of first responders in the World Trade Center died because of a complete lack of communication interoperability (Picciotto, 2002). Moreover, firefighters from Virginia, Maryland and the District of Columbia battling the Pentagon blaze had to use runners to communicate with each other as their radios lacked interoperability (Twoney & Leonnig, 2001).

This article examines the policy challenge posed by public safety communication interoperability by analysing US and EU policy responses. It suggests reasons for why there has been little application of the core regulatory principles of competition and safety to the interoperability issue in the US. The article also identifies intra-agency fears of a potential re-direction of hierarchical communication as a potential additional challenge that has not been fully recognized by policy-makers on both sides of the Atlantic.

2. The technical challenge of public safety communication interoperability

Public safety communication interoperability is "the ability of public safety personnel to communicate by radio with staff from other agencies, on demand and in real time" (Public Safety Wireless Network (PSWN), n.d., p. 2). It covers both radio communication between two similar agencies from different locales (e.g., firefighters from neighboring towns) as well as communication among different agencies (e.g., firefighters radioing police personnel). Analysis of major incidents over the last decade has identified the lack of public safety communication interoperability as one of the most important challenges faced by public safety agencies (Public Safety Wireless Network (PSWN), 2000).

[1] ACLU v. Reno I, 521 U.S. 844 (1997).
[2] 47 U.S.C. § 609 et seq, held unconstitutional by ACLU v. Reno I, 521 U.S. 844 (1997).
[3] 47 U.S.C. § 1401 et seq., held unconstitutional by ACLU v. Reno II, 217 F.3d 162 [3d Cir. 2000].
[4] 20 U.S.C. § 9134 and 47 U.S.C. § 254(h), held constitutional by United States v. American Library Association, 539 U.S. 194 (2003).

In principle, interoperability has been understood as both a technical and a political challenge. Technically, existing analog radio equipment needs to be replaced with new equipment that permits scalable almost instantaneous inter-agency radio communication given external constraints, like bandwidth. Digital radio networks provide the foundation for interoperable solutions. Digital voice encoding technology permits voice to be compressed into smaller bandwidth, thus enabling more communication to take place in a given frequency band. Furthermore, bandwidth can be saved by using technology to allocate and de-allocate bandwidth efficiently. Generally speaking, this allocation can be handled in a decentralized way, as with the Internet, or through automated switches in charge of bandwidth allocation. While the former offers robustness, it is currently burdened by unacceptably long communication setup times (above a second). The latter, often called a trunked infrastructure, offers significantly faster call setup times and thus is the current technology of choice for interoperable digital networks (PSWN, 1999). The use of digital technology also allows allocation of communication bandwidth to be prioritized. This can ensure that an urgent duress call gets through regardless of whether bandwidth is available or not. In such an emergency, the automatic scheduler will de-allocate the communication with the lowest priority to open up bandwidth for the duress call. Technically, interoperable radio technology facilitates direct cross-agency communication and a flattening of communication hierarchies, which, as 9/11 assessments have shown, may greatly enhance the capacity of public safety personnel to respond (Picciotto, 2002; Twoney & Leonnig, 2001).

Policy-makers around the globe have long understood the *technical* feasibility of communications interoperability among public safety organizations. However, policy-makers have perceived two fundamental *policy* challenges as impeding the achievement of this goal.

3. Policy challenges of communication interoperability

Digital-trunked infrastructures can accomplish communication interoperability. Yet, their success hinges upon two important factors. The first is the willingness of public safety agencies to replace their existing analog equipment with new digital-trunked infrastructure using a common standard and frequency. Only if there is a common frequency and standard will users from different agencies be able to communicate with each other using their new digital radios. This is a tall order given that there are 60,000 public safety agencies in the US[5] (and a similar number in the EU) and each one of them has its own communication structures and procurement strategies.

The second important policy factor is that public safety agencies must be financially enabled to procure new equipment. The Public Safety Wireless Network (PSWN), a federal initiative to raise awareness among public safety agencies of the interoperability challenge, has estimated a funding requirement of $18 billion to procure a nation-wide digital interoperable communication network in the US (Public Safety Wireless Network (PSWN), 1998). Given the federal structure of the US, the PSWN report estimated that more than 80% of the cost of replacement will have to be shouldered by local agencies. These agencies are precisely the ones that have the least funds available. The situation is not dissimilar in the EU: while the territory is smaller, the myriad organizations and jurisdictions and the dense web of overlapping interactions within and between them tend to make the situation as complex as in the US.

Achieving commonality is typically described as a coordination challenge (Lazer, 2001). Together, agencies from all jurisdictions would be better off with a common standard, yet individually they are reluctant to move in this direction given the potential cost of shifting away from their own standards and adopting a new one.[6] As Axelrod and others have argued, the larger the number of actors involved and the more short term their thinking, the more there will be a need for a higher authority to step in and act (Axelrod, 1984; Oye, 1986). Besen and Farrell (1994) have suggested that the absence of a centralized institution to facilitate bargaining may preclude a common standard due to conflicts among stakeholders over the distributional implications.

[5]This number was suggested by Sal DiRaimo on September 22, 2004 (see http://www.newmillenniumresearch.org/news/091404mediacoverage.html) and is corroborated by PSWN (1998). By contrast, Marilyn Ward (2003, p. 1) writes of more than 74,000 public safety organizations.

[6]The history of European standardization exemplifies this (Austin & Milner, 2001).

Not surprisingly, therefore, a "higher authority" did intervene in both the US and Europe; Congress mandated that the FCC step in and the EU intervened in Europe.

Public safety agencies are beneficiaries of communication interoperability. Through better communication and coordination across agency lines, they will be able to react to complex situations more efficiently. Consequently, one may frame the funding challenge as a strategic management problem to be solved at the agency level. Moreover, due to network externalities, the necessary funding is lower than what was required for procuring existing analog systems. A common standard and frequency will permit industry to reap scale economies in product development and production, thus lowering the relative cost of equipment. More specifically (and importantly), digital-trunked networks—the type favored for interoperable networks—permit more than one agency operating in the same locality to share the expensive backbone infrastructure. This cost sharing, in turn, lowers both the initial investment cost and the recurring maintenance cost.

Yet, these cost advantages are partly offset by a timing issue as every agency has a strong incentive to wait for other agencies in the same region to build out the network infrastructure that can then be shared (Lazer & Mayer-Schönberger, 2002). Even agencies that want to cooperate with each other find it difficult to do so given that their respective funding and budget cycles are rarely in sync. Keeping in mind that communication interoperability does not just benefit the public safety agencies but the public at large, policy-makers may be prompted to also solve the funding hurdle by central coordination. Indeed, public safety agencies have argued for this (Ward, 2003, p. 5).

The difference between the US and European policy approaches to interoperability has not been about different understandings of the coordination problems involved in each of the two policy challenges (i.e., commonality and funding). Rather, the difference has to do with whether the approach to the interoperability problem is based on understanding that the two policy challenges are fundamentally intertwined in the sense that taking a coordinative stance on one necessarily shapes the context within which the other is debated and acted on—and based on this understanding taking the appropriate steps.

4. The politics of communication interoperability

In the US, a congressional mandate tasked the FCC in 1993 to develop a framework to ensure that public safety communication needs are met through the year 2010.[7] Interoperability was included as a primary objective of the envisioned framework. For 2 years, the FCC studied the problem then consulted the stakeholders. In 1997, after prolonged deliberations, the FCC issued its order[8] allocating 24 MHz of spectrum in the 700 MHz band to public safety services. It also initiated separate proceedings to set the conditions for use of this spectrum. One year later, the FCC proposed to mandate comprehensive interoperability by conditioning the use of the 700 MHz band spectrum with certain requirements that only the stakeholder-proposed Project 25 standard could at that time fulfill.[9]

This intervention of a "higher authority" to attain coordination with explicit stakeholder participation seems impressive. However, a closer look exposes significant flaws. The spectrum in the 700 MHz band set aside by the FCC will only be available in 2007 when TV stations, forced by a mandate[10] to move to digital transmission, will have vacated that spectrum. Moreover, by 2001 the FCC was forced to rescind its previous forceful stance on the interoperability issue. This was due to stakeholder pressure from entities such as Association of Public Safety Communications Officials (APCO) and Motorola.[11] Under the new order,

[7]As part of the Omnibus Budget Reconciliation Act, 47 U.S.C. § 309(j)(10)(B)(iv).

[8]Reallocation of Television Channels 60-69, the 746-806 MHz Band, ET Docket No. 97-157, Report and Order, 12 FCC Rcd 22953 (1997).

[9]See The Development of Operational, Technical and Spectrum Requirements for Meeting Federal, State and Local Public Safety Agency Communications Requirements Through the Year 2010, WT Docket No. 96-86, First Report and Order and Third Notice of Proposed Rulemaking, 14 FCC Rcd 152 (1998).

[10]Reallocation of Television Channels 60–69, the 746-806 MHz Band, ET Docket No. 97-157, Report and Order, 12 FCC Rcd 22953 (1997).

[11]See Petition of APCO for Reconsideration and Clarification of the First Order and Third Notice of Proposed Rule Making (p. 10) and Motorola's Comments to Petitions for Reconsideration of the First Order and Third Notice of Proposed Rule Making (p. 7). These

spectrum was divided up into channels of much bigger bandwidth than previously envisioned, thus creating a smaller number of total channels available. And in an almost complete turn-around, this 2001 FCC order prohibited the trunking needed for full interoperability in all but eight out of the 128 envisioned channels.[12]

In short, stakeholder involvement before the FCC effectively crippled the coordinative effort to modernize radio equipment—equipment that the stakeholders themselves had termed old and obsolete.[13] Why then did this happen?

While achieving interoperability requires solving two intertwined challenges—commonality and funding—the FCC was only mandated to provide coordination for one. It looked solely at the issue of identifying a common frequency and linking its use with a common standard. The FCC did not (and given its mandate could not) address the important issue of funding the replacement investment. Public safety agencies, especially the local agencies that would have to shoulder four-fifths of the total cost, feared they would be incapable of doing so (PSWN, 1998). Consequently, they activated their national associations, such as APCO, to lobby against any wide-reaching FCC request they felt they could not pay for.[14]

The agencies and their associations quickly found powerful supporters. Significant equipment providers in the US feared that a common standard coupled with a strong interoperability order by the FCC might radically open the vendor market for competition.[15] Vendors of existing analogue and non-interoperable digital equipment loathed the prospect of losing protected markets. They had spent decades building and refining their nation-wide close ties with thousands of procurement officers from public safety agencies. Backed with arguments and money from vendors, the associations representing public safety agencies ultimately succeeded in their lobbying efforts. All lobbying focused on watering down the FCC's position.[16] The original congressional mandate to the FCC to ensure interoperability through 2010 had in effect been turned into achieving full interoperability by 2010.

Such a result could have been avoided by direct congressional action—either through regulations mandating agencies to switch or through federal financial help. Yet, a regulatory mandate would have been seen as direct federal involvement in state and local jurisdictions. Such intervention was unpopular during the Clinton administration. Given its commitment to states' rights, this was ideologically difficult for the Bush Administration to advance even in the wake of 9/11. And with only limited federal financial help forthcoming—in fiscal year 2000 the Department of Justice had requested $80 million for interoperability needs but "[t]his money was cut from the final DOJ budget and never requested again in subsequent years"

(*footnote continued*)
documents are available at http://www.fcc.gov/cgb/ecfs/. Motorola's lobbying effort was impelled by the fact that it had helped develop a technical standard that uses double the amount of bandwidth per channel that the FCC suggested. APCO had been involved in this process. Perhaps unrelated, yet underscoring the close relationship between both stakeholders, is the fact that shortly after these comments APCO announced its intention to build a new headquarters—Motorola made a sizeable donation to APCO's building project a few month later. See "Motorola announces $25,000 contribution to APCO building fund", at http://www.apcointl.org/about/pr/archive.html.

[12]Fourth Report and Order and Fifth Notice of Proposed Rule Making, WT-Docket No. 96-86. See also Third Memorandum Opinion and Order and Third Report and Order, 15 FCC Rcd at 19851–19860 ¶¶ 16–39.

[13]Even in their public statements, stakeholders were critical of existing equipment. For example, APCO lauded the FCC's decision to make spectrum available for digital networks for public safety organizations as providing "relief" from their analogue radio communication networks. APCO predicted that public safety organizations would look forward "to [implementing] the use of new technologies to aid in the fulfillment of their basic public safety responsibilities to the American public". See "APCO applauds FCC decision to reallocate 24 MHz of television spectrum for public safety agencies", Press Release, April 3, 1997, at http://www.apcointl.org/about/pr/archive.html#july91997.

[14]See Petition of APCO for Reconsideration and Clarification of the First Order and Third Notice of Proposed Rule Making, pp. 5–12, 18–21, at http://www.fcc.gov/cgb/ecfs/.

[15]A case in point is Motorola. The equipment manufacturer lobbied the FCC to adapt the standard it had helped design. The standard provided backward compatibility with both old analogue and non-trunked systems. This standard was also incompatible with a standard developed at about the same time by the Europeans—with the help of Motorola Europe (http://www.tetramou.org/MoU/index.asp). This in effect limited access to the US market. Not surprisingly by 2000, only one major equipment manufacturer—Motorola—offered infrastructure compatible with the standard Motorola had successfully lobbied for. See Motorola Comments to Petitions for Reconsideration, pp. 5–6 at http://www.fcc.gov/cgb/ecfs/. Motorola's information on this issue can be found at http://www.motorola.com/LMPS/RNSG/pubsafety/70-10.shtml.

[16]For example, APCO stated in its reply to the FCC that "[t]here are legitimate technical, operational, and feasibility reasons why some local governments must maintain conventional systems." See Reply A96-86, at http://www.apcointl.org/gov/a96-86.doc.

(Public Safety Wireless Network (PSWN), 2001, p. ES-3)—the public safety agencies feared the potential budgetary squeeze that the FCC might force them into.

The FCC was willing to go along with this watering-down of the original interoperability goal for three reasons.

- It, too, feared that a strict mandate without additional federal funding would financially break local public safety agencies. Little would be gained with such a strategy.[17]
- It understood that the availability of spectrum was dependent on digital TV catching on. With the passing of time, the FCC became less convinced that the 2007 re-allocation deadline would hold.[18]
- Thirdly, public safety agencies supported by equipment vendors had successfully demonstrated pragmatic interim solutions to reach a certain level of interoperability without infrastructure replacement. These solutions included the installation of cross-band switches.[19]

These cross-band switches and similar solutions provide a simple hard-wired way to combine two different radio channels so that everyone tuned to one channel can hear everyone else on the other channel. Equipment vendors saw a suitable market opportunity that would not disrupt the closed equipment markets. However, cross-band switches have severe shortcomings (Mayer-Schönberger, 2003, pp. 318–321). For example, they take time to set up and they fail to scale. Nevertheless, in the eyes of the public safety agencies, cross-band switches provide a relatively affordable interim solution that works even with old analogue radios. Consequently, the FCC decided not to dissuade public safety agencies from establishing at least a limited amount of interoperability in this way.

The FCC is not alone in its reluctance to act as a "higher authority" and impose coordination. As noted above, Congress failed to provide a clear mandate backed up by funding. This failing was then compounded by the FCC's stakeholder-involving policy-making process. The FCC felt strongly that the public safety issue of interoperability required stakeholder buy-in. This prompted the FCC to rethink its already deliberative process to become even more inclusive and deferential, and in turn provide these stakeholders with significant leverage to shape the outcome. In addition, the stove-piped structure of the FCC made it more difficult to take the core telecom policy threads discussed at the outset of the paper—competition and safety—and apply them to public safety communication, especially since progress in interoperability was contingent upon progress in another policy process involving powerful and reluctant stakeholders, namely TV stations' move to digital transmission (Garcia-Murillo & MacInnes, 2001).

There may be more reasons than these to explain fully why interoperability policy in the US so far has been largely unsuccessful. Yet, even this broad sketch renders three important conclusions. First, Congress failed to understand the connection between the commonality challenge and the funding challenge. Treating each as a distinct problem obscured the fact that the strategy to tackle one changes the shape and context of the other. Second, Congress selected inappropriate institutions to tackle the two challenges. It entrusted the coordination problem to the FCC despite its potentially ill-suited emphasis on stakeholder involvement and its stove-piped structure. Congress also expected public safety agencies to solve the funding problem themselves. Third, and related, Congress proved unwilling to act as a "higher authority" in solving the budgetary coordination challenge by providing direct federal financial support to agencies.

[17]In its Fourth Report and Order, FCC 01-10 (January 17, 2001, p. 14), the FCC acknowledged explicitly that financial considerations of public safety organizations had played a major role in the reconsideration of its earlier stance.

[18]This lack of conviction is reflected in the FCC's regulatory activism to speed up the stalled transition. For instance, in 2001 the FCC amended a core part of its original order, permitting stations to move to the new bandwidth without having to switch to digital before 2007 (Action by the Commission, September 7, 2001, by Order on Reconsideration of the Third Report and Order FCC 01-258). The result was mixed. Thus, in 2002, and still dissatisfied with the pace of transition, the FCC issued an order to require manufacturers to include a digital receiver in all TV sets with screens of 36 inches and larger by July 2004. The goal was to stimulate demand for digital content (Second Report and Order and Second Memorandum Opinion and Order, August 8, 2002, FCC 02-230). In explaining the order, FCC Commissioner Abernathy noted that over the years the transition had been stalled, and without strong FCC intervention this would remain the case. See also Cass (2002).

[19]For an overview see Kaluta (2001).

5. The European policy response

European policy-makers have faced similar challenges. Setting a common frequency and standard started in 1991 (European Radiocommunications Committee (ERC), 1991). By 1993, the European Radiocommunications Committee (ERC) had successfully negotiated with NATO the release of 10 MHz of spectrum to be used for emergency services radio communication across Europe.[20] At the same time, the European Telecommunications Standards Institute (ETSI) initiated the process of developing a common standard for a digital-trunked network in order to provide full interoperability. Unlike the slow-paced FCC process in the US, ETSI moved swiftly. By 2000, more than 300 documents relating to version one and two of the common standard, TETRA, had been published. In 1996, the first 6 MHz of spectrum was made available by ERC for immediate use—but only with radio equipment conforming to the TETRA standard.[21] By 2001, not just EU member states but 26 European nations had passed national laws setting aside relevant frequency bands for use by TETRA networks.[22]

Judging from previous standardization battles, such as that over high-definition television (Farrell & Shapiro, 1992), one would not have expected a swift process to establish European unity and to settle on a common continent-wide emergency services radio communication frequency and standard. As in the US, a combination of factors contributed to this outcome. The perceived success of selecting the Global System for Mobile Communication (GSM, formerly Groupe Spécial Mobile) standard seemed to suggest to European policy-makers that picking a standard was a useful strategy in advancing innovation and creating new competitive markets (Funk, 1998; Pelkmans, 2001). The ensuing mobile phone frenzy in Europe had created what in Brussels was perceived to be a robust ecosystem of equipment vendors competing and innovating with intensity, reinforcing a sense among regulators that picking a standard would lead to economic growth (Haug, 2002). GSM became the global leader in 2G wireless communications, it facilitated the growth of European telecom equipment providers like Nokia and Ericsson, and helped lower significantly the per-minute mobile phone charges for European consumers (Kano, 2000).[23] The achievement of the common market and similar Europeanization processes, especially the successful pan-European telecommunication liberalization, had further underscored the positive effects of European coordination, permitting decision makers in Brussels to easily forget the HDTV standardization disaster. The incorporation of the Schengen framework into the EU[24] and the realization among many European public safety officials that catastrophes neither stop at borders nor involve just one agency—as exemplified by the tragic avalanche catastrophe in Galtür (Mayer-Schönberger 2003, pp. 321–323)—demonstrated the need for cross-border and cross-agency cooperation. Taken together, these factors created a "can-do" attitude among European policy-makers that facilitated the speedy selection of a common frequency and standard.

The Europeans also faced the funding hurdle. Like their US counterparts, European public safety agencies were using outdated radio equipment. New digital trunked TETRA-based networks required steep infrastructure investment. In budgetary terms, European agencies were in no better shape than their US colleagues. Although European national governments tend to provide more funds for public services, the funding necessity for digital-trunked networks came at a time of unprecedented pan-European fiscal belt-tightening—the consequence of monetary union and the introduction of the Euro on January 1, 1999. Due to the Maastricht Treaty and the so-called Growth and Stability Pact, EU member states were mandated to reduce fiscal debts. Consequently, they had very few discretionary funds to subsidize new public safety communication infrastructure (Jones, 2004, pp. 65–74). The EU itself was restructuring its agricultural budget

[20]Recommendation T/R 02-02 E (1993, revised 1997), Harmonised Radio Frequency Channel Arrangements for Emergency Services Operating in the Band 380–400 MHz.

[21]ERC Decision of March 7, 1996 on the harmonized frequency band to be designated for the introduction of the Digital Land Mobile System for the Emergency Services (ERC/DEC/(96)01).

[22]Only France has so far refused to adopt TETRA. It opted instead for its own proprietary standard, TETRAPOL. Sweden, the Czech Republic and Slovakia, the other "laggards", are in the process of adopting TETRA.

[23]It is irrelevant here whether GSM was in fact the best standard to be picked, or whether picking a standard is the best macroeconomic strategy, as Farrell and Shapiro (1992) have questioned. See also Gandal, Salant and Waverman (2003). GSM is a success, and thus shaped the perception of policy-makers.

[24]Treaty of the European Union, Official Journal C 340, 10.11.1997, pp. 145–172, articles 29–42.

and repositioning its regional development subsidies to gear up for the next round of enlargement of EU membership and had no significant funds available either.

European national policy-makers have found different responses to this funding challenge. Many of them have focused on the possibility of lowering funding needs by actively facilitating infrastructure sharing among public safety agencies. For example, the Belgian government set out to plan, procure and run a nation-wide, fully interoperable public safety network to be shared by all of its public safety agencies. In this plan, only one nation-wide infrastructure needed to be built and maintained instead of separate infrastructures for each and every agency.[25] The Belgian ASTRID project may have been one of the first infrastructure-sharing initiatives but it was not the only one. More recently in the US, states such as Colorado, Delaware and most parts of Michigan have adopted infrastructure-sharing initiatives.[26] Policy-makers in these states have made the radio infrastructure available to state and local agencies for nominal or no fees in order to provide a significant incentive for agencies to join. Increasing numbers of national (in the European case) and state (in the US case) policy-makers are looking at infrastructure initiatives as a successful strategy for harnessing technological advantage to lower the investment necessary to join, thus significantly reducing the cost of entry for individual agencies.

These kinds of shared infrastructure initiatives are premised on the notion that there is a fundamental linkage between the commonality and funding challenges. Selecting a standard that scales makes shared infrastructures possible. This, in turn, requires less funding. It is this (at least implicit) understanding of the two challenges that distinguishes the European approach from the US *federal* approach. An example from another European country, the United Kingdom, demonstrates that understanding the linkage between commonality and funding enables policy-makers to employ market forces in order to lower the funding hurdle even further.

Instead of having public safety agencies fund the new communication infrastructure and/or use constrained public funds to subsidize the effort, UK policy-makers, after a lengthy procurement process,[27] awarded a private sector telecom provider, British Telecom (BT), the license to build and maintain a nation-wide TETRA-based public safety communication network.[28] Public safety agencies contract with BT to use the infrastructure and pay a monthly fee for using it.[29] The UK government also provided BT with an anchor user of the network by inking a multi-year contract with BT to provide the communication infrastructure for its national police force.[30]

Under this private–public partnership,[31] it is BT's task to create and maintain the infrastructure and to bear the investment risk. BT needs to convince as many agencies as possible to sign on. The UK government felt that a private sector player would be significantly more successful than a government agency,[32] while BT—experienced in selling wireless services—sensed a business opportunity. The UK government further sweetened the deal for BT by broadening its potential customer base from public *safety* agencies to public *service* agencies. Call prioritization, a feature of the common standard chosen, makes possible this broadening without risking non-essential public service network traffic crowding out the urgent communications of public safety personnel. The system automatically gives priority to call requests from public safety agencies over less important public service agency communications. This is the case even if this requires terminating less important communications. Consequently, for users from public safety agencies

[25]See http://www.mobilecomms-technology.com/projects/astrid/.

[26]For more details see http://www.pswn.gov.

[27]Procurement was intended as a competitive process with initially three consortia participating. After two withdrew, the competitive process collapsed. The British government then negotiated with the sole remaining bidder, BT, employing two cost models to compare BT's projected cost with a "should-cost" model and a public sector comparator. The procurement process was later criticized in the press but was vindicated in a Committee of Public Accounts Report (Committee of Public Accounts (CPA) (2001)).

[28]BT's Airwave service later became part of mm02 when BT split its wireless and land businesses.

[29]BT used Motorola Europe's TETRA equipment to build the infrastructure.

[30]"BT wins its biggest ever government contract to set up police digital radio service". March 8, 2000. *PR Newswire*, at http://www.prnewswire.co.uk/cgi/news/release?id=18823. For an overview of the rollout of the service across the UK see http://www.airwaveservice.co.uk/airwave370.asp.

[31]The agreement with BT was negotiated and signed under the Private Finance Initiative by the Police Information Technology Organization (PITO), a body established by the British Home Office to manage procurement.

[32]See CPA (2001) for an extensive review of the government's viewpoint.

the network feels like a proprietary network for themselves. By the same token, when network utilization by public *safety* agencies is low, public *service* agencies can use the network for non-urgent communication and data transfer. This broadening of the potential user base results in a better business case for BT. By the end of 2003, BT had rolled-out its infrastructure in two-thirds of the UK, and in most urban areas. By 2004, coverage had reached more than 90% of British territory. After some initial hurdles,[33] recruitment of public safety and service agencies to the BT program has been coming along. More than 60,000 police officers were using the service every day by mid-2004, and many other public safety organizations had signed up for service.[34] As of mid-2004, BT is short listed for further contracts with the major fire and ambulance services.[35]

In short, one of the central regulatory threads alluded to at the outset of this paper, "deregulation" or competition, has been injected into public safety communication interoperability regulation on at least three levels. First, the government held an open, competitive tender process. Second, equipment was procured by a private infrastructure provider as well as public safety organizations from competitive equipment markets. Third, with the exception of the national police force, public service agencies were free to keep their old system or switch to the new digital one, thus putting significant pressure on BT, the service provider, to provide a competitive offering and sign up users swiftly. This injection of a competitive thrust, in turn, has begun to bring the sub-field of public safety communication into line with the overall telecommunications regulatory framework—a framework that is characterized by the regulatory threads of competition and safety. Other European nations have decided to follow the British lead, yet despite some attention[36] it has not yet caught on in the US.[37]

To sum up, this article has argued that over the last decade two core values have influenced telecommunication regulation on both sides of the Atlantic. Policy-makers have pushed for competition to unleash the power of the market, and regulated when they saw the safety and security of citizens or the nation being threatened. In Europe, this thinking has been extended to the area of public safety communication interoperability. This extension was possible as European policy-makers, at least viscerally, understood the linkage between the two hurdles of interoperability—commonality and funding. Emboldened by what they perceived as previous successes of central coordination, such as establishing GSM as the European standard and propelling it to the leading global cell phone standard, European policy-makers, together with their European telecom sector counterparts, felt capable of facilitating such a political choice. By contrast, US federal regulators have been unable to link the two challenges. This is partly because of a lack of understanding of the linkage. It is also partly due to stakeholder politics restricting the extent to which this linkage could be exploited, thus necessitating a separate (and significantly less successful) tackling of the commonality and funding challenges. Nor have US policy-makers been operating within an environment of private and public sector stakeholders that is supportive of the linkage between the two challenges. These factors may help explain why, in relative terms, Europeans have to date been more successful than their US counterparts in establishing a regulatory framework for communication interoperability. These factors do not, however, predict that Europeans will necessarily achieve interoperability sooner than the US. Understanding the linkage between commonality and funding and acting on it is a necessary, but not a sufficient component of ultimate success.

[33]The two most often reported hurdles were financial and environmental. Some public safety organizations, including some police units, were concerned about the cost of radio sets. The government alleviated this fear by subsidizing radio set investment for the first three years of use (CPA, 2001). Citizens' and users' fear of electromagnetic emission from radio masts (and radio sets) in some locations provided a second hurdle. This took longer to overcome. See "Residents object to radio mast". *BBC News*, November 19, 2002, http://news.bbc.co.uk/1/hi/england/2491383.stm.

[34]For an overview from the provider's perspective, see http://www.airwaveservice.co.uk/airwave14_462.asp.

[35]See http://www.airwaveservice.co.uk/airwave14_480.asp.

[36]See PSWN (2001).

[37]In Sweden, the TETRA infrastructure is being built and run by a consortium including Saab, Swedia, and Nokia (http://press.nokia.com/PR/200404/940360_5.html). Rattled by the Galtür avalanche catastrophe, Austrian policy-makers chose Siemens in 2002 to build and run a nationwide TETRA-based infrastructure for public safety agencies, much like BT in Britain. Due to contractual difficulties, the contract was later annulled and the procurement process restarted (http://ecaustria.at/?url=/?id=1600932).

6. Fear of change? Reframing the interoperability challenge

Perhaps, though, in addition to commonality and funding there is one other challenge that policy-makers have overlooked. Agencies have been characterized as ultimately gaining from interoperable communication. Consequently, the problem has been viewed in terms of encouraging individual agencies to look at the collective good. This presupposes that public safety agencies are homogeneous units. But what if gains from interoperability are unevenly distributed *within* agencies?

Within corporations and bureaucracies, email and the Web enable users to communicate with each other directly and therefore to potentially disregard layers of hierarchy. Similarly, interoperable communication networks make possible different topologies of information flows within and between public safety agencies. Channels and talk groups can be created, shaped and designed at will to best facilitate communication flows. These interoperable networks replace old analogue radio infrastructure with its unalterable structure of communication flows; flows that are embedded in its design. Incidentally or not, communication flows in analogue systems tend to be fairly stove-piped, facilitating an implicit communication hierarchy. Most radio communication is either among a group of first responders from one agency on location, or from one of the group (usually the person in charge) back to the dispatch center. Only the dispatcher can contact other agencies. Replacing this old fixed topology of communication flows with one that can be designed and modified at liberty will force any agency to face the question of what communication topology it desires, and how it envisions linking its network with other agencies' networks. So far, agency leadership has enjoyed a privileged communication position due to the stove-piped communication structures of the old radio systems. It will likely be difficult to continue these structures in a digital network world.

Malone (2004) juxtaposes hierarchical structures with networked organizations that are based on less hierarchical communication flows. He describes the many potential gains reaped from more decentralized communication structures. Fountain (2001) suggests that agency leadership may resist changes to communication cultures and structures. This may involve implementing information and communication technologies "in ways that reproduce […] institutionalized sociostructural mechanisms" (Fountain, 2001, p. 90). She sees cross-agency communication—the core aim of interoperable communication networks—as particularly difficult to achieve due to the complexity involved, the lack of social capital and learning, and the lack of trust between leadership of different agencies (Fountain, 2001, pp. 67–82). It seems safe to say that public safety agency leadership will likely behave like any organizational leadership that feels threatened by a lessening of communicative control and loss of power due to a reshaping of communication hierarchies.[38]

To be sure, it is not certain that any redesigned communication topology automatically diminishes the power of agency leadership. But any switch to a communication topology that can be redesigned—like digital trunked networks—entails the *risk* for leadership of a loss of power. Consequently, the reluctance of agency leadership to embrace interoperability may not simply be fueled by concerns over agency ownership and cost, but also by the desire to maintain one's own power position within the agency. If this is the case, setting standards and providing financial incentives may not be enough to provide an impetus for change.[39] Moreover, if intra-agency challenges are present in European as well as US public safety agencies, arguably the most intriguing dynamics to study take place after public safety organizations have signed up to an interoperable network, as is the case in the UK.

Again, this additional organizational explanation suggested here requires validation beyond anecdotal case studies and reference to general organizational theories. However, it does imply the need for policy makers to go beyond addressing commonality and funding when regulating for interoperability.

[38]In fact, this author's numerous personal encounters with public safety agency leadership have strongly resonated with the theory of leadership resistance.

[39]Surveys have shown that while agency procurement officers desire to buy interoperable equipment agency leadership are reluctant to commit the funds needed for this switch (National Institute of Justice (NIJ), 1998).

7. Conclusion

This article examined an understudied area of telecommunications regulation, the interoperability of public safety radio communication. It suggested that the two policy challenges that must be met to achieve interoperability—commonality and funding—are fundamentally intertwined. Addressing them independently will be more difficult than utilizing their connectedness. Indeed, interoperability strategies that are based on a sound understanding of this connectedness may even permit a transplantation of general telecom policy threads—like competition—to this domain. So far, European regulators have been more successful in providing the necessary policy framework for interoperability than their US counterparts. This article has argued that European policy-makers' ability to see the two challenges as connected may well have been an important factor in explaining their success. Interoperability, though, may face further hurdles. Specifically, the success or failure of interoperability initiatives may be linked to intra-agency fears of a potential re-direction of hierarchical communication flows brought about by new (and configurable) communication infrastructure. If this turns out to be the case, telecommunication policy-makers desiring to regulate for interoperability will have to take inter- and intra-agency organizational dynamics into account as well.

References

Austin, M., & Milner, H. (2001). Strategies of international and European standardization. *Journal of European Public Policy*, *8*(3), 411–431.

Axelrod, R. (1984). *The evolution of cooperation*. New York: Basic Books.

Benkler, Y. (2001). Siren songs and Amish children: Autonomy, information, and the law. *New York University Law Review*, *76*(1), 23–113.

Besen, S., & Farrell, J. (1994). Choosing how to compete: Strategies and tactics in standardization. *Journal of Economic Perspectives*, *8*(2), 117–131.

Cass, C. (2002). FCC orders switch to digital tv. *Government Technology*, August 8, at http://www.govtech.net/?pg=news/news&id=20801.

Committee of Public Accounts (CPA) (2001). *Public private partnerships: Airwave*. 64th report at http://www.publications.parliament.uk/pa/cm200102/cmselect/cmpubacc/783/78303.htm.

Diffie, W., & Landau, S. (1998). *Privacy on the line: The politics of wiretapping and encryption*. Cambridge, MA: MIT University Press.

European Radiocommunications Committee (ERC) (1991). *Harmonisation of frequencies for police and security services in Europe*, at http://www.ero.dk/documentation/docs/doc98/official/HTML/REP006.HTM.

Falkenrath, R. (2001). *The shootings at Columbine high school: The law enforcement response*. John F. Kennedy School of Government Case No. C16-01-1612.0, at http://www.ksgcase.harvard.edu/case.htm?PID=1612.

Farrell, J., & Shapiro, C. (1992). Standard setting in high-definition television. *Brookings Papers on Economic Activity, Microeconomics*, 1–77.

Fountain, J. E. (2001). *Building the virtual state—information technology and institutional change*. Washington, DC: Brookings Institution Press.

Funk, J. (1998). Competition between regional standards and the success and failure of firms in the world-wide mobile communication market. *Telecommunications Policy*, *22*(4-5), 419–441.

Gandal, N., Salant, D., & Waverman, L. (2003). Standards in wireless telephone networks. *Telecommunications Policy*, *27*(5-6), 325–332.

Garcia-Murillo, M., & MacInnes, I. (2001). FCC organizational structure and regulatory convergence. *Telecommunications Policy*, *25*(6), 431–452.

Haug, T. (2002). A commentary on standardization practices: Lessons from the NMT and GSM mobile telephone standards histories. *Telecommunications Policy*, *26*(3-4), 101–107.

Hazlett, T., & Sosa, D. (1997). Chilling the Internet? Lessons from FCC regulation of radio broadcasting. *Michigan Telecommunications and Technology Law Review*, *4*(fall-spring), 35.

Jones, E. (2004). European monetary union and the problem of macroeconomic governance. In R. Tiersky (Ed.), *Europe today*, (2nd ed) (pp. 59–84). Lanham, MD: Rowman & Littlefield.

Kaluta, R. (2001). *New developments in interjurisdictional communication technology*, at http://www.iacptechnology.org/Library/TechTalk/TechTalk0401.htm.

Kano, S. (2000). Technical innovations, standardization and regional comparison—a case study in mobile communications. *Telecommunications Policy*, *24*(4), 305–321.

Lazer, D. (2001). Regulatory interdependence and international governance. *Journal of European Public Policy*, *8*(3), 474–492.

Lazer, D., & Mayer-Schönberger, V. (2002). Governing networks: Telecommunication deregulation in Europe and the United States. *Brooklyn Journal of International Law*, *27*(3), 819–851.

Levy, S. (2001). *Crypto—how the code rebels beat the government—saving privacy in the digital age*. New York: Viking.

Malone, T. (2004). *The future of work*. Boston: Harvard Business School Press.

Mayer-Schönberger, V. (2003). Emergency communications: The quest for interoperability in the United States and Europe. In A. M. Howitt, & R. L. Pangi (Eds.), *Countering terrorism—dimensions of preparedness* (pp. 299–342). Cambridge, MA: MIT Press.

National Institute of Justice (NIJ). (1998). *State and local law enforcement wireless communications and interoperability—A quantitative analysis*. Washington, DC: US Department of Justice, Office of Justice Programs.

Oye, K. (1986). *Cooperation under anarchy*. Princeton: Princeton University Press.

Pelkmans, J. (2001). The GSM standard: Explaining a success story. *Journal of European Public Policy*, *8*(3), 432–453.

Picciotto, R. (2002). *Last man down: A firefighter's story of survival and escape from the World Trade Center*. New York: Berkley Books.

Public Safety Wireless Network (PSWN) (1998). *LMR replacement cost study report*, at http://www.publicsafetywins.gov/PolicySolutions/Funding/lmr_coststudy.pdf.

Public Safety Wireless Network (PSWN) (1999). *Comparison of conventional and trunked systems,* at http://www.safecomprogram.gov/admin/librarydocs/cvtcomp_repfinl.pdf.

Public Safety Wireless Network (PSWN) (2000). *Program symposium compilation report, August 1997—December 1999*, at http://www.safecomprogram.gov/admin/librarydocs11/symposiumrpt6_orlando.pdf.

Public Safety Wireless Network (PSWN) (2001). *The report card on funding mechanisms for public safety radio communications*, at http://www.safecomprogram.gov/admin/librarydocs6/report_card_on_funding_mech.pdf.

Public Safety Wireless Network (PSWN) (no date). *Public safety and wireless communications interoperability—critical issues facing public safety communications*, at http://www.safecomprogram.gov/files/interopbooklet.pdf.

Rappaport, K. (1998). In the wake of Reno v. ACLU: The continued struggle in western constitutional democracies with Internet censorship and freedom of speech online. *American University International Law Review*, *13*, 765.

Twoney, S., & Leonnig, C. (2001). Rush is on to boost region's response to terror attacks. *The Washington Post*, September 30 (p. A01).

Vogel, S. (1996). *Freer markets, more rules: Regulatory reform in advanced countries*. Ithaca: Cornell University Press.

Ward, M. (2003). *First responder interoperability: Can you hear me now?* Congressional record of testimony to the 108th congress of the United States, House of Representatives Committee on Government Reform, November 6, at http://reform.house.gov/UploadedFiles/Ward%20Testimony.pdf.