

# **Non-Interoperability at 700 MHz: Lower Revenues & Higher Prices**

BY

**Martyn Roetter, D.Phil.**

**Alan Pearce, Ph.D.**

**Barry Goodstadt, Ph.D.**

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INFORMATION AGE ECONOMICS

(202) 466-2654

IAEpearce@aol.com



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## Executive Summary

The introduction and continuation of non-interoperability across the various band classes defined for the 700 MHz “digital and economic dividend” spectrum for mobile communications in the U.S. has a number of serious adverse consequences for the:

- (i) Revenues and Federal budget contributions from future spectrum auctions;
- (ii) National Broadband Plan (NBP);
- (iii) Competition, Innovation, and Pricing in the U.S. Wireless Market.

“Digital dividend” spectrum refers to frequencies in the sub 1 GHz range or UHF (ultra-high frequency) band that have traditionally been allocated to analog TV broadcasts. They are now allocated for the deployment of wireless broadband services following the transition, in 2009, to all-digital broadcasting which can accommodate the same number of TV channels—and in fact, many more—within much less bandwidth. In the U.S., the “digital dividend” spectrum includes the frequencies 698-806 MHz, or the former UHF TV channels 52-69. Additional frequencies in the UHF band may become available for wireless broadband in the future depending on the outcome of various proposals by the FCC and negotiations with the broadcasters who currently hold them. The “economic dividend” comes from the use of this spectrum to fulfill national public policy goals to make available 4G wireless broadband services to all Americans on an equal, non-discriminatory, interoperable basis. The expansion of wireless broadband coverage and capacity will generate increased broadband-enabled economic activity and employment opportunities. Similar “digital and economic dividend” initiatives are being progressively undertaken in countries across the world as they have in the U.S., where broadcasters who no longer need the spectrum successfully transitioned to digital.

The consequences of 700 MHz non-interoperability for the NBP and the U.S. wireless market will create negative impacts on governmental budgets at all levels (Federal, State, and local) through associated increases in the costs of wireless-dependent public sector services and fewer opportunities for, and therefore lower annual tax revenues from, broadband-enabled growth in economic activity and employment. The direct adverse one-time impact of non-interoperability on Federal revenues could be several tens of billions of dollars from spectrum auctions alone. The indirect annual impact which is much harder to quantify would be felt at all levels of Government and might cumulatively be substantially larger or at least as large over ten or more years.

It is distressing that the two largest U.S. wireless operators – Verizon Wireless and AT&T Mobility (the Big Two) have introduced 700 MHz services based on non-interoperability that increase their market power in the U.S. at the expense of all other service providers and stakeholders. Their own customers, as well as their competitors, are affected by this decision. Their argument that non-interoperability is an inevitable consequence of requirements to avoid or mitigate interference is disingenuous and ignores interoperable alternatives for the 700 MHz band in which interference will not be an issue. Furthermore, public statements by the Big Two’s own executives about the value of, and need for, interoperability and accessibility are inconsistent with their implementation of 700 MHz non-interoperability in the devices they offer. Interoperability of the Public Switched Telecommunications Network (PSTN) has been a major contributor to the economic wealth of the U.S. This arose because in 1934 the U.S. Congress stipulated in the Communications Act that the fixed telephone networks must be interconnected, interoperable, and ubiquitous, in order to serve all Americans equally. That policy was appropriate and wise in 1934 and should be applied to all wireless services today because it is in the nation’s national and public interest.

A similar principle and policy of interoperability has also been applied to mobile networks for over 25 years until the use of the 700 MHz band. For example, in defining the A and B bands in the original 850 MHz cellular frequencies awarded respectively to non-wireline and wireline carriers in the 1980s, the Federal Communications Commission (FCC) mandated that they be interoperable, i.e., mobile telephones had to be capable of operating in both bands. This interoperability policy was initially mandated by the U.S. Congress in the Communications Act of 1934, and embodied in the 1996 Telecommunications Act and required that all telecommunications technologies and services stemming from them should be made available to all Americans on an equal, non-discriminatory, non-preferential basis, at affordable rates. This Congressional mandate contributed to the creation of a telecommunications-information infrastructure that became the envy of the world while bestowing enormous economic and social benefits on the entire nation.

Interoperability is a critically important key to achieving the national broadband goal expressed by FCC Chairman Julius Genachowski on October 27th: “Mobile is one of the fastest-growing and most promising sectors of our economy, and having the world’s largest market for 3G and 4G subscribers will be a key competitive advantage enabling us to lead the world in mobile innovation.”<sup>1</sup>

## Introduction

This brief paper identifies the key consequences and implications of limiting 700 MHz interoperability in terms of its impact on future spectrum made available for mobile broadband use, and national 4G mobile broadband deployment. This impact will have cascading negative effects on Federal, State, and local budgets, and also on the U.S. economy. Specifically, it will seriously endanger competition in the U.S. wireless market and the quality and prices of wireless services for domestic customers as well as travelers from abroad, stalling the deployment of mobile 4G broadband.

Remarkably, the positions and statements of the Big Two wireless operators in favor of interoperability are at complete variance with their actual business strategies and actions because they are deploying anti-competitive non-interoperability within the 700 MHz band, recognized as “prime” spectrum for the introduction of broadband in the wireless sector.

In the course of our research we have evaluated a number of data sources including:

- The results of prior wireless auctions
- Academic papers on wireless auctions
- Papers and proceedings from regulators
- Papers and positions expressed by equipment and components manufacturers

A few selected examples of these sources are cited in this paper, although space does not permit inclusion of a comprehensive bibliography. That more extensive bibliography will be included as our research continues.

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<sup>1</sup> Statement at the FCC Open Meeting on the Connect America Fund (USF/ICC Reform, [http://hraunfoss.fcc.gov/edocs\\_public/attachmatch/DOC-310695A2.doc](http://hraunfoss.fcc.gov/edocs_public/attachmatch/DOC-310695A2.doc)).

## Revenues and Federal Budget Contributions from Future Spectrum Auctions

Many factors affect the outcomes of spectrum auctions, held at specific times and places, and in particular market circumstances. The impact of non-interoperability in particular relates to its consequences for the number of likely bidders in future spectrum auctions in the U.S., revenues from which have been estimated by the Congressional Budget Office (CBO)<sup>2</sup> at only \$3 billion from 2011-2020. In contrast the FCC's 700 MHz auction, held in 2008, awarded 80 MHz of spectrum that yielded almost \$19 billion for the U.S. Treasury<sup>3</sup>.

A key factor that affects the prices paid for auctioned spectrum is the number of financially qualified bidders who are motivated to participate. Non-interoperability across a band discourages all but the largest existing operators from bidding. Other bidders, who recognize that the spectrum they may acquire will be non-interoperable with spectrum held by the Big Two, will be discouraged by the prospect that they may not be able to acquire competitive devices, in terms of cost and performance, in a timely manner because component and device vendors will understandably focus their limited development resources on the larger business opportunities and profits offered by the Big Two<sup>4</sup>. Device manufacturers will be reluctant and slow to develop (if at all) devices that can only serve small markets and hence will provide them with small revenue streams that may be insufficient to justify the development costs they incur. Their manufacturing costs will benefit from only relatively limited economies of scale. Hence the prices operators and end users will have to pay for such devices will be greater than for devices which serve substantially larger markets, which in the U.S. only AT&T and Verizon can offer in the 700 MHz band. Because of this obvious problem, investments made by operators other than the Big Two in acquiring valuable 700 MHz spectrum, have already been "stranded," or forced to remain unused for a much longer period than is desirable to the detriment of the U.S. economy, small and medium sized wireless operators, and their customers. Ironically the CEOs of both major defenders of non-interoperability—the Big Two—have expressed opinions that are belied by their own companies' initiatives and behavior in introducing non-interoperable devices in their 700 MHz spectrum.<sup>5</sup>

The FCC has proposed to make up to 120 MHz of additional sub 1 GHz spectrum available, within five years, for future mobile broadband deployments. Comparable spectrum offered in other countries on an interoperable basis, e.g., Germany, Sweden, Spain, Italy, and Hong Kong, has commanded a high price, when compared to spectrum above 1 GHz, by virtue of its two key advantages for mobile broadband, namely: (i) Greater propagation range, which substantially reduces the costs of broadband coverage in rural areas, and (ii) Superior in-building penetration which enables a higher quality of service to be provided to mobile users when indoors -- over 50% of mobile traffic involves in-building use. The Table below illustrates the ratios of prices paid for spectrum auctioned in different bands in several

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<sup>2</sup> "The Budget and Economic Outlook: Fiscal Years 2010 to 2020," p. 63, Table 3-5, Congressional Budget Office, <http://www.cbo.gov/ftpdocs/108xx/doc10871/01-26-Outlook.pdf>.

<sup>3</sup> In contrast five auctions of 120 MHz of PCS spectrum (1.9 GHz) yielded a total of almost \$40 billion and one auction of 90 MHz of AWS spectrum (1.7/2.1 GHz) generated almost \$14 billion.

<sup>4</sup> "700 MHz Device Flexibility Promotes Competition," Peter Cramton, <http://www.cramton.umd.edu/papers2010-2014/cramton-700-mhz-device-flexibility-promotes-competition.pdf>.

<sup>5</sup> Remarks by Randall Stephenson, CEO Chairman at the Mobile World Conference, Barcelona, Feb. 15<sup>th</sup>. 2011: "AT&T is committed to the world's most advanced network, and we want it the most open and highly available and easily addressable," and "If our object is to grow the [wireless] pie, interoperability is necessary." [http://www.computerworld.com/s/article/9209502/AT\\_T\\_chairman\\_urges\\_open\\_devices\\_platforms\\_and\\_networks\\_globally;see\\_also\\_infra\\_note\\_8](http://www.computerworld.com/s/article/9209502/AT_T_chairman_urges_open_devices_platforms_and_networks_globally;see_also_infra_note_8).

countries, comparing the higher “digital dividend” spectrum prices, so-called “beachfront property,” to prices of frequencies around 2 GHz. The 700 MHz band in the U.S. is today uniquely non-interoperable, although at the time of the auction, bidders other than the Big Two could reasonably have hoped that this would not be the case.<sup>6</sup>

**Table: Ratios of Prices Paid at Auctions for Spectrum below and above 1 GHz<sup>1</sup>**

Country	Auctions and Bands in Price Comparison	Spectrum Price Ratio <sup>2</sup>
U.S.	700 MHz (2008) to AWS (2006)	1.56
Germany	Multiband auction (2010), 800 to 2100 MHz	6.6
Spain	Multiband auction (2011), 800 to 2 500 MHz	15.5
Italy	Multiband auction (2011), 800 to 1800 MHz	3.1

1. Ratios calculated from auction results published on the web sites of the FCC and European regulators.
2. Spectrum prices are typically expressed in terms of \$/MHz\*POP, i.e. the price paid for a spectrum license divided by the product of the bandwidth acquired (in MHz) and the population in the area covered by the license. Hence this ratio is a measure of the relative value the winning bidders placed on spectrum in the “digital dividend” band compared to spectrum at higher frequencies.

Service providers in the U.S., especially those that currently hold no or only very limited sub 1 GHz spectrum<sup>7</sup>, may well be prepared to pay high prices for sub 1 GHz spectrum that will be auctioned in future. These prices may reflect the larger multiples shown in the Table above that have been paid for sub 1 GHz spectrum in Europe compared to spectrum around 2 GHz. But this outcome will only be realized *if* this “new” spectrum is offered in an unequivocally interoperable structure, and under other conditions that attract multiple bidders who are not convinced that there is NO point in bidding against the Big Two. In an auction dominated by a duopoly, it is likely that the prices of spectrum will be very low under any circumstances, since it will be easy for this duo to coordinate their bidding tactics, without any formal collusion. In contrast, an intensely competitive auction of 80-120 MHz of interoperable spectrum would yield total *one-time* receipts of several and perhaps many tens of billions of dollars—far in excess of the \$3 billion “assumed” in the CBO report.

## National Broadband Plan (NBP)

Non-interoperability, as currently practiced by both AT&T and Verizon Wireless in the 700 MHz band—their devices are not interoperable across their two networks, let alone with the 700 MHz frequencies of other operators—means that data roaming agreements, and hence 4G mobile broadband coverage to their own customers, as well as those of other operators, will be lower than it could have been if interoperability had been promoted and adopted by the Big Two.

Non-interoperability is hostile to the goals of the National Broadband Plan for ubiquitous mobile broadband, in addition to the expectation of high dollar returns to the U.S. Government for the licensed use of taxpayer spectrum resources. Meanwhile, the lack of an interoperability requirement is “money in the bank” for the emerging duopoly of the largest two telecommunications players. Furthermore,

<sup>6</sup> For example for the Upper C block the FCC specified, “..the licensee must allow any device to be connected to the network as long as the device is compatible with, and will not harm the network (i.e., no “locking”), and the licensee cannot impose restrictions against content, applications, or services that may be accessed over the network (i.e., no “blocking”).

<sup>7</sup> The Big Two benefit from a substantial, even discriminatory legacy advantage in sub 1 GHz spectrum, having inherited the bulk of the 850 MHz cellular frequencies originally awarded in the 1980s at no cost in which modern broadband systems can now be deployed.

broadband-related opportunities for business creation and expansion, along with, most importantly, employment, plus the increased tax revenues they will generate, will be lower than they could be with interoperability. The *annual* “shortfall” in tax revenues at all levels of Government could be about \$3.5 billion, if, for example, broadband penetration were 1% lower with non-interoperable than interoperable spectrum, due to the greater coverage. It is also noted in the next section that higher transmission speeds will be achieved in an interoperable environment.

Even worse on the cost side of Government budgets, public safety agencies, which have to acquire multiple or multimode devices to ensure interoperability across the 700 MHz band, will have to pay more to meet their needs at a time when these budgets are already severely strained<sup>8</sup>. A recent opinion article by Verizon Communication’s CEO emphasizes the importance of interoperability in this context, belying his own company’s introduction and justification of non-interoperable devices in the crucial 700 MHz band.<sup>9</sup>

## Competition, Innovation, and Pricing in the U.S. Wireless Market

Non-interoperability of spectrum will increase the market power of the Big Two with no offsetting national economic advantages. Indeed, non-interoperability will harm the interests of everyone else, including the Big Two’s own customers, along with those of their competitors. The negative effects of any further increases in the market power of the Big Two have been amply and convincingly documented in many filings submitted in connection with the proposed acquisition of T-Mobile USA by AT&T.<sup>10</sup> Approval of this merger will further depress the prospects for revenues from future spectrum auctions, since it will remove one significant likely bidder from the picture, namely T-Mobile.<sup>11</sup> It is conceivable that if the merger is allowed, it may effectively remove two bidders from the auction, namely AT&T, since AT&T might conclude that it does not need, and/or cannot afford, additional spectrum in the near-to-medium term as a consequence of the billions of dollars paid to Deutsche Telekom, T-Mobile’s owner.

Consequences already identified in the context of the AT&T/T-Mobile deal, e.g., for higher pricing and less innovation, that will ensue from an increase in the market power of the Big Two, will undoubtedly hurt Government budgets at all levels by increasing the prices of Government services delivered over broadband networks along with a diminution of potential tax revenues stemming from the depressed deployment and growth in broadband-enabled and innovation-driven economic activity and employment.

On a technical note, non-interoperable spectrum will also entail lower peak and average speeds enjoyed by customers over wireless broadband networks. If a spectrum band is non-interoperable the implementation of carrier aggregation to boost both these elements of performance, as is foreseen in

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<sup>8</sup> See L. Moore, “Public Safety Communications and Spectrum Resources: Policy Issues for Congress,” Congressional Research Service Doc. No. R40859 (September 1, 2010) (“The participation of commercial carriers in developing and deploying, for example, a common radio interface, is expected to put the costs of public safety radios in the same price range as commercial high-end devices (\$500). By contrast, interoperable radios for the narrowband networks at 700 MHz cost \$3000 and up, each.”)

<sup>9</sup> Lowell C. Mcadam, New York Times, 10/22/2011, <http://www.nytimes.com/2011/10/22/opinion/wireless-spectrum-should-be-reallocated.html> : “Finally, Congress must ensure that police officers, firefighters and other emergency workers have the spectrum they need, as well as a workable plan and resources for an interoperable nationwide broadband network for critical communications. The system remains as inadequate as it was on Sept. 11, 2001.”

<sup>10</sup> See for example, “Preliminary Analysis of the Impacts and Consequences Of the Proposed AT&T/T--MOBILE Merger,” Information Age Economics, <http://fjallfoss.fcc.gov/ecfs/document/view?id=7021690990>.

<sup>11</sup>T-Mobile holds no sub 1 GHz frequencies, in contrast to AT&T, discrediting A&T’s assertion that rural areas currently uneconomical to serve will be miraculously transformed into geographies it can serve by acquiring T-Mobile’s assets.

future LTE and even hybrid LTE/HSPA network deployments, will be more difficult to implement and therefore less widespread, thus harming and hampering the nation's economic recovery.

## Is Non-Interoperability Justified?

Non-interoperability is not justified and is not in the national interest. Nor is it in the long-term interests of the Big Two, Verizon and AT&T Mobility. The adverse economic, budgetary and wireless operational consequences of 700 MHz non-interoperability are so substantial, diverse, and widespread that its justification should require solid evidence of a countervailing and overwhelming harm that can only be avoided by non-interoperable operation. The avoided harm presented by the advocates of non-interoperability is the alleged interference associated with interoperability that, if real, would seriously impair the capacity and possibly the quality of the mobile services offered in the 700 MHz band. However, it has been demonstrated that these interference concerns can be handled through typical network planning and coordination measures, and do not require unusual block-specific filtering by the devices<sup>12</sup>. Most recently, amidst concerns regarding AT&T's announcement with Harris to partner in the deployment of a nationwide LTE network for public safety users stemming from AT&T's 700 MHz holdings located in a different frequency range (Band Class 17) from the public safety allocation (Band Class 14), AT&T executive director for advanced mobility solutions Mobeen Khan dismissed concerns as a "myth." Khan explained that "Multi-frequency and multiprotocol devices have been working in the market for a long period of time. With the processing speeds and the radio capabilities, that's really a problem that's been solved ... so that's really not an issue."<sup>13</sup>

## Conclusion

Non-interoperability of spectrum will harm Federal, State, and local budgets in the U.S., both directly and indirectly. The direct source of harm will be lower potential future revenues for the Federal Government from spectrum auctions. Indirect harmful budget consequences at all levels of Government will include: (1) Increased costs to provide essential government services as a result of higher prices for wireless equipment and services, and (2) Lower tax revenues as a result of slower growth in economic activity and employment. The laudable goals of the National Broadband Plan will be delayed and slowed in terms of GDP and employment growth. Slower growth will be a result of the smaller coverage and lower capacity of broadband services compared to the outcome if spectrum is interoperable within every frequency band.

Interoperability of wireless devices throughout the 700 MHz band and subsequent future bands, to the extent technically possible, is the best policy position, supportive of consumers, taxpayers, innovation, and ubiquitous broadband deployment, to maximize existing and future mobile broadband spectrum. Anything less than full interoperability is a tragic waste of limited taxpayer resources.

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<sup>12</sup> See, for example, "700 MHz Band Analysis," May 6, 2010, Wireless Strategy LLC, Reston, VA, attached to written *ex parte* submission to the FCC, [http://ruraltelecomgroup.org/wp-content/uploads/2010/09/2010\\_05\\_10-700\\_MHz\\_Band\\_Analysis\\_as\\_Filed\\_5\\_10\\_2010\\_Final.pdf](http://ruraltelecomgroup.org/wp-content/uploads/2010/09/2010_05_10-700_MHz_Band_Analysis_as_Filed_5_10_2010_Final.pdf). Ironically T-Mobile USA was a party to this filing, 10 months prior to the announcement of its transaction with AT&T, since when it has abandoned its criticisms of AT&T including those related to behavior it vigorously opposed earlier on the grounds of their discriminatory and anti-competitive nature.

<sup>13</sup> See Jackson, Donny, "Harris-AT&T Alliance Continues Partnership Trend," *Urgent Communications*, October 27, 2011, available at [http://urgentcomm.com/networks\\_and\\_systems/commentary/harris-att-continue-partner-trend-20111027/](http://urgentcomm.com/networks_and_systems/commentary/harris-att-continue-partner-trend-20111027/).



## RESEARCH TEAM

### **Alan Pearce, Ph.D.**

Dr. Pearce founded Information Age Economics, a Washington, DC research company, in 1979 after a senior-level public policy career at the Federal Communications Commission, the US Congress, and the Executive Office of the President. At the FCC he was one of the prime architects that helped lay the foundation of a new information era. During a five-year tenure in the Office of the Chairman, Pearce helped oversee the investigation of AT&T and Western Electric, et al., which eventually led to the breakup of the Bell System in 1984; the early policies that encouraged the convergence of computers and communications; the launching of domestic satellites to provide telecommunications-information-entertainment services; the beginning of public policies encouraging the development of cable TV; investigations into the business and profits of children's TV programming, and business relationships between the Hollywood movie and program production industry and the TV networks; the economic effects, if any, of the sports anti-blackout legislation on professional football basketball, baseball, and ice hockey; and wireless and spectrum policies that resulted in the creation of universally available services at affordable prices.

Since leaving the government, Dr. Pearce has provided professional services to telecommunications, wireless, satellite, cable TV, movie and program production companies, and radio and TV broadcasting corporations, along with software and equipment manufacturers. He has also consulted with a wide variety of government organizations at the international, federal, state, and local levels. A prolific writer and researcher, he has lectured on privatizations and appropriate regulatory structures, spectrum auctions, antitrust issues and actions, mergers and acquisitions, appraisals and valuations franchises and service rates throughout the world. Dr. Pearce has also served as a part-time faculty member in the business schools at the University of Southern California, the University of Maryland, and Georgetown University; the economics department of The George Washington University; the Master's Program at The New York Law School; and the Telecommunications Department at Indiana University.

Prior to coming to the United States, Dr. Pearce was both an undergraduate and graduate student at The London School of Economics and Political Science, University of London, leaving with a bachelor's and a master's degree, and has a doctorate in business and telecommunications from Indiana University.

### **Barry Goodstadt, Ph.D.**

Dr. Goodstadt is Principal and Founder of Telecom, Utility and Regulatory Consulting, LLC. and is a consultant with 25+ years experience in market analysis and evaluation of voice,

video and data services as well as other technologically based products and regulatory issues associated with these products and services. His experience includes work in telecommunications consulting, as a utility industry executive, as a market researcher and as an expert witness. He has served as a partner-level consultant at Arthur D. Little, Inc. and was a Principal Consultant with A.T. Kearney.

He has focused his attention on competition for video and broadband services among cable operators, satellite service providers, wired and wireless telephone companies. His work in the wireless space has included projects for U.S., Canadian and Middle Eastern operators. He has conducted research and analysis on wireless and broadband services, and related emerging technologies (including the Wireless Web, WiFi, and WiMAX offerings) as well as alternative broadband provisioning (including broadband over powerline or BPL). His work also includes analysis of Market research focused on the impact of a new cellular vocoder for existing customers on a US wireless network. He has also carried out a number of studies focused on adoption of wide area wireless data and wireless LAN technology by the public safety (i.e. police and fire agencies) sector.

Dr. Goodstadt has considerable skill in qualitative analysis and in statistical analysis. He frequently makes use of multivariate methods for modelling of complex buying decision processes including discrete choice methods and Bass forecasting models. He has extensive speaking experience and is a frequent speaker at industry conferences.

Dr. Goodstadt received his Ph.D. in Social/Organizational Psychology from Temple University.

### **Martyn Roetter, D.Phil.**

Dr. Roetter is a former Vice President at Arthur D. Little Inc., and has over 30 years of global consulting experience at a number of U.S. and Europe-based firms, as well as his own sole proprietorship, with business strategy, technology-related issues, and public policy. He has frequently dealt with the interactions between business, technology, and finance, as well as regulation, politics, and public policy. He has carried out strategy assessment and implementation work as well as project due diligence for network operators, service providers, components and equipment vendors, and their investors. His clients and their target geographies have ranged extensively across the Americas, Europe, Asia, and the Middle East and Africa. Most recently he has been concentrating on the economics, markets, and business plans of wireless communications operators, including techno-economic comparisons of new broadband wireless technologies such as WiMax, HSPA, EV-DO, and LTE, as well as, in the broader arena of ICT, next generation Web services and the implications of all-IP networks for fixed/mobile competition and convergence and related

regulatory issues. He has tackled a number of projects involving competitive and other business dynamics that reflect the changing shape of globalization, i.e. the “globalization of globalization”, in which the traditional economic powerhouses of North America, Western Europe, and Japan have been joined by major actors such as China, India, and Brazil, as well as financial investors from the Middle East.

He served as a non-executive member on the Board of Directors of Allen Telecom (leading global supplier of wireless subsystems) from 1998 until its acquisition by Andrew Corp. in 2003. He was educated in England, Germany, and the U.S., and holds a doctorate in physics from the University of Oxford. A U.S. citizen, he speaks English, French and German.