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Date: February 15, 2002

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Subject: FCC Technological Advisory Council II, Third Meeting Report

To: Members of the FCC TAC

Attached is Report: Third Meeting of FCC Technological Advisory Council II. The Chairman of the TAC has approved this report. The meeting was videotaped and that tape serves as the official minutes. This report, prepared to facilitate and document the ongoing work of TAC, contains an encapsulated version of the meeting and is being posted on the public web site.

Robert W. Lucky
Chairman
FCC TAC

Jules A. Bellisio
Executive Director
FCC TAC

Report: Third Meeting of FCC Technological Advisory Council II

0.0 Executive Overview

The Federal Communications Commission Technological Advisory Council held the third meeting of its second two-year cycle on Wednesday December 5, 2001 in Washington, D.C. (FCC TAC II, Meeting 3). As described in previous meeting reports, the Council is to provide scientifically supportable information on those emerging technologies likely to impact the work of the FCC. The Council has thirty-three members who were selected because of their professional and technical expertise, some of whom participated in the first TAC.

The TAC is organized into five working groups to address spectrum management, optical networking, consumer and home networking, access to telecommunications for the disabled, and network security. Groups worked between the meetings and expanded on each area during roundtable discussions at this meeting.

Spectrum management includes issues associated with the noise floor, software defined radios (SDRs), ultrawideband (UWB), and the proposal previously made by the TAC for the Intelligent Radio "Bill of Rights." The group has established a liaison with DARPA, the Defense Advanced Research Projects Agency, as both DARPA and the TAC are exploring new ways to improve the efficiency of spectrum utilization. DARPA's Next Generation Communications (XG) effort was reviewed. A TAC-commissioned study to characterize the noise environment continues apace. Assuming that many of the technological problems relative to spectral sharing and spectrum reuse can resolved, the group is working on those changes in management philosophy that might be proposed to make the idea a workable reality. Closely related to noise, interference and spectral reuse is the issue of the interference tolerance of existing and emerging systems. Future spectrum management that may make use of dynamic trading, sharing, and overlay will likely depend on the creation of a catalog of well-defined, logical, and enforceable rights and interference tolerance objectives that could be applied to end-to-end systems.

The *optical networking* group will review the status of industry standards on optical interconnects including those agreements needed to interconnect the optical networks of two or more providers. They will flag any issues that may be of concern to the Commission. The group will explore the main barriers to more widespread diffusion of all types of broadband access including fiber access. They will catalog best practices and economic incentives that might be used to aid local communities in modernizing requirements and permitting rules so as to remove barriers to rapid field installation. A survey of broadband deployment elsewhere in the world will look at operating practices and lessons learned. Using an awareness of the unique details of the environment in places like Korea, Canada, Japan, and Europe relative to the US, they will explore what is and is not working. An objective would be to discover those methods that we can adopt to accelerate our broadband deployment.

Interoperability and compatibility between residential systems and intelligent networked appliances are key concerns of the *consumer and home networks* group. A report from the Internet Home Alliance reviewed some of the trends in home technology that might be useful to the Commission. This work

specifically targets the issue of interoperability between the multiple networks that are emerging in the marketplace. Another interesting trend is the deployment of 802.11b wireless LAN access in high usage areas. The relationship between this type of "hot spot" networking and 3G (third generation) commercial wireless was discussed. There is the opportunity for unlicensed wireless LAN to either greatly enhance or in some cases even replace some of the projected 3G services, but much of this will depend on whether or not seamless interoperation as experienced by the user can be achieved. The group proposes to produce a white paper providing a roadmap through the consumer and home networking landscape, and discuss the impact on FCC priority areas.

Work on *access to telecommunications for the disabled* is to point out technical issues the FCC needs to be aware of in preparing the Commission for its actions. An important issue to be addressed is the preservation of features to help the disabled that have already been introduced but could be lost as new technology is substituted for old. Features and functionalities that need preservation or substitution as technology advances will identified and reported in engineering journals so that future technologies can be launched with accessibility built-in from the start.

Network security is understood to include issues of integrity, confidentiality of communications, and the technical enablers for the management of content rights. An overarching question that remains to be discussed and answered is whether or not this work should be continued within the TAC by virtue of being adequately covered by other groups sanctioned by the Commission. We will take care not to duplicate the work being done in the NRIC (Network Reliability and Interoperability Council).

The next formal TAC meeting is scheduled for Wednesday March 20, 2002.

Prepared by J. A. Bellisio

Approved by R.W. Lucky January 15, 2002

Report: Third Meeting of FCC Technological Advisory Council II

1.0 Introduction

As announced, the third meeting of the Federal Communications Commission Technological Advisory Council II (FCC TAC II, *or TAC*) took place on Wednesday December 5, 2001 at The Portals, 445 12th Street, SW., Washington, D.C. Designated Federal Officer (DFO) Mr. Julius Knapp, Deputy Chief, Office of Engineering and Technology, Federal Communications Commission, opened the meeting. The TAC is chartered for two years at a time, and this meeting was the third one of its second two year cycle. The mission and operating principles of the TAC were described in the Report of the First Meeting of the TAC (April 30, 1999), available on the FCC web site **http://www.fcc.gov/oet/tac/**. At this meeting, working groups presented findings developed since the last meeting and used them as a basis for the open discussion of items of interest to the Commission.

The general items for ongoing TAC consideration fall into five major areas, spectrum management, optical networking, access to telecommunications for the disabled, consumer and home networking, and network security. Each of these areas is explained in more detail in this report. It should be understood that the topic areas are intentionally broad and subsume all of the interest areas of the previous instantiation of the TAC. Working groups and chairs for each group have been active since the first meeting of TAC II addressing each of the five areas. Annex 5 lists the chairs of each group and TAC members who are participating.

This report is a reorganization and distillation of discussions at this third meeting of TAC II written to facilitate the ongoing work of the Council. A complete videotape of the meeting serves as the verbatim minutes (*see Annex 1*). This report reviews the presentations and remarks made at the open meeting and draws on some of the drafts prepared between meetings, but does not, per se, necessarily represent the final recommendations of the TAC as a whole.

The next formal TAC meeting is planned for Wednesday March 20, 2002. The dates of subsequent general meetings are: June 12, 2002, September18, 2002, and December 4, 2002.

2.0 Agenda as Announced

TECHNOLOGICAL ADVISORY COUNCIL II
Agenda –Third Meeting
Wednesday December 5, 2001
Federal Communications Commission Meeting Room
The Portals, 445 12th Street, SW
Washington, D.C.

10:00 AM- Opening	Julius Knapp, FCC Designated Federal Officer (DFO)
10:10- Introductions and Opening Remarks	Commission Representatives, Robert Lucky, Chairman, and TAC Members
10:30- DARPA Next Generation Communications Program	Paul Kolodzy
11:30- Discussion on Spectral Issues	TAC Members
12:00- 1:00PM	-Break-
1:00- The Internet Home Alliance	Tony Barra
1:20- 3G and Hot-Spot Networking	Dennis Roberson
1:40- Specifics of TAC Optical Networking Program	Stagg Newman
2:20- Access for the Disabled Awareness Documents	Larry Goldberg
2:40- General Discussion on Security Issues	TAC Members
3:00PM- Adjourn	Julius Knapp, DFO

3.0 Membership of the Technological Advisory Council TAC II

Member biographies can be found in Report: First Meeting of FCC Technological Advisory Council II, *Annex 2*. (**http://www.fcc.gov/oet/tac/**). Annex 2 of this report gives member e-mail information, and Annex 3 lists FCC staff contacts.

Except as indicated (*), all of the following were present at the TAC II first meeting:

TAC Chairperson:

Robert W. Lucky - Corporate Vice President, Applied Research, Telcordia Technologies

TAC Executive Director

Jules A. Bellisio - Principal Consultant, Telemediators, LLC. (Telcordia Representative)

Members of Council:

*Kwame A. Boakye - Vice-President, Technology, Harris Corporation

*Fred M. Briggs - Chief Technology Officer, WorldCom, Inc.

Susan E. Estrada - President and Founder, Aldea Communications, Inc.

*David J. Farber - Professor, University of Pennsylvania

*Bran Ferren - Co-Chairman and Chief Creative Officer, Applied Minds, Inc.

*Larry Goldberg - Director of the Media Access Group, WGBH

*Richard R. Green - President and CEO, CableLabs

Eric C. Haseltine - Executive Vice President of Research and Development, Inc., Walt Disney Imagineering

Dale N. Hatfield - Director of the Interdisciplinary Telecommunications Program, University of Colorado at Boulder

Christine Hemrick - Vice President, Strategic Technology Policy, Cisco Systems, Inc.

Dewayne L. Hendricks - Chief Executive Officer, Dandin Group, Inc.,

Charles L. Jackson - Independent Consultant

Kevin Kahn - Intel Fellow, Director, Communications Architecture

Kalle R. Kontson - Vice President, IIT Research Institute, Division Manager, Center for Electromagnetic Science

Gregory D. Lapin - Chair, ARRL RF Safety Committee

Paul F. Liao - Chief Technology Officer and President, Panasonic Technologies, Inc.

Wah L. Lim - Vice President, Corporate Technology and Ventures, Hughes Electronics Corporation

*Willie W. Lu - Principal Wireless Architect, Siemens-Infineon

*David C. Nagel - President and Chief Executive Officer, Platform Solutions Group, Palm, Inc.

Kevin J. Negus - Chief Technology Officer and Vice President of Business Development, Proxim, Inc

Stagg Newman - Senior Telecommunications Practice Expert, McKinsey and Company

*M. Niel Ransom - Chief Technology Officer, Alcatel USA

Dennis A. Roberson - Corporate Vice President and Chief Technology Officer, Motorola

*Andrew G. Setos - Executive Vice President, News Technology Group

Nitin J. Shah - Executive Vice President for Business Development and Strategy, ArrayComm, Inc

*Gerald Sharp - Vice President and Chief Technology Officer, ionex telecommunications

*Douglas C. Sicker - Director of Global Architecture, Level 3 Communications, Inc.

*Barry Singer - Senior Vice President, Philips Research, Managing Director, Philips Research USA

*Jessica Stevens – Chief Executive Officer, Telegen Corp.

Gregg C. Vanderheiden - Professor/Director, University of Wisconsin, Madison

*Robert M. Zitter - Senior Vice President, Technology Operations, Home Box Office

Designated Federal Officer

Julius Knapp - Deputy Chief, Office of Engineering and Technology.

****Not present at this meeting***.

About 40 members of the public were present at the meeting and comments from the public are reported as appropriate. The meeting was webcast, videotaped, and carried by closed circuit television throughout the Commission's offices. Live RealAudio access to the TAC meeting was made available through the FCC web site at: **http://www.fcc.gov/realaudio/** . It is expected that future TAC meetings will be available from this site.

4.0 Summary of Remarks by Representatives of the FCC

Commissioner Michael J. Copps, sworn in on May 31, 2001, introduced himself and indicated that he was quite pleased to find out that there were a number of advisory committees that businesses participated in. As Assistant Secretary of Commerce in the Clinton Administration, he became a strong believer in the kind of public sector-private sector partnership that is mirrored in these kinds of activities. Decisions in the fast-moving world of converging science, technology and applications, and now the issue of putting together a credible homeland defense, will really require making full use of a group like the TAC. While the FCC has some of the best engineers in the world, they can't keep up with everything by themselves and depend on the knowledge, expertise and judgment that the TAC can offer. Commissioner Copps remarked that the current group of Commissioners was very receptive to the work of the TAC he personally looked forward to working with all of the TAC members.

5.0 Topics of Interest to the Commission and for TAC Consideration

The TAC is focusing on five major subject areas, spectrum management, optical networking, access to telecommunications for the disabled, consumer and home networking, and network security. The spectrum group includes issues associated with the noise floor, software defined radios and ultrawideband - all topics considered by the last TAC group and the technological enablers that form the solution to the overarching problem of spectrum usage. Because optical networks demand broadband connections to final users to realize their full potential, the evolution of broadband access using *all* available technologies is under the umbrella of the optical group. The consumer networking group is looking at the total problem of interconnection everywhere (except for internodal networks) in the consumer domain, not just in the home. Network security is understood to include issues of integrity, confidentiality of telecommunications and the technical enablers for the management of content rights.

During the interim, working groups, with chairs, were formed for each of these five primary focus areas (Annex 5), and discussions held by the groups between the meetings were expanded upon by the entire TAC at this meeting.

6.0 Spectrum Management

Dewayne Hendricks, Chair of the spectrum management working group, has established a more formal liaison with DARPA, the Defense Advanced Research Projects Agency, as both DARPA and the TAC are involved with looking at new ways to improve the efficiency of spectrum utilization. Paul Kolodzy (pkolodzy@darpa.mil) of DARPA spoke about DARPA's Next Generation Communications (XG) effort. Paul spoke to the TAC previously on another of DARPA's programs. Part of the XG's program goal is to try to increase spectrum efficiency by a factor of 20. In addition to the synopsis of the next section, there is more information on the XG program at http://www.darpa.mil/ato/solicit.htm.

6.1 DARPA XG Program

An overarching military need to be addressed is the provision of assured communications for our forces anywhere in the world without fixed infrastructure and with "zero" setup time. This is a need that DARPA hopes to get both the commercial and aerospace market interested in in order to solve some of the critical technological problems. Although the problem (as stated - no infrastructure and zero setup time) is inherently different from the commercial situation, there are a host of capabilities that are likely to have commercial applications in the future. In particular, the technologies that vastly improve spectrum utilization will clearly have commercial impact.

Dr. Kolodzy described a number of emerging technologies of current interest to DARPA. Nano-mechanical array signal processing (NMASP) makes use of electromechanical components on a microscopic scale. These elements are so small that they can be made to change shape and vibrate at megahertz rates and beyond to the gigahertz region. They can be used for filters and microresonators. A key attribute for spectrally efficient software defined radios (SDRs) will be the frequency agility and compact size of preselect filters. NMASP may be the breakthrough technology for these critical components. DARPA tends toward extremely high-risk, high-payoff technologies. This is a three-year project so after about three years we should be able to understand if we can actually build these devices and how well they scale to mass production.

In building an intelligent radio, if one can actually accomplish front end preselect filtering with NMASP and the digital control of analog circuits, the next question becomes one power amplification. Frequency agility demands a power amplifier that operates efficiently over a wide range. Another DARPA supported initiative is experimenting with a new approach. Instead of trying to construct a power amplifier that can operate simultaneously over a very wide range, they are trying to rapidly tune the amplifier so that its effective operating range is quite large although its instantaneous bandwidth is quite narrow. The goal is to get a100:1 improvement in efficiency by demonstrating a new generation of highly adaptable analog r-f components with the ability to self-assess, self-tune, and optimize in real time, thus extending the performance of analog components to the intrinsic semiconductor device limits.

The high spectral utilization SDR will require an analog to digital converter, currently a very power hungry element especially for mobile systems. Research on antimonide-based compound semiconductors is targeted at building the low power, high speed a to d converter. In general, this technology may be ideal for future systems as they become more mobile, more complex, more demanding and require a large reduction in power-delay product, higher speed and a reasonable level of integration.

Moving from the device to the systems level, the Small Unit Operation Situational Awareness System (SUO SAS) takes mobile communications, cellular telephony in a sense, down to the combat field unit.

The military problem is different in that commercial wireless has a fixed infrastructure to build upon, and usually can depend upon good lines of sight with users. Unfortunately, military personnel don't like to have good lines of sight with each other, and also tend to go into environments where commercial-style cell phones are unlikely to work. In those environments frequency agility is something to really take advantage of. This program is looking at frequency agility at the individual warfighter level and how to actually build up the mobile ad-hoc networks on the fly without cell towers or network infrastructure. SUO SAS is frequency agile and simultaneously trades off power, bandwidth and data rate in making connections. Although low probability of enemy detection and antijam are military objectives, there are commercial flavors of these same base technologies which will eventually spin off.

Another SUO SAS concept is that of saving power by not having to transmit back to a central node to establish links. If ad-hoc, multihop, peer to peer communications can be achieved, considerable power can be saved. Researchers are trying to demonstrate that such networks can be stably configured at large scale and with transit latencies below 200 milliseconds. Massively parallel simulations of the protocols, all the way down through the physical layer are necessary to resolve these issues. Right now, there are nonmobile realizations of multihop mesh networks with a limited set of nodes.

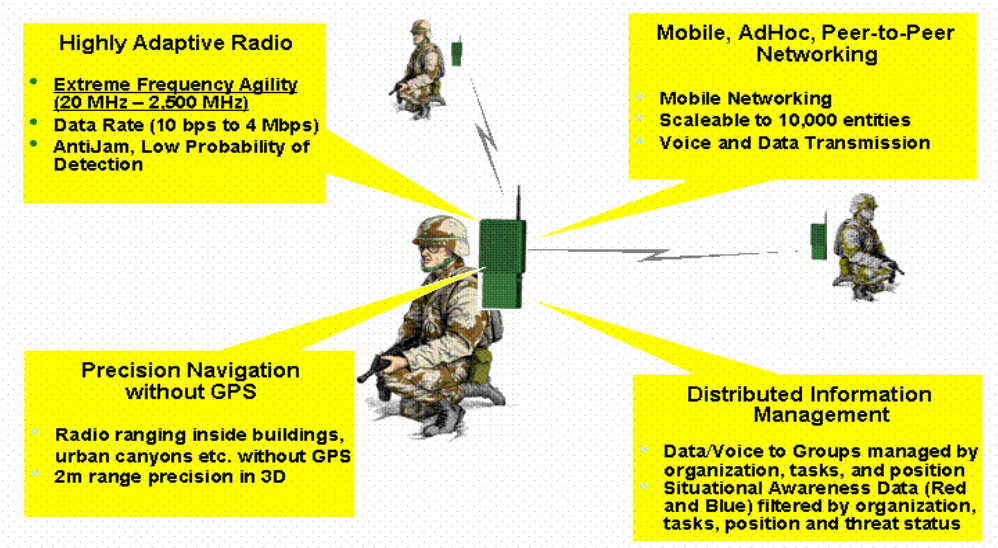


Figure 1: *SUO SAS Program Goals* *Source:* DARPA

As can be seen from Figure 1, the technologies being explored in the military context could easily have important commercial implications. There are many problems remaining to be solved, for instance, the amount of overhead and management information requiring interchange between nodes can become a serious limitation in many applications.

The big problem for the military as well as civilians is, of course, spectrum availability. The solution may rest with adaptive, opportunistic usage by intelligent SDRs, especially since the military has to be very flexible anyway in how it operates around the world. It is the multidimensional problem of finding temporarily unused spectrum and using it efficiently. Part of the XG program is to look at the potential of taking measurements to find out how big the unused holes are in space, time and frequency, but this will not be the definitive study. DARPA will need to coordinate with others like the FCC and the TAC. Ultimately, if this work is successful, we can consider migrating to the kind of "policy-based" spectral management which has been discussed in the TAC. Operating policies and changes would come from

a policy server, either centralized or distributed. It will be possible to create adaptable, geographically-distributed, noninterfering, ad-hoc networks that can actually take advantage of the holes in the spectrum. If we had one common allocation policy across the world, that would make the job considerably easier, nevertheless, the policies in each country are generally known so one could preload local data to avoid searching through areas that are known to be unavailable. All of these ideas are being pursued in currently funded research programs. The mobile ad-hoc networking problem is an especially hard problem since many nodes may be hidden from a prospective transmit location. Figure 2 shows how an ad-hoc network might be formed.

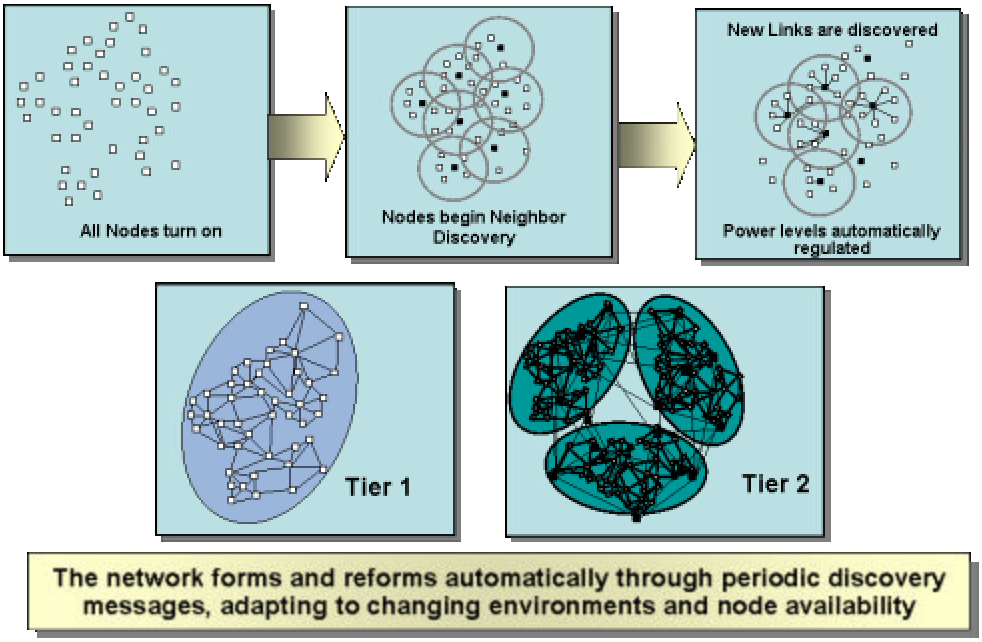


Figure 2: *Hierarchical Network Formation* *Source:* DARPA

6.2 Discussion on Spectral Usage

A very useful path forward for the spectrum working group would be to first assume that much of the technological work as described above will be successful, then outline some of the options for changes in the overall regulatory strategy that would be required to make spectrally efficient devices based on this technology actually work in the environment managed by the Commission. As the TAC moves to its second year of this term, the TAC could start by constructing and working through some thought experiments. Such thought experiments should be also validated with experimentation. One of the things that Dewayne Hendricks has tried to do in his own work is to set up (albeit mostly in other parts of the world) radio regulatory "havens" to test some of the concepts. For the commercial sector, a solution to the fixed-point problem should come before the problem is expanded to include mobility.

The thought experiments should definitely also include the unlicensed bands. Some of the emerging notions on sharing could be very applicable in reducing some of the chaos that may be developing, even though many of the issues are quite different between the licensed and unlicensed worlds.

There is a general agreement that one primary key to solving the spectral utilization problem will be to make use of the apparently unused holes in frequency, time, and space. But a critical question remains: When is a hole really a hole? Is it possible to promulgate a set of rules, a *Bill of Rights*, that will allow users to autonomously make this decision? Many issues come to mind. Moving into apparently unused spectral territory removes the opportunity for someone else to do the same, so in a sense cost is transferred to someone else. This is especially a problem when that spectral territory is ostensibly in the hands of an auction winner. It would appear as though *voluntary* sharing with users trading spectrum on a businesslike basis would have the best chance of early success. The TAC should look at the kinds of operating rules that would be needed to make a system like this work.

Closely related to the reuse issue are the rights and responsibilities of spectral incumbents. Right now, when an operator obtains a license there is some ambiguity as to the level of noise and interference that the licensee should be prepared to tolerate. Obviously, the licensee's system must work in the presence of the natural background noise and be resistant to the existing level of unintentional interference, but what about the future? Is it reasonable for a licensee to expect that all others have an unending obligation to not intrude on their spectral territory in any way? Maybe, when the Commission grants a license, there should be a clear understanding as to the level of interference that the licensee must be able to tolerate as part of the agreement. If engineers had a long term projection of the working environment, they could design for it. Under current practice, there is a strong motivation to design for lowest cost or maximum capacity assuming current conditions. Depending on the point of view, this results in either "optimum engineering" or "fragile, marginal system design." As radio design becomes more sophisticated and every fragment of performance is squeezed out, the problem of interference intolerance can actually get worse. A good project for the spectrum group would be to explore the issue of how to more completely define responsibilities when one is granted a license so that while rights are protected everyone else's future options are not foreclosed.

6.3 Spectrum Management – Going Forward

The noise study work as described in previous reports continues apace and we expect deliverables to be reported at the next meetings. Annex 4 lists the project team. Assuming that many of the technological problems can be worked out, the group should try to work through some of the scenarios that could make the whole idea of spectral sharing and reuse work. Closely related to both noise/interference and spectral reuse is the issue of interference tolerance requirements for systems. A job for the spectrum committee to would be to outline some spectrum management alternatives for the future based on the new technologies. A catalog of well-defined, logical, and enforceable rights and interference tolerances could be created.

7.0 Consumer and Home Networking

Paul Liao, chair of the consumer and home networking group, introduced Tony Barra

(tbarra@twmi.rr.com) who will be the next President of the Internet Home Alliance. The Alliance commissioned a consulting firm to do a landscape of the trends in home technology and Mr. Barra reviewed some of the findings that might be useful to the Commission. This work specifically targets the issue of interoperability between the multiple networks that are emerging in the marketplace. Another interesting trend is the deployment of 802.11b wireless LAN access in high usage areas. Dennis Roberson discussed this type of "hot spot" networking and its relationship to 3G (third generation) commercial wireless.

The penetration of consumer and home network technologies are a key part of what Chairman Powell has termed the "Great Digital Broadband Migration." As he explained in his speech of December 8, 2000, this migration is driven by technologies that are "radically altering economic assumptions and underlying cost structures. It is changing the game of capital formation and altering business models." He further stated that the FCC needs "to go to school to learn the technological underpinnings that affect policy [and obtain a] greater understanding of innovation theory and economic incentives." Julius Knapp has specifically requested that the consumer and home networking working group help the FCC understand the evolution of these technologies (i.e., a roadmap) and how these technologies contribute to satisfying our nation's long term expectation for products and networks that provide communications, entertainment, work productivity, life environment, and homeland security services.

Most recently, the Chairman has provided a listing of the FCC's top priority areas and objectives. These areas and simplified statement of the objectives are:
(1) Broadband Deployment,

- Assure consumer has choice of multiple platforms
- Universal service (ubiquity and affordability)
- Minimize regulations with recognition that current definitions/classifications/labels of services are no longer valid

(2) Competition Policy,
- Set as the ultimate objective facilities based competition
- Assure consumer has choice of multiple platforms
- Simplify interconnection rules
- Universal service (ubiquity and affordability)

(3) Spectrum Allocation Policy,
- Market-oriented allocation policy
- Interference protection
- Spectral efficiency
- Reserve and protect spectrum for public safety

(4) Re-examination of the Foundations of Media Regulation,
- Ensure traditional goals of diversity, competition, and localism are met

(5) Homeland Security
- Secure the Nation's communications infrastructure
- Enhance emergency response through communications

Each of these five priority areas will potentially be impacted by consumer and home network technologies and are reflected in the objectives for the working group.

7.1 The Internet Home Alliance

The Internet Home Alliance consists of over 30 organizational members and is made up of consumer product manufactures, retailers and other interested parties such as Panasonic, Sears, and General Motors. The alliance is looking to foster and develop the mobile "Internet lifestyle" from the person, to the connected home, and into the car. One of the road blocks to be addressed for this industry is insufficient collaboration along the value chain. The alliance also promotes some significant pilot programs that allow companies to get together and test some real solutions with new products. Part of also the attraction of the alliance is the pooling and leveraging of resources, increasingly important in these economic times. The alliance arranges financial and marketing support to encourage member companies to lead pilots.

A pilot on energy management has been recently completed and there has also been one constructed around structured wiring. These pilots are meant to support the main deliverables of the organization. These deliverables include guidance on the key factors to be considered in selecting alternatives for consumer use, projections on technology evolution, and, most importantly, a framework for predicting device-to-device compatibility and interoperability. Driving the interoperability challenge is the evolving proliferation of different network types including power line, 802.11b, Bluetooth, 3G, HomeRF, FireWire (IEEE 1394), and even just 2.4GHz streaming video. Figure 3 graphically illustrates the interoperability problem.

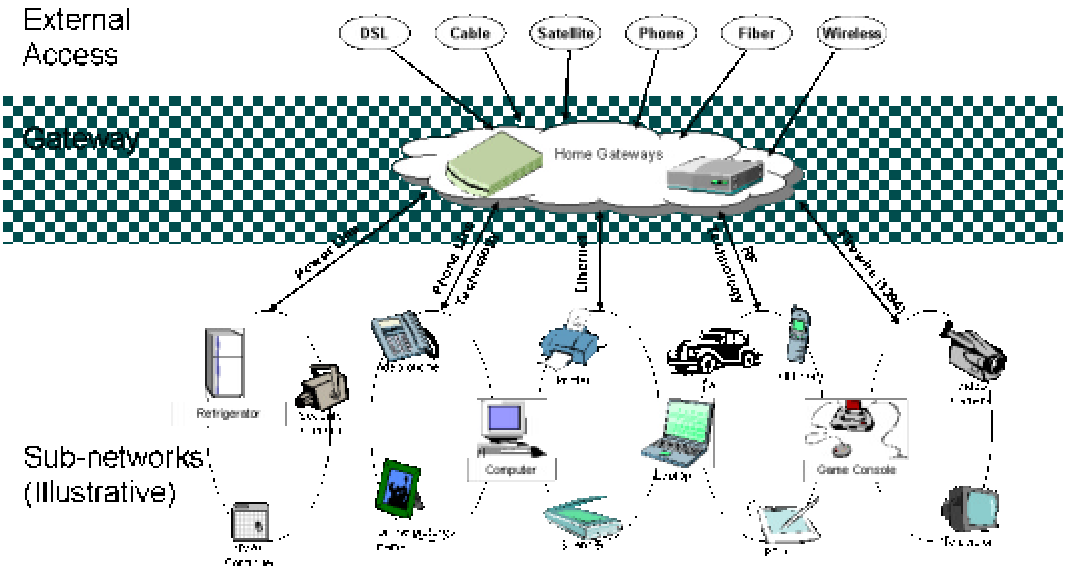


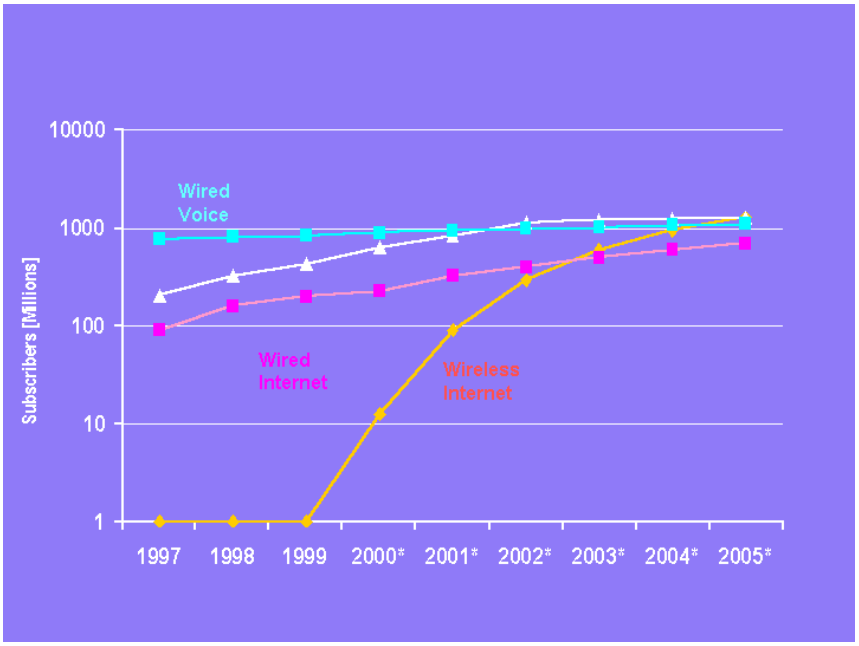
Figure 3: *Proliferation of Networks Around the Home* ***Source:*** T. Barra

In an attempt to bring some rationalization to the compatibility problem, the Alliance is developing an interoperability framework. What is required is a common definition of interoperability and an assessment of the ability for two specific devices to interoperate. Following conventional engineering practice, the conceptual model is layered into a transfer level with the physical ability to send and retrieve data, an information interchange layer with the ability to send and receive data in addressable, reliable and modular packets, and a functional interaction layer with the ability to send and receive data in a recognizable format and means to act upon it in a standardized way.

The Alliance is not a standards group but more like an industry forum thinking about issues from a consumer perspective. Forums typically interface to different standards bodies as appropriate. The Alliance tries to provide a level playing field for a diverse set of members, not all of which may have the same level of sophistication relative to the driving issues. There are currently several missing pieces with regards to the interaction with other groups. There needs to be more participation with network service providers, cable companies, and the cellular providers. Another important missing piece is representation by the content holders.

7.2 Hot Spot Networking and 3G

Dennis Roberson showed Figure 4 which supports the widespread notion that wireless access will eventually predominate. The white line in the figure is today's wireless voice. The top most line of the figure, the wired telephone system that we're all familiar with, converges with it just about now, and will, in fact, going forward exceed the wired world in terms of number of subscribers.



Estimate

Figure 4: *Wireless Takes Over* ***Source:*** Motorola

This trend combined with Internet growth leads one to believe that the combination will take over the world – at least technologically. What is more surprising, it is projected that the *number* of wireless connections to the Internet, not considering bit rate, will exceed the number of wired connections by 2003.

Figure 5 shows the progression in performance and capabilities of the global, licensed, wireless industry as we move to 3G, the third generation.

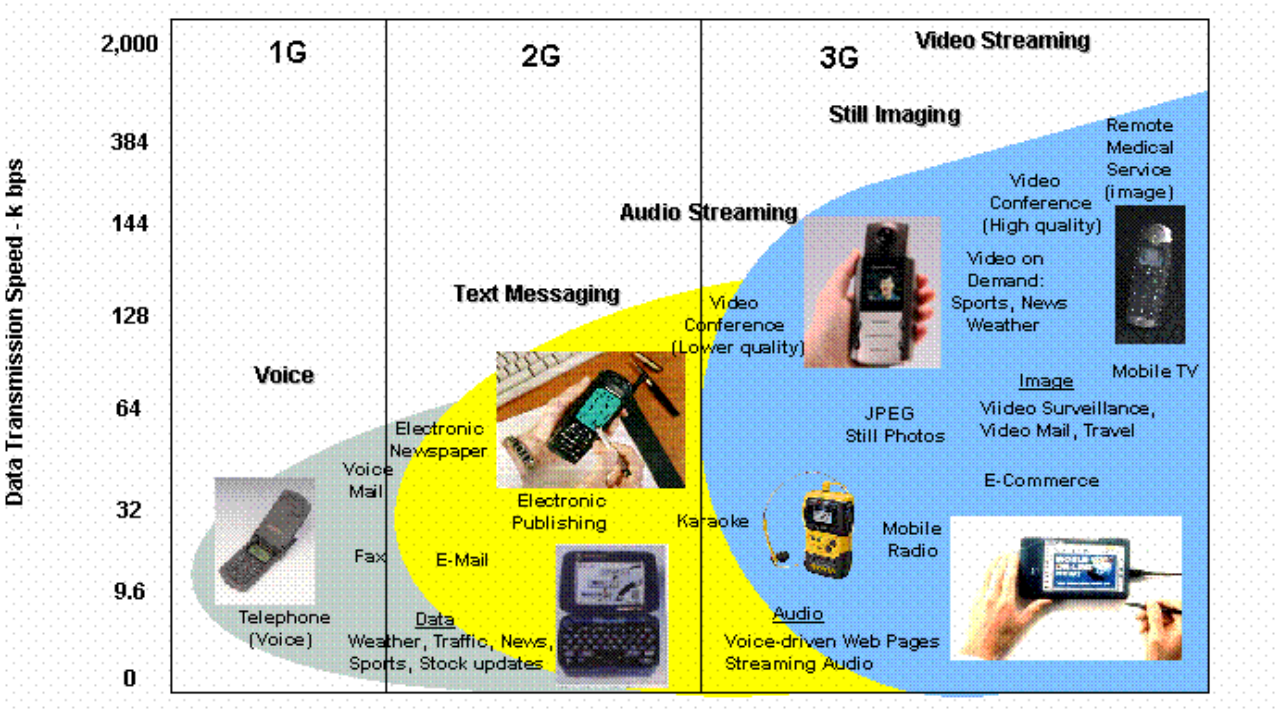


Figure 5*: The Promise of 3G* ***Source:*** Motorola

From a spectral efficiency standpoint, a lot of the technologies as they proceed forward do have enhancements in the number of bits per Hz, critical to the proper utilization of the spectrum. From a deployment standpoint, what we have seen around the third generation (as we moved from the success of I-mode and auctions UK) was euphoria at the start of 2000 and depression at by end of 2000. By the time we got to Germany and the later auctions, we were no longer sure that this was such a good thing. There are a lot of questions over the 3G notion, and there are even people like Nicholas Negoponte, a board member of Motorola, who is saying that 3G was ill conceived and flawed from its inception. Not everyone is prepared to go this far, but it is true that there have been a lot of difficulties with the third generation.

At the same time that licensed 3G is promising to cover all wireless applications, inroads into the same territory are being made by several key WLAN / PAN (Personal Area Network) Radio Technologies. See figure 6. All of these technologies belong to the unlicensed world, and 802.11b has seen an especially high level of acceptance.

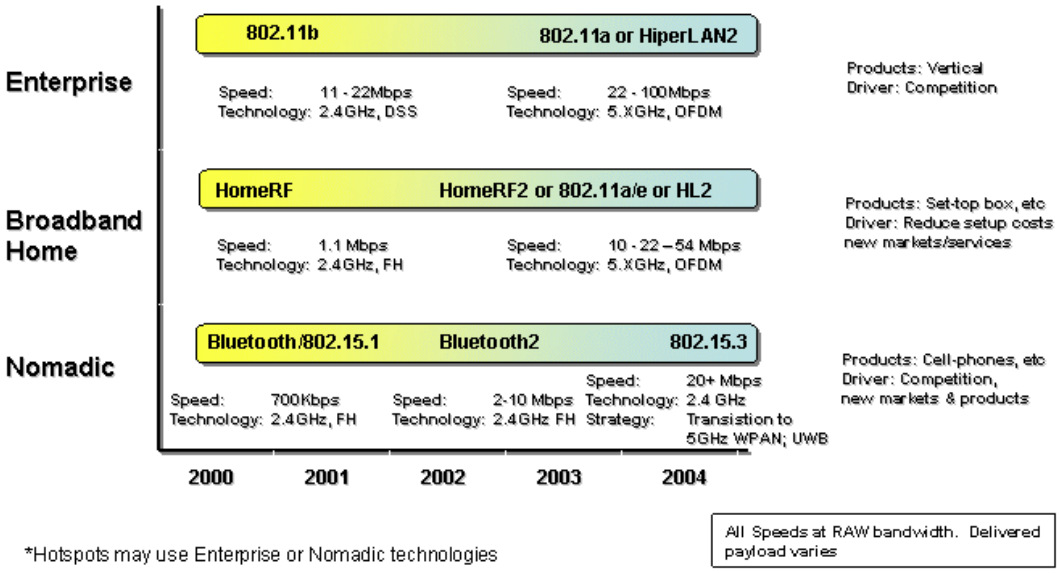


Figure 6: ***Key WLAN / PAN Radio Technologies*** ***Source:*** Motorola

This brings us directly to the notion of hot spots, because even with what we've looked at in terms of 3G, it will be a goodly number of years before one can reliably get to the data rates needed everywhere. But there are opportunities that come from that problem, everywhere from the enterprise level to the home level to the nomadic level. Figure 7 shows how one might synergistically utilize both unlicensed WLAN and cellular technologies.

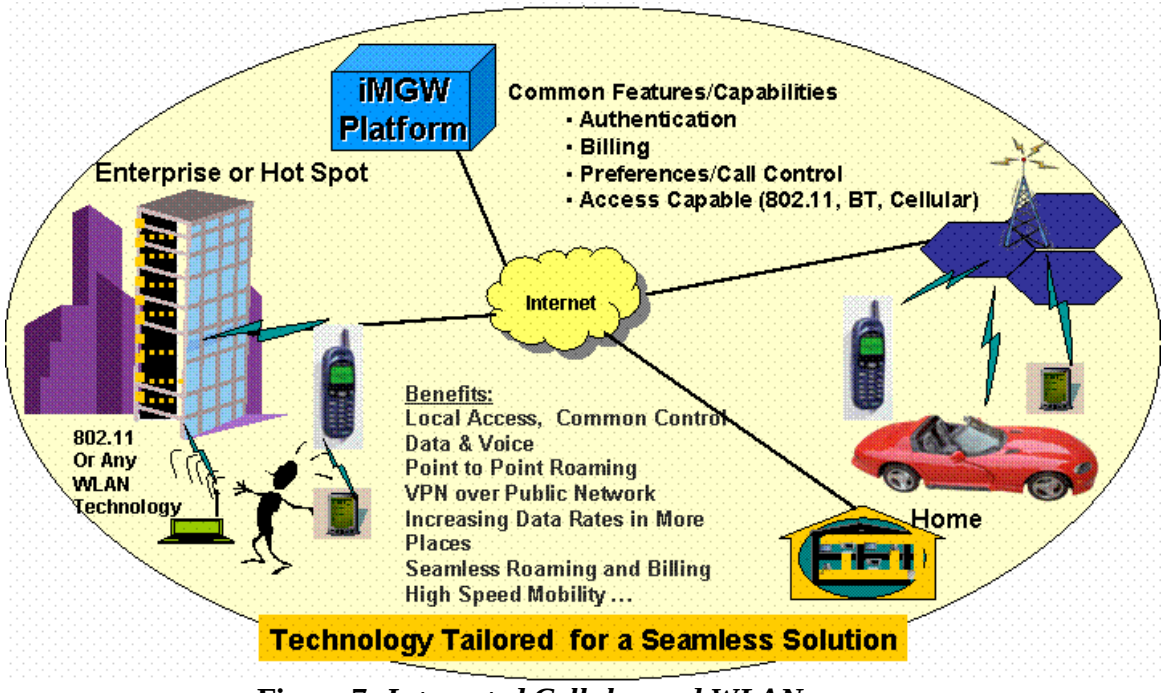


Figure 7*: Integrated Cellular and WLAN* ***Source:*** Motorola

We could imagine hot spots such as Reagan airport, the Pentagon, or the FCC, that might be covered by 802.11b at high bandwidth. In the broader Washington area we could have a 2.5G GPRS overlay to provide reasonably good data performance with the ability to connect to standard cellular service. There would be complete coverage optimized to the environment. At a campus location, the ability to have various levels of performance and costs will result with the same concept of wireless Internet within high usage areas, then going on out to lower performance as one moves further from the center. So the point of all this is that we have the opportunity with wireless LAN either to enhance or in some cases even replace some of the 3G services.

One of the biggest challenges for wireless service providers is to capitalize on this opportunity without having it interpreted as an unmitigated threat to their plans. If one can cover a local area effectively with WLAN, there is a much better overall utilization of the spectrum. While this may be a slightly cheaper way to deliver data, it is fundamentally a much more efficient way in terms of the social use of spectrum. The challenge is to create a business model that not only leverages both technologies, but also gives the industry the benefit of the kind of rapid introduction of innovation that characterizes unlicensed entrepreneurs. One of the reasons that the hot spots have become so exciting is because they developed in the arena of unlicensed spectrum. The innovation and cost reduction that has occurred as a result have made this whole idea very attractive.

Because of the backhaul costs that are associated with WLANS at public hot spots, the economics turn out to be more complex than one might imagine from a simple analysis. The marketplace needs to be given the freedom to try several of different working models. If artificial barriers are placed between groups who might own or deploy different technologies which logically should reinforce each other, the issues of system optimization roaming can become prohibitively complicated. Historically, licensed and unlicensed were independent themes but now there are certainly reasons for convergence.

7.3 Consumer and Home Networking – Going Forward

(1) The group proposes to produce a white paper providing a roadmap through the consumer and home network landscape, and discuss the impact on the five FCC priority areas.
(2) The group expects to prepare presentations on specific issues including:

- Hot spot networking (802.11b as an alternative or complement to 3G)
- Update on threats to the reliability and security of consumer and home networks
- Copyright protection issues associated with home networking
- Open standards consumer appliances with network interfaces
- Impact of consumer and home networking on unlicensed spectrum bands

8.0 Optical Networking

Stagg Newman gave a short review of the major directions of the optical networking group. A first deliverable is proposed to be a road map on optical interconnects, that is, a review of those agreements needed to interconnect the optical networks two different providers. It appears as though much of the technology road map has already been done in various standards bodies. The group will put together a short paper that reviews the standards for optical network interconnect and flags any issues that we think may be of concern to the Commission. Now that Jeff Goldthorpe has joined the FCC, he has agreed to be a "client" for this work to ensure that the true concerns of the FCC are

being addressed.

The second group area and road map is broadband access including fiber access. We will explore the main barriers to more widespread fiber diffusion. Some barriers are regulatory such as local permitting and construction issues. We could catalog “best practices” and economic drivers that might be used to aid communities in modernizing street usage requirements so as to remove barriers. There are also barriers to other access technologies such as fixed wireless and DSL which could also be address in these road maps.

The last area for a road map, something Chairman Powell and the Commission have expressed particular interest in, is a survey of broadband deployment elsewhere in the world. It will look at best practices, worst practices, and lessons learned. We will have to have a detailed understand of the environment and what is unique relative to the US in places like Korea, Canada, Japan, and Europe. We should explore what is working, what is not working, the different models, and those methods that we can adopt to accelerate our broadband deployment. There are technologies for installing fiber in Europe that aren't permitted in most local localities in the US, for example, shallow slot trench insertion in streets.

A real concern is that the US is evolving into a fiber-have and fiber have-not business world. The businesses that are on the fiber network are going to get all the advantages of Ethernet technology. Less than 5% of our businesses are on the fiber network today. Some economic analyses show businesses could justify extending this to only about 10 or 11% fiber with today's installation technologies, producing a tremendous split in the business community. Business should be the first driver for pulling in more bandwidth.

Some people are very passionate about how Canada with their Canarie (http://canarie.ca/hub/hub.html) system and different regulatory model has apparently leapfrogged us. It is something we should take an objective look at. Some people are devout believers and then other people reject the concept completely. It seems very hard to get an objective view in the middle. What are the lessons here for the US infrastructure? Has this really succeeded, and where are the barriers to doing this in the US? It would be very enlightening to have a Canarie proponent speak to the TAC.

8.0 Access to Telecommunications by Persons with Disabilities

Gregg Vanderheiden presented a report from the telecommunications by persons with disabilities working group. We are all aware of the outstanding progress that has been made in computing and microelectronics. Following Moore's law, and if we can crack the software complexity problem, what we will be able to do with intelligent systems to aid persons with disabilities will be truly remarkable. Figure 8 speculates on some of these possibilities.

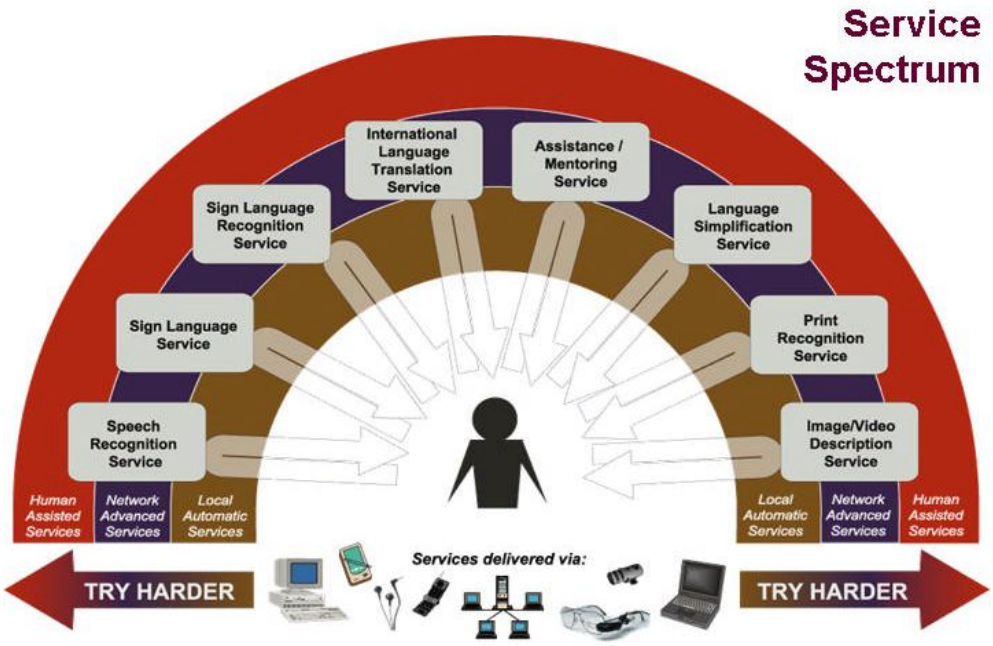


Figure 8:*Personal Services on Demand* ***Source:*** G. Vanderheiden

We can envision sign language conversion, sign recognition, international language translation, and the ability to have information described to you that you don't understand or can't quite see. We have potential to add devices also that are so inexpensive that they can be within the reach of everyone regardless of their economic status. Basically, being able to accommodate a very wide range of abilities and disabilities will be just a matter of installing the appropriate software. We will not be talking about phone calls, but will be having teleconversations, if you will. They could be visual, auditory, or text, with all three always available everywhere so people can communicate in whichever medium just works best for them. We're almost getting there just not because we care about people with disabilities, but because all people find convenient the availability of text chat, instant messaging, and message-waiting vibrators that originally were introduced to help the disabled but are now used by everyone.

Unfortunately, unlike the phone system, where we don't allow there to be phone systems that don't connect to other phone systems, we do have text messaging systems which are set up so that they don't connect to other text messaging systems. This is one of the things that we need to be looking at.

Also, we need to make sure that as we go from the old to the new we don't forget many of the features that were embedded at great effort in the old systems to aid the disabled. What will it take and who is responsible for making sure that we have the proper backwards compatibility to the old technologies to be sure that things keep working in a logical way?

There is one additional challenge. We have information and telecommunications separated. As an example, if someone calls a company and has a conversation with a person, we consider that part of telecommunications and it should have features to be accessible to the disabled. If the next day that customer contact person is replaced with a computer that is indistinguishable from a human being, suddenly the company no longer has to provide any type of accessibility because that's now an information service. Clearly we have a problem here.

9.0 Robustness, Reliability, Integrity and Security of the Network

There was no report from this group at the meeting. An overarching question that remains to be discussed and answered is whether or not this work should be continued within the TAC by virtue of being adequately covered by other groups sanctioned by the Commission. We should take care not to duplicate the work being done in the NRIC (Network Reliability and Interoperability Council). TAC will have to monitor and have liaison to the FCC NRIC to determine what the future of this TAC group should be.

10.0 Procedure for Technical Work

The preparation of technology roadmaps may generically be one of the most valuable types of deliverables for the Commission. Maps are not necessarily focused on particular problems, but paint a picture of much of what's happening in a particular area technologically. Maps could be documents outlining where we see technology going and what issues might arise. They could be a logical output for one or more of the working groups.

At the third meeting, each group outlined a broad picture of work that might be done. The next step for each group will be to refine and prioritize work into a manageable work plan, and propose specific deliverables with an achievable time line. Our experience has been that we can only attack a few problems with the sort of detail required.

Annex 1: Official Meeting Minutes

A VHS videotape of the Wednesday December 5, 2001 meeting serves as the set of comprehensive minutes of that meeting and represents the official archive. Copies of the meeting tape can be obtained from the Commission's contracted copier, In Focus. They may be reached by phone at: +1 (703) 843 - 0100 *ext*. 2278.

This report is a reorganization and distillation of discussions at the public TAC meeting and includes some supporting information produced between meetings. It is written for the purpose of facilitating the ongoing work of the Council and as an informal summary for those who may be interested. It is *not* the minutes.

Annex 2: Addresses of Current TAC Members

Name	E-Mail Address
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Vanderheiden, Gregg	GV@trace.wisc.edu
Zitter, Robert M.	robert.zitter@hbo.com

Annex 3: FCC staff

FCC staff available to address questions from the TAC:

General Issues:

Kent Nilsson: Special Counsel and Deputy Chief, Network Technology Division
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KNILSSON@fcc.gov
Phone 202-418-0845

With respect to specific Federal Advisory Committee Act (FACA) questions, a resident expert is FCC attorney:

Paula Silberthau: Attorney, Office of General Counsel
PSILBERT@fcc.gov
Phone 202-418-1874

Additional FACA information is at the Office of Government Policy web page at:

http://www.policyworks.gov

FCC staff associated with the TAC are:

Jeffrey Goldthorpe, Chief, Network Technology Division, Office of Engineering and Technology (Jeff is the new TAC Designated Federal Officer)
JGOLDTHORP@fcc.gov

Julius Knapp, Deputy Chief, Office of Engineering and Technology,
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Bruce Franca, Acting Chief, Office of Engineering and Technology,
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Peter Tenhula, Senior Legal Advisor, Office of Chairman Michael Powell,
PTENHULA@fcc.gov

Annex 4: FCC TAC Noise and Interference study

The project team for the FCC TAC Noise and Interference study is as follows:

Prof. Richard Adler, U.S. Naval Postgraduate School, Monterey, CA rwa@attglobal.net
Mr. George Hagn, Hagn Associates Ltd., Annandale, VA ghagn@erols.com
Mr. George Munsch, Munsch Engineering, San Antonio, TX munsch@attglobal.net
Mr. Ray Vincent, Consultant, Davis, CA wrvincent@urcad.org

Annex 5: Working Groups

Current list of working group membership. Note that the Executive Director is always a member of all committees**.**

Spectrum Management/ SDR/ Noise Study:
Hendricks, Dewayne, CHAIR
Bellisio, Jules
Boakye, Kwame
Farber, David
Ferren, Bran
Hatfield, Dale
Hemrick, Christine
Jackson, Chuck
Kontson, Kalle
Lapin, Gregory
Lu, Willie
Negus, Kevin
Newman, Stagg
Roberson, Dennis
Setos, Andrew
Shah, Nitin
Singer, Barry
Stevens, Jessica

Optical Network Issues:
Newman, Stagg, CHAIR
Bellisio, Jules
Boakye, Kwame
Briggs, Fred M.
Estrada, Susan E.
Farber, David
Hemrick, Christine
Kahn, Kevin C.
Lucky, Robert W.
Ransom, Niel
Sharp, Gerald
Sicker, Douglas
Stevens, Jessica

Network Security, Integrity and Reliability:
(Chair, Vacant)
Bellisio, Jules
Briggs**,** Fred M
Farber, David
Hemrick, Christine
Roberson, Dennis
Setos, Andrew
Zitter, Robert M.

Consumer and Home Networks:
Liao, Paul, CHAIR
Bellisio, Jules
Green, Richard
Haseltine, Eric
Jackson, Chuck
Lapin, Gregory
Lim, Wah
Negus, Kevin
Roberson, Dennis
Setos, Andrew
Shah, Nitin
Sharp, Gerald
Singer, Barry
Stevens, Jessica
Vanderheiden, Gregg
Zitter, Robert M.

Access to Telecommunications by the Disabled:
Goldberg, Larry, CHAIR
Bellisio, Jules
Liao, Paul
Sicker, Douglas
Vanderheiden, Gregg