# Report: Seventh Meeting of FCC Technological Advisory Council II

## 0.0 Executive Overview

The Federal Communications Commission Technological Advisory Council held the seventh and last meeting of its second two-year cycle on Wednesday December 4,2002 in Washington, D.C. (FCC TAC II, Meeting 7). 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-two members who were selected because of their professional and technical expertise, some of whom participated in the first TAC.

In reviewing the effectiveness of the TAC, we heard from Commission representatives that the TAC is viewed as having fulfilled its original charge and as a consequence is expected to be rechartered for another two year term. A new charter, already drafted and approved by the Commission, is now being processed through the various agencies that need to sign off on it. The basic underlying theme – "headlights" to help keep the Commission aware and abreast of new technologies – will continue but procedures will be improved. For TAC III, it is planned to have the Commission and the Council jointly define specific and different topic areas to target for each quarterly meeting. Using a symposium format, outside speakers will present on that subject for the day for the meeting. There will be time during the meeting to have a dialogue of the type we have become familiar with between the members of the TAC, an exercise which has apparently proven to be quite valuable.

The TAC *spectrum management group* works on issues associated with the noise floor, software defined radios (SDRs), and ultrawideband (UWB). A notion which has been discussed and has gained strong TAC support is that the most promising key to improved spectrum availability is a modernized spectrum management scheme capitalizing on intelligent devices and spectral reuse. There were four related talks at the meeting which directly concerned spectrum efficiency and spectrum policy. We heard that low-cost software defined radios (SDRs) were on the verge of wide availability, and that these peripherals for computers could be programmed to emulate a wide variety of radios using free and open software. With the anxiously anticipated flexibility of the SDR will also come the specter of difficult to regulate uncontrolled use. It may be necessary to address the issue of the rights and responsibilities of the SDR vendor and owner sooner than we expected. Closely related to this concept is the idea of the intelligent radio "Bill of Rights" proposed at the TAC some time ago. An update on progress in exploring this model indicates that it would be useful to attract economists and social scientists to help in developing more of the underlying philosophy.

Co-chairs of the Spectrum Policy Task Force, formed to assist the Commission in identifying and evaluating beneficial changes in spectrum policy, gave a readout to the TAC. The task force has proposed a new concept, "interference temperature," as a means of managing and avoiding interference. The group also addressed many of the same wider issues relative to spectral management that the TAC has been interested in.

To shed some light on the question as to whether or not there was anything in Part 15 rules that

was inhibiting to innovation, TAC members responded to a questionnaire on this topic. There seems to be a preponderance of sentiment that Part 15 is *not* generally a major obstacle to innovation.

Digital rights management issues are a concern of the *consumer and home networking group* in considering the balance between consumer's rights, the rights of the content owners, and the rights of the electronic device makers. If rights problems are not adequately resolved, this issue can be a show-stopper, literally in this case, for both home network and broadband deployment. From a regulatory standpoint, it is important to understand the capabilities and implications of various new rights management technologies. An update on fingerprinting and watermarking indicates that significant progress has been made in developing techniques to account for royalties and to *track and identify* usage violators although complete *prevention* of unauthorized use may be impossible to achieve.

The Commission is interested in the viability/nonviability of intermodal facilities-based broadband competition for the mass market. The *optical networking group* has collected a fact base concerning the technical feasibility, the economics, and the geographic availability of various forms of broadband access both for today's services and for the future. A comprehensive set of reports complete with supporting information now available on the TAC website. The bottom line relative to whether there really is viable competition across modalities seems to be that for Internet access it does exist between DSL and cable modem for the places that are DSL addressable. Also, for video programming services, there is widespread cable vs. satellite competition, but in both cases it is just a duopoly. Beyond that, several technologies, particularly wireless and power line communication, have the *potential* for competition in the future but with no assurance that competition will ever develop.

The FCC was given the task of creating, maintaining, and enforcing regulations to ensure accessibility to telecommunications services by persons with disabilities. The *access to telecommunications for the disabled group* has been addressing the problem of technology evolution and accessibility. People with disabilities use special "assistive technologies" (AT) in order to access and use telecommunication technologies. The ATs couple to standard telecommunication technologies in various ways, but evolution may cause these connection methods to disappear or fail to work. Designs often don't take the AT into account resulting in new technologies that will not work with existing AT. With rapidly advancing technologies the Commission's duties are likely to get more complicated. In advancing the FCC's accessibility charge, we need to consider which evolving technologies are most likely to create new barriers that the FCC will be asked to address. At the same time, it would be smart to take advantage of new technologies to simplify required regulations, and also to foster new technologies that might even reduce the need for regulations. It would generally be best if disability access could be achieved using mainstream technologies especially in places where access currently requires AT.

Prepared by J. A. Bellisio
Approved by R.W. Lucky January 24, 2003

# Report: Seventh Meeting of FCC Technological Advisory Council II

## 1.0 Introduction

As announced, the seventh meeting of the Federal Communications Commission Technological Advisory Council II (FCC TAC II, *or TAC*) took place on Wednesday December 4, 2002 at The Portals, 445 12th Street SW., Washington, D.C. Designated Federal Officer (DFO) Mr. Jeffery Goldthorp, Chief of the Network Technology Division, Federal Communications Commission, opened the meeting. The TAC is chartered for two years at a time, and this meeting was the seventh (and last) one of its second two year cycle. 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 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 at http://www.fcc.gov/oet/tac/report990430.doc.

The general items for ongoing TAC consideration, as requested by the Commission, fall into several 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 of four groups have been active since the first meeting of TAC II addressing the main topics of interest to the Commission. *Annex 4* lists the chairs of each group and TAC members who are participating.

This report is a reorganization and distillation of discussions at this seventh 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.

It is anticipated that the Commission will recharter the TAC for another two year period and that there will be four meetings per year. It is likely that the first meeting of TAC III will be in March or April of 2003, however, at the time of this writing no specific plans have been announced.

**2.0 Agenda as Announced**

# TECHNOLOGICAL ADVISORY COUNCIL II

Agenda–Seventh Meeting
Wednesday December 4, 2002
Federal Communications Commission Meeting Room
The Portals, 445 12th Street, SW
Washington, D.C.

| | |
|---|---|
| ***10:00 AM*- Opening** | **Jeffery Goldthorp, DFO (FCC Designated Federal Officer)** |
| ***10:01*- Introductions and Opening Remarks** | **Commission Representatives, Robert Lucky, Chairman, and TAC Members** |
| ***10:05*- Rechartering of the TAC** | **Edmond Thomas and Jeffery Goldthorp** |
| ***10:25*- GNU Radio: Open Source Software and Hardware for Software Radio** | **Eric Blossom** |
| ***11:05*- Software Radio "Bill of Rights" and Implementation** | **Kalle Kontson** |
| ***11:35*- Findings of Spectrum Policy Task Force** | **Paul Kolodzy and Peter Tenhula** |
| ***12:05 - 1:00 PM*** | **-Break-** |
| ***1:00*- Watermarking and Fingerprinting** | **Ton Kalker** |
| ***1:30*- Part 15 Questionnaire** | **Gregory Lapin** |
| ***1:40*- Readout on Broadband Access** | **Stagg Newman** |
| ***2:40*- Disability Access** | **Larry Goldberg** |
| ***3:00 PM*- Adjourn** | **Jeffery Goldthorp, DFO** |

## 3.0 Membership of the Technological Advisory Council, *FCC TAC II*

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

***TAC Chairperson***:

Robert W. Lucky - Corporate Vice President (Retired), 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 - Independent Consultant

*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

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***

Jeffery Goldthorp - Chief of the Network Technology Division, Federal Communications Commission

*(* = **Not present at this meeting**.)*

*Annex 2* of this report gives member e-mail information, and *Annex 3* lists FCC staff contacts. Member biographies can be found in Report: First Meeting of FCC Technological Advisory Council II, *Annex 2*. ( http://www.fcc.gov/oet/tac/TACII_report6.pdf, *Annex 2*)

About 30 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/mt120402.ram. It is expected that future TAC meetings will also be available from the http://www.fcc.gov/realaudio/ site. Persons interested in listening to future meetings should know that the webcast typically begins to be accessible at no more than about five minutes before the 10:00 AM meeting start time.

**4.0 Remarks by Members of the Commission and the Future of the TAC**

Jeff Goldthorp thanked all for all of the service and help the TAC has provided to the Commission over the last four years. The FCC is especially pleased with the extent to which the TAC has continued to fulfill the charge as set out in the original charter, and as a consequence is almost certain to recharter the TAC for another two year term. A new charter, already drafted and approved by the Commission, is now being processed through the various agencies that need to sign off on it. Although TAC activities are expected to go forward without missing a beat, the Commission and members now have the opportunity to review what should stay the same and what we expect will change in the next round of the TAC. The basic underlying theme – "headlights" for the agency to keep the Commission aware and abreast of new technologies – will continue. It apparently has proven to be very helpful for the FCC to hear an outside-the-beltway perspective on how newer technologies will have meaning from a policy standpoint. What will change in the next TAC is the procedure for doing that. In the first two instantiations of the TAC, working groups were formed at the beginning of the two year term and continued to work on a specific area of interest. For TAC III, we plan to have the Commission and the Council jointly define specific and different topic areas to target for each quarterly meeting. These topics would be areas of technology that we all think we need to learn more about. Using a symposium format, we will organize a set of outside speakers to come in to talk on that subject for the day for the meeting. There will be time during the meeting not just to hear and listen to what the speakers have to say, but to have a dialogue of the type we have become familiar with between the members of the TAC. Jeff commented that at least half of what is learned from the TAC is from the dialogue that goes on after the speakers are finished. It is extremely valuable and should be encouraged.

By focusing on specific areas that we could concentrate on each quarter, the next TAC will be more flexible in terms of the things that we look at. The new charter has been drafted in this way. We expect that the first meeting of TAC III will be in the springtime of 2003, but first the Commission must select the membership for the new group.

## 5.0 Topics of Interest to the Commission for Consideration by the current TAC

At the request of the Commission, the current TAC is focusing on several 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, ultrawideband, and the intelligent radio "Bill of Rights" - 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 in the consumer domain, not just in the home. Network security, a topic distributed among several groups, is understood to include issues of integrity, confidentiality of telecommunications and the technical enablers for the management of content rights.

Since the last meeting, four chaired working groups were active to address each of these primary focus areas (see *Annex 4* for website information and group membership). Discussions held by the groups between the meetings were expanded upon by the entire TAC at this meeting.

## 6.0 Spectrum Management

A notion which has been discussed and has gained strong TAC support is that the key to improved spectrum availability is a modernized spectrum management scheme capitalizing on intelligent devices and spectral reuse. Working group Chair Dewayne Hendricks and his group have been inviting speakers to develop these ideas. There were four related talks at the meeting which directly concerned spectrum efficiency and spectrum policy. We heard that low-cost software defined radios (SDRs) were on the verge of wide availability, and that these computer peripherals could be programmed to emulate a wide variety of radios using free and open software. With the anxiously anticipated flexibility of the SDR will also come the specter of difficult to regulate uncontrolled use. It may be necessary to address the issue of the rights and responsibilities of the SDR vendor and owner sooner than we expected. Closely related to this concept is the idea of the intelligent radio "Bill of Rights" proposed at the TAC some time ago. An update on progress in exploring this model indicates that it would be useful to attract economists and social scientists to help in developing more of the underlying philosophy.

The Spectrum Policy Task Force was formed to assist the Commission in identifying and evaluating changes in spectrum policy that will increase the public benefits derived from the use of radio spectrum. We got a readout of this group's report from the co-chairs. The task force has proposed a new concept, "interference temperature," as a means of managing and avoiding interference. The group also addressed many of the same wider issues relative to spectral management that the TAC has been interested in.

Finally, in response to the question as to whether or not there was anything in Part 15 rules that was inhibiting to innovation, Greg Lapin presented responses to a questionnaire on this topic that was sent to TAC members. There seems to be a preponderance of sentiment that Part 15 is

*not* generally a major obstacle to innovation.

### 6.1 GNU Radio: Open Source Software and Hardware for Software Defined Radio

Eric Blossom (eb@comsec.com) of Blossom Research, Monterey, CA, is an electrical engineer and computer scientist who has worked for both large companies and start-ups. Being especially interested in the social impact of technology, he was drawn to the issues surrounding free and open source software and the GNU project in particular. As Eric described, the "free" of free software is analogous to *liberty* and not necessarily the monetary price. The user has access to the source, is free to modify it, and is encouraged to contribute the modifications back to the community. This is where there is a distinction with *open source* code. There are various examples of licenses currently offered such as the GNU General Public License (GPL), BSD, MIT, and Mozilla. Eric spoke specifically about the GNU-based software defined radio (SDR), but the larger GNU Project itself was launched in 1984 to develop a complete Unix-like operating system in free software, the GNU system. *GNU* is a recursive acronym formed from "GNU's Not Unix."

There is a strong culture of exploration, learning, fixing, and improvement associated with GNU and free software. Unlike most commercial code where people can look at the code but not modify it, with free code nothing is frozen, hidden, or secret. One can take it apart without permission to see how it works or to learn how others solved similar problems. If something is broken or if it doesn't work the way the user likes, the user can try to fix the problem or tailor it to their needs.

We should appreciate that free software not a fringe activity. There is a world-wide community of users including well-known publicly traded companies that support or distribute free software such as IBM, HP, Red Hat, and Mandrake. We note that Google runs on GNU/Linux and Yahoo runs on FreeBSD.

This brings us to GNU Radio, a toolbox for building software radios and a platform for experimenting with digital communications and SDRs on commodity hardware. Blossom is the main driver of the GNU SDR. A basic motivation from a radio-building experimenter's point of view is to get the software "as close as possible to the antenna." This creates enormous flexibility. A single piece of stable, general purpose hardware can be reconfigured on the fly with software. By comparison, modifying circuits in hardware is a time consuming, solder and workbench project, whereas software is amenable to fast, desktop redesign. But beyond just ease for the experimenter, as we have heard at previous TAC meetings, the SDR enables the dynamic reconfiguration of radios in the field and completely new working concepts such as the cognitive radio.

The SDR based on GNU expands the "free software ethic" into what were previously hardware intensive arenas. The hardware platform of Blossom's implementation can work with a commodity PC or embedded system, uses low-cost RF front end tuner modules from the TV receiver industry, and incorporates high speed analog to digital converters. Today a GNU Radio receiver can be easily configured to emulate an FM broadcast receiver or fully functional ATSC

television receiver. A transmit version can even generate (at low power) the ATSC transmitter signal. Free code for all this is available at distribution sites around the world. This kind of capability is now available on the desktop in the $1,000 range with $250 in sight.

The emergence of the low-cost, generally available SDR which can be configured with free, modifiable, open software will present a new issue for regulators. What will be placed in the hands of the public – entrepreneurs, amateurs, and even those with malicious intent – will be machines which in principal can emulate, send, and receive any radio signal on any band. Of course, it was always possible for an individual to build an illegal radio, but this new technology represents a quantum change in this situation. Any person will be able to buy a general purpose SDR in the same way that any other peripheral for a home computer (like a printer) can be obtained. Then, with the world-wide availability of software that can even be modified if needed, any radio transmitter or receiver can be emulated. Bans on receiver types will be circumventable with ease. Mandates such as the proposed ATSC broadcast flag will be hard to enforce (and may even fail in the presence of a single web-connected noncompliant receiver). And, although not generally an issue for the Commission, it will be possible to implement proprietary systems without the benefit of any license from the patent holder. Because the software is open, as a practical matter virtually all mandated restrictions will be at risk (except for total power output which remains a classical hardware issue). Unlike illegal or infringing hardware, software (which could be considered a type constitutionally protected speech) can easily be distributed to millions worldwide for application on commodity SDRs. It brings into question what activities could actually be restrained by a certification procedure for SDR transmitters. We need to assume that a smart and motivated software hacker will be able to defeat any limiting control. All of this brings up legal and political problems relative to the rights and obligations of the hardware and software builders (and users) which are probably beyond the purview of the TAC. This emerging issue, however, should fall into the category of a classic "heads-up" message to the Commission from the technology front. In the GNU SDR environment, we have the makings of a powerful new technology that has the potential of solving the spectrum management problem, but we may also have other people in the world writing and distributing software with their own agenda.

Some of the issues described are not unique to this situation. If a person has the instrumentality to design something that the government says is illegal, then they have a personal choice as to whether or not to use it and risk the penalty if caught. But one major problem here relates to the legal responsibilities of the producer of the general purpose hardware and software. If it decided that these producers are liable if their work product is easily repurposed to an illegal function even though many legitimate uses are intended, then this will act as an enormous obstacle to innovation.

Some GNU Radio resources are the GNU home page with links to source code: http://www.gnu.org/software/gnuradio and the mailing list: discuss-gnuradio-request@gnu.org Open source resources can be found at Source Forge: http://www.sf.net with open source hardware at: http://www.opencores.com

The visuals for Eric Blossom's presentation can be found at:

http://www.fcc.gov/oet/tac/GNU_Radio_12_4_02.pdf

### 6.2 A Wireless Device Bill of Rights

Kalle Kontson reviewed some of the policy implications of the proposed First Draft of an *Intelligent Wireless Device "Bill of Rights"* in light of the recent Spectrum Policy Task Force Report (which will be reported on next). Several years ago it was suggested that new spectrum regulation might be based on such a rights concept. As with the original Bill of Rights, this would be a succinct list robust enough to be stable over time and technologies. Unlike regulations, which largely *prevent* action, the Bill would bestow upon intelligent devices the right to *take* action without having to ask for permission. With these rights would also come certain responsibilities. Since this was the last meeting of TAC II, Kalle wanted to give the status of work and to consider whether this represented real value or just a philosophical exercise. He did it in the form of a critical review of what we have, which at this point is more correctly described as a caricature of what the Bill might be, rather than an actual legal document.

The skeleton of the Bill as proposed has three main parts which are reproduced here:

**Article 1: Any intelligent wireless device may, on a non-interference basis, use any frequency, frequencies, or bandwidth at any time to perform its function.**

- Article 1, Tenet 1: To exercise rights under this Article, intelligent devices must be mentally competent to accurately determine the possibility of interference that may result from their use of the spectrum, and have the moral character to not do so if that possibility might infringe on the rights of other users.
- Article 1, Tenet 2: To exercise rights under this Article, intelligent devices must actively use the wireless spectrum within the minimum time, spatial, and bandwidth constraints necessary to accomplish the function. Squatting on spectrum is strictly prohibited.

**Article 2: All users of the spectrum shall have the right to operate without harmful electromagnetic interference from other users.**

- Article 2, Tenet 1: Priority of rights under this Article may be determined by the proper authorities only in cases of national emergency, safety of life, or situations of extreme public interest.
- Article 2, Tenet 2: Rights under this Article may be exercised only when the systems exercising the rights are designed, as determined by the state of the practice, to be reasonably resistant in interference.

**Article 3: All licensing, auctioning, selling or otherwise disposition of the rights to frequencies and spectrum usage shall be subordinate to , and controlled by Articles 1 and 2, above.**

Using more descriptive language, Article 1 is the *Right to Use* clause. Interestingly, it can be implemented under either an exclusive use or *commons* model. It does not necessarily demand an unlicensed paradigm. Secondary markets or easements can be used to convey access from a license holder to someone else. Generally, we assume that "must carry" or "equal access" provisions will be essential. In the exclusive use model there are licenses and ownership of

spectrum, but that spectrum can be used very flexibly, including being offered up for sale in secondary markets or reused through easements. This is exclusive use with spectrum husbandry. By analogy we can think of the public restaurants vs. public highways models. Everybody can get on the road and drive, but the road is not owned by any one particular person. A public restaurant, on the other hand, uses a private ownership model, but there are also legal expectations and precedence for open access. Certain rules, some of which are written down and others just accepted, imply the rights and prohibition for all the parties. Easements are a little different. Easements typically say that one doesn't have to pay or give anything, as long they can operate without the owner noticing any undesirable intrusion.

Some interesting research issues are whether or not it is possible to invent a futuristic mesh network architecture that preserves Article 1 and optimizes capacity, and if this requires the postulation of the ubiquitous network manager "in the sky" (or on the Web). Dr. Dave Reed's work on network scaling which was reviewed in TACII Report 4 (http://www.fcc.gov/oet/tac/april26-02-docs/tac4-26report.pdf ) is relevant to these questions.

There's nothing that says that we need to provide unlicensed spectrum for free. Authorization is also a key ingredient. It is somewhat unsettling to imagine uncertified equipment trying to do these kinds of things especially if we are depending on giving open access to good citizens who exhibit rational behavior and use intelligent protocols. As described in the previous section, uncertified equipment may become more available than we wish.

Article 2 is the *Right to be Protected.* We need to make a distinction between what Article 2 implies and the unlicensed model. Most unlicensed implementations do not require protection for receivers, but Article 2, in fact, says there also is a right to be protected from complaints from owners of poorly designed equipment. It is a demand on receiver performance. A receiver can't be unreasonably sensitive. The article may demand an active participation to announce your presence and say, "I intend to be here and expect to be protected." Maybe a transmitter standard will need to involve a beacon channel announcing the sender's presence.

The Article 2 right to be protected goes beyond the current unlicensed commons model. It demands some receiver standards in order to earn the right to be protected, and may imply certification of receivers. It also requires addressing harmful interference head-on, including the monitoring and management of "interference temperature."

Article 3 is kind of Supreme Law clause.

To avoid trying to seize a bridge too far, the new rules could be introduced band-by-band. It is somewhat ironic that many of the new *rights* concepts seem to imply new and restrictive active ingredients, such as the requirement to announce your presence. There is also the problem of the potential introduction of the big-brother model where permission is required before action. Besides the overhead of central planning, a lot of communications in the computer world are just a few packets. Considering the likely latencies of getting permission to just transmit a couple of packets, it seems like this doesn't really make sense.

In summary, there seem to be policies and architectures that could support the spirit of a Bill of Rights. The Bill can be complementary to the Spectrum Management Task Force recommendations. Clearly, the current draft is not ready for prime-time, but we should not spend time perfecting the language because it is more important to get the basic concept and philosophy right first. There are economists and other deep thinkers at universities who, if they understood what an interesting hot issue this could be, would probably be anxious to work on the problem. As an action item, we should pull together a paper on this whole concept laying out the technical landscape and some of the objectives of the solution set to attract contributions from the "soft-sciences" community.

The visuals for Kalle's presentation can be found at:

http://www.fcc.gov/oet/tac/TAC_Examing_Bill_of_Rights_4Dec02.ppt

**6.3 Findings of the Spectrum Policy Task Force**

Chairman Powell established the Spectrum Policy Task Force in June 2002 to assist the Commission in identifying and evaluating changes in spectrum policy that will increase the public benefits derived from the use of radio spectrum. Peter Tenhula, co-director of the Spectrum Policy Task Force and Senior Legal Advisor in the Office of Chairman Powell, introduced the report. The producers are seeking comments and hope to have TAC members, individually or as a group, participate in the comment cycle that ends in January (February for reply comments). We understand that the Commission Chairman wants to be assured that this report gets publicized and doesn't sit and collect dust. One of the concepts that he is intrigued by is the proposal to use *interference temperature* as a potentially groundbreaking inference metric. Peter Tenhula introduced Paul Kolodzy to give an overview of the Task Force findings, especially relative to the two key issues of interference temperature, and management schemes for promoting more efficient access to the available spectrum. Paul was OET Senior Spectrum Policy Advisor and Chair of the FCC Spectrum Policy Task Force.

The task force proposes to adopt a more quantitative approach to interference avoidance, management, and control based on the concept of "interference temperature." The group defines interference temperature as the *total* RF energy at a given location from the combination of ambient noise and all other sources. The interference temperature metric would establish maximum permissible levels of interference, characterizing the worst case environment in which a receiver would be expected to operate. Different threshold levels could be set for each band, geographic region or service, but only after review of the condition of the RF environment in each band. This will require a systematic study of the existing RF noise floor.

One recurring and often thorny issue is how to protect users against harmful interference. Despite the fact that the Commission has had extensive and generally successful experience in managing interference issues, these issues have been increasing in technical difficulty and prevalence due to the changing RF environment generated by new devices and new technology. The rules should specify a more accurate measure of interference that takes into account the cumulative summation of all the undesired RF energy available to be captured by a particular receiving antenna for delivery to the receiver. To achieve this objective, as well as to transition

interference management to more accurate real-time measurements, the Task Force recommends that the Commission adopt this new interference temperature metric to quantify and manage interference. The interference temperature measures the RF power available at the receiving antenna per unit bandwidth.

Conceptually, interference temperature measurements would be taken at various receiver locations to estimate the real-time condition of the RF environment. The degree of certainty of the estimate of the environment would depend on such factors as transmitter signal ranges, uniformity of signal levels over an area, the density of temperature measuring devices and the sharing of the data taken by nearby devices, e.g., through "ad-hoc cooperative wireless networks." The Commission could use the interference temperature metric to establish maximum permissible levels of interference, thus characterizing the worst case environment in which a receiver would be expected to operate. Different threshold levels could be set for each band, geographic region or service, and these thresholds should be set after the Commission has reviewed the condition of the RF environment in each band.

There are still many answer tough questions that need answering and this would be an area where the experience and resources associated with the TAC could be invaluable. One aspect is, of course, a new noise floor study to continue some of the work already initiated by the TAC. A much more serious look at trying to understand the noise floor is required.

The Commission's review of the RF environment should include actual spectrum measurements of the RF noise-plus-interference floor. In addition to obtaining better data regarding the noise floor, the Task force recommends that the Commission adopt a standard methodology for measuring the noise floor. Further, they also recommend that the Commission create a public/private partnership for a long-term noise (interference temperature) monitoring network and for the archiving of data for use by the FCC and the public.

Figure 1 depicts a possible scenario resulting from the current open ended nature of the RF noise floor. A communications system has been designed to operate at a distance from the transmitting antenna at which the signal strength approaches the level of the noise floor that existed when the system was established. Over time, the noise floor can rise unpredictably – this due to additional interfering signals, perhaps including out-of-band emissions from new users and further aggregation of unlicensed devices. As a result, signal coverage can be degraded without warning. Additional interfering signals will progressively worsen coverage.
.

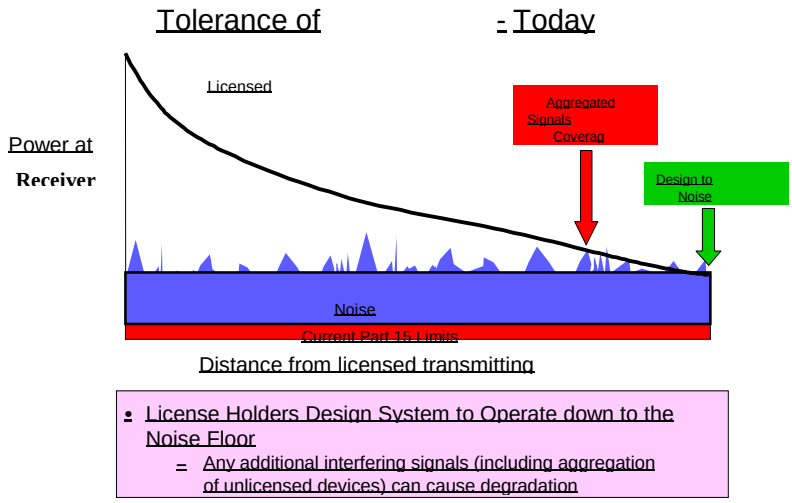


**Figure 1: Interference Avoidance** ***Source:*** **Spectrum Policy Task Force**

Figure 2 modifies the scenario by placing an interference temperature cap over the service area.

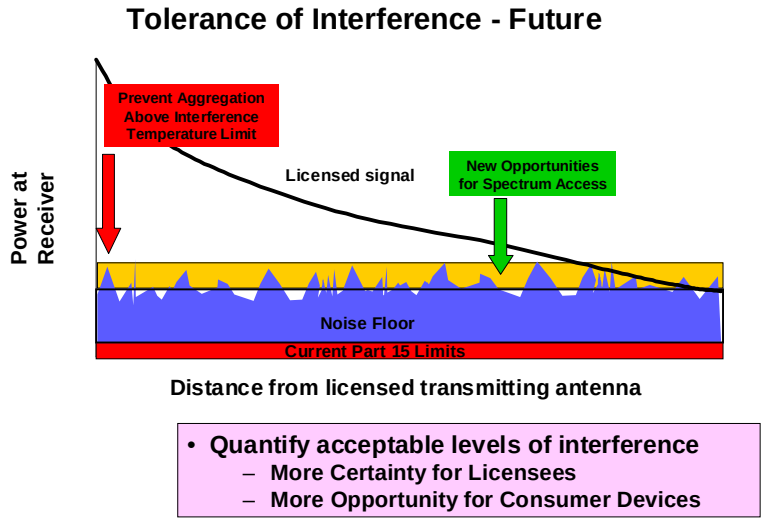


**Figure 2: Interference Avoidance – Future Proposal** ***Source:*** **Spectrum Policy Task Force**

Two key benefits will result from the application of the interference temperature metric. First, licensed spectrum users will obtain certainty with regard to the maximum permissible level of aggregated noise or interference in their band. The interference temperature would quantify the level of acceptable interference in a particular band. For example, any transmissions from other

sources that increase the noise level above the interference temperature would be considered "harmful interference" in accordance with Commiss ion rules. Second, to the extent that the interference temperature in a particular band is not reached, other users (e.g., unlicensed devices) could operate in the same band – with the interference temperature serving as the maximum cap on the potential RF energy they could introduce in the band. This would thus increase access to the band for other users or devices.

Interference temperature sensory and control mechanisms could be used to maintain both in-band and out-of-band emissions within permissible limits. For example, a low power unlicensed RF device could be designed to scan its particular frequency band before transmitting. Its built-in "thermometer" would record interference temperature data and compute the appropriate statistical aggregate value. The device would then project the increase in interference temperature due to its operation over its nominal range. This value would be compared with the permissible limit. If its operation would exceed the limit, the device's controller could execute an appropriate response such as reducing power, switching to a different transmit frequency (if available) or, perhaps, continuing the scanning/sensing process to locate an opportune time to transmit. The technology now exists to build such sensory control systems. Automated transmitter power control, for instance, is used in certain types of wireless and satellite communications systems. Cordless telephones also adapt to the environment by selecting an unused frequency.

The interference temperature concept immediately brings up many typical technology questions. There needs to be standardization of measurement techniques and of the methodology and format used to report noise the floor which would include resolution in space, time, frequency, and amplitude. We will need to utilize both private and government measurements, and make use of monitoring stations, in-situ devices, and computer models. Measurements could be just available to the network, or to individual devices that share measurements, or both.

The second major issue dealt with by the Task Force is that of spectrum efficiency and utilization. There is wealth of both hard and anecdotal evidence to suggest that much of the apparent shortage of spectral availability is caused by an inefficient governmental allocation mechanism. Most "prime spectrum" has already been assigned to one or more parties, and it is becoming increasingly difficult to find spectrum that can be made available either for new services or to expand existing ones. Although virtually the entire good spectrum is spoken for license-wise, field measurements show that a huge proportion of spectrum is not actually in continuous use at any given time and place. There are so many usable are holes in the spectrum in time, frequency and location that we must conclude that the problem is a lack of an appropriate access control mechanism and not true scarcity. The idea, which has been discussed at length at previous TAC meetings, is that by increasing accessibility with new management paradigms, we might be able to mitigate much of the spectrum resource scarcity that we think we have. Improving access to the spectrum can be achieved through permitting licensees greater flexibility, and by other means. It is the view of the Task Force that the time is now for spectrum policy reform.

To promoting more efficient access to spectrum, the Task Force recommends designating

additional bands for unlicensed spectrum use to better optimize spectrum access and provide room for expansion in the fast-growing market for unlicensed devices and networks. In the licensed spectrum bands, we should pursue secondary market policies that encourage licensees to provide access for "opportunistic" uses above the interference temperature threshold through leasing of spectrum usage rights. We should explore the possible granting of "easements" for some opportunistic uses in new spectrum bands, but be sensitive to the potential impact on planning and investment by licensed users.

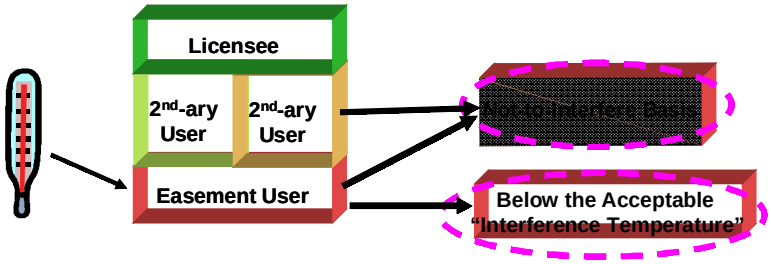


**Figure 3: Promoting Access to Spectrum - The New Model** ***Source:*** **Spectrum Policy Task Force**

In Figure 3 we see several stratagems for spectral usage illustrated. A licensee has authorized several secondary users presumably by subletting some spectrum on the secondary market. At the same time easements have been granted to users who are so far below the allowed interference temperature that they are invisible to others. Other easement users are strong enough to be seen, but by operating in agreement with other users produce no harmful interference. In Figure 4, this same idea is extended to include accommodation of secondary users accounting for the strong geographic variability of interference effects. In rural areas, for instance, we would expect flexible regulation of power levels, and secondary market mechanisms to encourage leasing of spectrum usage rights and in defining geographic licensing areas.

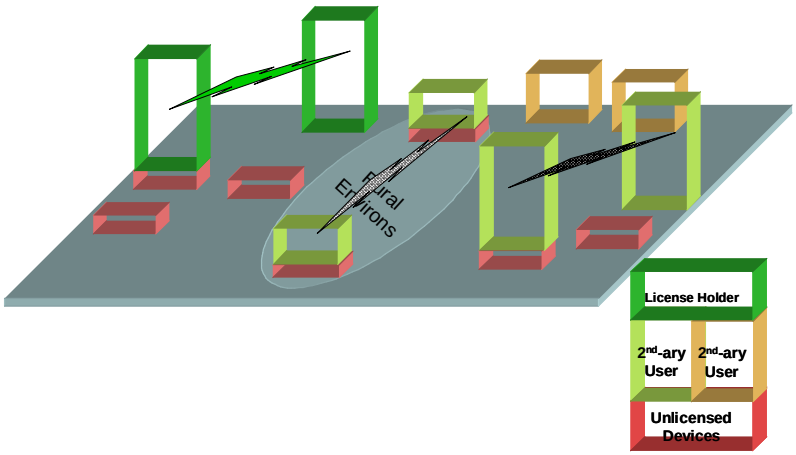


**Figure 4: Promoting Access to Spectrum in the Space Dimension** ***Source:*** **Spectrum Policy Task Force**

In Figure 5, we further extend flexibility to include the time dimension.

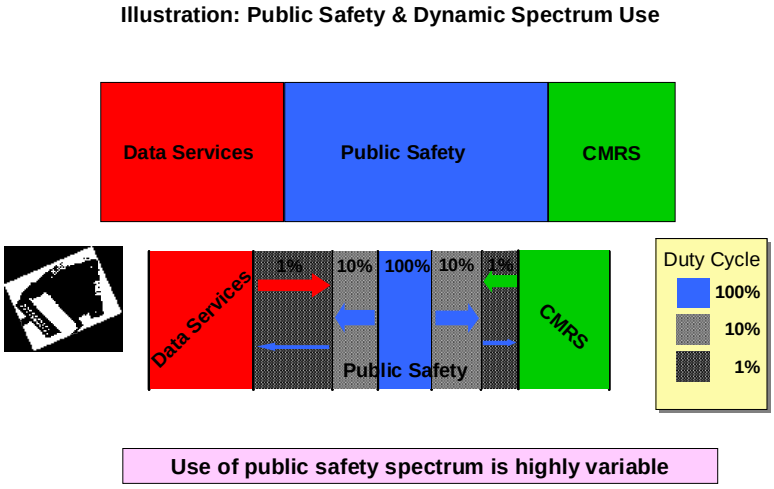


**Figure 5: Promoting Access to Spectrum Through Increased Flexibility**

***Source:*** **Spectrum Policy Task Force**

Although quite controversial, it is a fact that many public safety bands have significant intervals of light usage which could be reassigned to other users, assuming of course, that all of the capacity could be instantly recaptured in an emergency.

All of these proposals for a modernization of the management of spectrum access produce a host of technology questions including the viability of dynamic sharing, the availability of frequency agile devices, the overall cost effectiveness of spectrum sharing, constraints resulting from the necessity of providing a defined QoS, and the development of an effective microcharging technology. There are philosophical questions contrasting distributed versus centralized control, and the tradeoffs between flexibility and robustness.

All agreed that the producers of the Task Force report did an admirable job. They are wrestling with many of the same front-line issues that have concerned the TAC for several years – noise floor and spectral access management. The problem now is how to convert these ideas into actionable plans. We have the germ of many new, powerful concepts, but serious funding will be required if these ideas are converted to rulemaking-ready directives. As a means of getting started, we might consider doing limited experiments in areas which are historical incubators for new paradigms (such as the Bay Area). The National Science Foundation is very interested in this topic and are proposing a workshop for February 2003 to stimulate thinking in the community on these issues. We may also need an open measurement forum to send out the word to the community that we' re interested in this challenge and to propagate the message that the data is needed.

Generally, since we are demanding more intelligence from devices and one might ask if we are inadvertently pushing out dumber devices and losing the opportunity for lower cost solutions. Dumb devices could have a very good place, but not *poorly designed* dumb devices. A very efficient device that doesn' t have much intelligence but has a well focused application is not ruled out by what is proposed. We allow for a great diversity of solutions. The more important problem is that of the legacy of devices and rules that exist in every band. Some of those devices are dumb and inefficient. They need to be weeded out for the betterment of the overall society but this will certainly lead to some real controversies.

The visuals for Paul Kolodzy's presentation can be found at:
http://www.fcc.gov/oet/tac/TAC_December_2002.ppt

The home page of the Spectrum Policy Task Force (with links to all of the reports) is at:
http://www.fcc.gov/sptf/

### 6.4 A Part 15 Questionnaire

At the June, 2002 FCC TAC meeting Ed Thomas posed a question to the spectrum working group, loosely quoted here: "One thing I'm sure OET would be interested in is the existing rules, the Part 15 rules. Is there anything in them inhibiting to innovation? I would love to have this group make some commentary on it, that's worth its weight in gold to me. Certainly you could use examples of some of these things and take the position that 'If this did not exist as a restriction, we could do all sorts of good things." I would suggest this as something that has a great deal of value."

Greg Lapin, on the part of the consumer and home networking group, solicited comments from the entire TAC on the survey below and presented his findings at this meeting.

**FCC TAC Part 15 Survey (Questionnaire)**

1. Do you think that FCC Part 15 Regulations inhibit innovation?
   Are the regulations too limiting? If so, what specific limitations should be changed?
   - Power and antenna limitations?
   - Frequency limitations?
   - Modulation limitations?

   Could more stringent regulations, insuring that there will be no unknown types of interference, permit additional innovation?
2. Currently, Part 15 intentional radiating devices are constrained by the following: "*Operation is subject to the following two conditions: (1) this device may not cause harmful interference, and (2) this device must accept any interference received, including interference that may cause undesired operation.*" Should the FCC deal with interference issues with licensed services in a different way? What?
3. For individual (possibly non-technical) users in the home:
   - Can they effectively control their own spectrum and make appropriate decisions on how to deal with interference issues that may arise between Part 15 devices?
   - Can each user be guaranteed that there will be no interference from, or to, users in nearby homes or apartments?
4. In a spectrum with no rules, how can individual users be assured of effective communications?
5. Please comment on anything else that you feel is important to this question.

What we mean by 'Part 15' devices in the limited context of this question are intentional radiators that operate on an unlicensed basis. These devices usually share spectrum with licensed services, must not interfere with licensed services, and must accept interference from licensed services. The original basis of this survey as done by the home networking group was to address Part 15 devices in the home, but the survey was expanded and answered by about half of all TAC members or their designates.

The majority of respondents do not consider that part 15 generally inhibits innovation. It was suggested that a better solution would be a new category, not Part 15, for highly regulated and controlled, type-accepted equipment to be used for unlicensed very low power applications with the broadest possible choice of spectrum. As for restrictiveness, Part 15 regulations have actually fostered a great deal of innovation by limiting only a minimal number of characteristics. We should note that innovative "Free-For-All" ad-hoc networks have sprung up creating unlicensed networks using 802.11 technology, and that that was not in the original scope of the FCC's intent for private, unlicensed, LAN technology. One person felt that the sharing of licensed spectrum by unlicensed devices ultimately will not work and that unlicensed devices should be assigned their own spectrum. On the opposing side, many of the respondents feel that the limitations and obstacles imposed by part 15 regulations actually encourage innovation.

In looking to identify specific legislation holding back innovation, most of the respondents did not feel the rules on the transmit energy should be changed, but the opinion was more evenly balanced on relaxing types of modulation and frequency use. However, a comment that exemplifies many of the opinions about making changes to regulations, is that there is much to be said for regulatory stability. A great deal has been and is planned to be invested assuming the existing rules, and the prospect of an unstable playing field may do more to inhibit innovation than any small adjustment that can be proposed.

The next part of the first question examined the opposite contention, that more stringent regulations insuring that there will be no unknown types of interference could foster additional innovation. Instituting stringent regulations may permit more innovation and allow additional players into the game. Constraints can often force innovation to occur as opposed to being able to use a more obvious, less innovative solutions. As to whether or not FCC should deal with interference issues with licensed services in a different way, most felt that the current fundamental principles were sound.

The next question dealt with the responsibilities and expectations of home user who is cannot be counted on to be technologically astute. With the potential for interference and incompatibility between various part 15 devices, it's generally held that the consumer must be responsible for using the technologies that work together and not using the ones that don't. Although the majority of the respondents felt that the average user would not be capable of doing this, one opposing view is that a Darwinian process would take place and the inferior devices and services would disappear from the market possibly with brutal consequences to manufacturers and service providers. However, the majority believed that this would not occur and if, in most cases, this is a trial-and-error situation at best, in which they are at the mercy of whatever the manufacturer of the equipment has provided. As more devices proliferate it will become more difficult for a consumer to determine the reasons their products do not operate if the reason is interference

The final topic dealt with the concept of removing all regulations which would allow for a Darwinian competition for the best devices. The majority do not feel it would work in a beneficial way. There was a sentiment expressed in answer to this question and to others that regulation does not necessarily have to come from the FCC. It can be imposed by industry

standards, which is kind of an interesting point of view the way it is now and the issues of the 2.4 GHz band, but things might work better in the future.

In summary, the majority of the opinions in the part 15 survey are that the current structure of Part 15 is good, particularly since it has been evolving along with the technology. A prevailing view is that many of the regulations are not all that bad and can actually spur on innovation rather than inhibiting it. Also, a moving regulatory target is difficult for industry to deal with and may inhibit innovation by making companies unwilling to take a leap to put a product on the market.

The visuals for Greg Lapin's presentation can be found at:
http://www.fcc.gov/oet/tac/Part_15_Survey_12_4_02.ppt

**7.0 Consumer and Home Networking**

In the working group on home networking, digital rights management issues often come up in considering the balance between consumer's rights, the rights of the content owners, and the rights of the electronic device makers. If the rights problems are not adequately resolved, this issue can be a show-stopper, literally in this case, for both home network and broadband deployment. From a regulatory standpoint, it is important to understand the capabilities and implications of various new rights management technologies. Ton Kalker (ton.kalker@ieee.org) of Philips Research Labs (in Holland) was asked to give us an update on fingerprinting and watermarking. A lot of the rights management technology that is now in proposal comes from Ton and his group.

The root of the rights dilemma stems from the fact that all content must ultimately be rendered in analog form if it is to be used and enjoyed by humans, but these same users do not necessarily share the same interests as the content provider in terms of either royalty payments or redistribution of copies. Because content must ultimately appear "in the clear", tot al control is impossible without eliminating some of the most lucrative applications. Because the most valuable content must appear at many (if not millions of locations) and is desirable to a global audience, the best we can expect to do is to manage the scale of the problem. This is in sharp distinction to the military secrecy problem (not considered here) where cryptographic techniques applied within a well-controlled community can be very effective.

As an example of how the technologies of watermarking and fingerprinting are to be used, consider the case of rights organizations wanting to know how often a particular song is broadcast and whether any of this content has been redistributed by other means. Today, monitoring stations do this manually. This can be automated using watermarking or fingerprinting. As will be described, watermarking actively changes audio to imperceptibly embed secret identity codes into sample values. Fingerprinting, on the other hand, compares naturally occurring features of the unmodified audio to be identified with a database of a large number of previously stored features of audio clips.

Watermarking has been around for some time. Generically, it can be viewed as an overlay

communications technology where new messages are injected into existing content by adding signals which appear to be a virtually imperceptible increase in background noise to the primary user, but are in fact signals which have a known, often secret, and detectable structure to the user of the overlay channel. It is in this parasitic side channel that the rights information is embedded. Watermarking requires active modification of the content and is generally not present in legacy content. Although direct jamming is difficult but doable, there is a way to completely compromise the system by creating false watermarks.

Fingerprinting, by comparison, is a passive technology so content is not affected and therefore will work with legacy content. It is the automated implementation of "Name That Tune." Ton gave a live demonstration of audio fingerprint identification. He played about five seconds of a commercially available popular song over a loudspeaker and picked up the audio with a microphone linked to the identification software and database. By comparing the time evolution of various frequency components and other characteristics of the music, the system immediately was able to make a correct match (using a database of a large number of previously stored features) to the stock recording giving both title and artist. Very impressive.

Fingerprints are reputed to be impossible to inaudibly modify, however, they cannot distinguish between different copies of exactly the same content and a connection to a database is always required. If there is no model (fingerprint) of the recording in the database, there is of course, no match. Good algorithms and methods for fuzzy fingerprint matching now exist. Ton says that the feasibility of very large systems with millions of songs has been proven.

It is easy to imagine how fingerprinting can be used to tally the usage of the broadcast of recorded content for purposes of royalty tracking. But there are more important consumer applications and policing functions being proposed. Among these are the control of unauthorized copying and redistribution of content (e.g., via the "Darknet", *see* http//:crypto.stanford.edu/DRM2002/darknet5.doc). Unless certain uncircumventable functionalities are added to each consumer's player device (politically, a very contentious proposition), such activity can not generally be prevented but the (human) sources of the problem may be identifiable for prosecution. Ton described a number of system scenarios combining both fingerprinting and watermarking which strive to achieve this traceability. Some of the attributes the rights management people are trying to achieve include not only identifying song/artist but also the identity of the last legal purchaser, and all in a way which is resistant to compromise and legal challenge.

Fingerprint technologies have now reached sufficient maturity to be put onto the market. Watermarking and fingerprinting, both independently viable methods for consistent identification, are especially powerful when used together, as, for instance, when the watermark cryptographically contains both the fingerprint itself and the identity code of the last purchaser. All of these techniques, and more, will be needed if a viable business model is to be constructed which converts peer-to-peer distribution from a rights-owner's nuisance to profit enabler. An emerging political problem with all of these technological mechanisms is that they put the definition of *fair use* in the hands of the content owner. Regulatory authorities like the FCC will have to consider the impact on the public if *broadcasters* use some of these systems and citizens

are blocked from doing things that they have been doing for years.

The visuals for Ton Kalker's TAC presentation can be found at:
http://www.fcc.gov/oet/tac/Watermarking_Fingerprinting_12_4_02_fccv02.ppt

Greg Lapin's questionnaire on the impact of Part 15 on innovation, which was done under the auspices of this group, was reviewed earlier in this report.

**8.0 Optical Networking and Broadband**

The Commission, and Jeff Goldthorp and Behzad Ghaffari in particular, are interested in the viability/nonviability of intermodal facilities-based broadband competition for the mass market. They asked the TAC to supply facts concerning the technical feasibility, the economics, and the geographic availability of various forms of broadband access both for today's services and for the future. The policy on how to stimulate competition is not in the purview of the TAC, but since the TAC can provide the fact base for decision making, Stagg Newman asked a small group to take a deep dive into an analysis of the technical and economic issues of broadband and wireless systems and report findings to the FCC. The result of this effort, including some work done subsequent to the December TAC meeting, is a comprehensive set of reports complete with supporting information now available on the TAC website.

The overview: Readout on Broadband Access is at:
http://www.fcc.gov/oet/tac/Broadband_Access_Supporting_Materials_12_4_02.ppt

Individual reports including:

- Broadband Access Platforms for the Mass Market –An Assessment
- Broadband Access for Multiprograming Video / Audio Services
- Cable opportunities and Cable Access Technology
- Cable Telephony
- DSL-Cable Modem Comparison
- HSI- Satellite in low density areas
- Primary Versus Secondary Line Telephony

are at: http://www.fcc.gov/oet/tac/bb_access_materials_12_4_02.zip

A readout to Jeff Goldthorp and Michelle Carey (Division Chief, Competition Policy Division, Wireline Competition Bureau) of the material that was presented to the TAC on *An Assessment of Broadband Access Platforms for the Mass Market* was scheduled for December 17, 2002. Following the TAC meeting, a considerable amount of editing and refinement of the reports was done to produce the work product now on the website.

The total set of findings was too great to be presented in its entirety at the TAC meeting, so Stagg summarized the task, defined the services and provided a synopsis of suitability of broadband access platforms today together with some key economic factors and the projected

availability of broadband to all Americans. The study is primarily a near-term look, that is, an analysis of what is (and the viability of) what can actually be deployed today.

The services being bought by consumers today fall into three categories, voice, Internet access, and multiprogram video services. There is an important distinction between primary line and secondary line voice especially when we think about the economic competitive ability of broadband access. Primary line implies a service that will displace what people have in their home today - complete with reliable powering, legacy dialers, hook switches, ringers, and full-function yet passively connected extensions. A secondary line may just provide outgoing bypass. We define high-speed Internet access as basically what people are buying in the market today with cable and DSL being the primary vehicles - a few hundreds of kilobits up to the low megabits per second downstream and a few hundred kilobits per second upstream. There are still a lot of open questions relative to video on demand and whether it will be delivered predominately by real time viewing on-line or use the file download model.

Figure 6 gives a summary of broadband access platform suitability. The TAC had previously supplied the FCC with an analysis of many BB platforms. These analyses were updated, more detailed material was supplied, and an additional platform was added. PLC is power line communications, a technology that has recently emerged as being more practical than originally estimated. The key features, advantages, disadvantages and limitations are addressed.

Availability in the marketplace is represented by the three different sized black circles. That' s very important because when the commission worries about regulation typically *real* competition has a different weight in the decisions as compared to *prospective* competition. The "moons" summarize suitability.


Suitable includes technical ability to deliver desired services as well as costs as a function of addressable market

| Suitable ---------- Available | LMDS | Low Ghz Licensed Wireless | Unli-censed Wireless | Strastos-pheric Platforms | 3G |
|---|---|---|---|---|---|
| Voice – Primary Line | | | | | |
| Voice – Secondary Line | | | | | |
| High Speed Internet | | | | | |
| Multi-Program Video | | | | | |

| Suitable ---------- Available | Cable | DSL | VDSL | FTTx | PLC | Satellite |
|---|---|---|---|---|---|---|
| Voice – Primary Line | | | | | | |
| Voice – Secondary Line | | | | | | |
| High Speed Internet | | | | | | |
| Multi-Program Video | | | | | | |

**Figure 6: BB Access Platforms Suitability** ***Source:*** **Stagg Newman / TAC Working Group**

Figure 7 is an overview of the four major factors affecting broadband platform economics.

**Revenue Generating Services**

- Ability to share costs across multiple service offerings
- Ability to share marketing and SG&A across multiple offerings
- Ability to reduce churn
- …..

**Customer Equipment & Installation**

- Costs of customer equipment
  - For primary line telephony, "Smart NID or equivalent to handle basic phones, extensions, etc.
  - For digital video Set Top Box per TV
- Costs of customer installation
  - For primary line telephony, connection of I/W to "Smart NID" or replacements of same
  - For internet access, connection of PC to network access link
- Cost of customer engineering
  - For wireless, line of sight engineering
  - Compatibility w/ computer environment

$$$s

**Network Access Costs**

- Costs per "port" to add customers
- Costs of ROWs and/or antennae sites
- Costs of civil engineering and construction
- Costs of concentration and backhaul
- Cost of network engineering
  - Traffic engineering for shared media
  - RF engineering for wireless
- …..

**Operations, Billing, and Customer Care Systems**

- Costs of developing software support systems
- Ability to modify systems for new services/features
- Scalability
- …….

**Figure 7: Major Factors Affecting BB Platform Economics** *Source:* **Stagg Newman / TAC Working Group**

The technical and economic tradeoffs between different platforms not only evolve with time but are impacted by a host of other factors, consequently no one solution can fit all markets and services as illustrated in Figure 8.

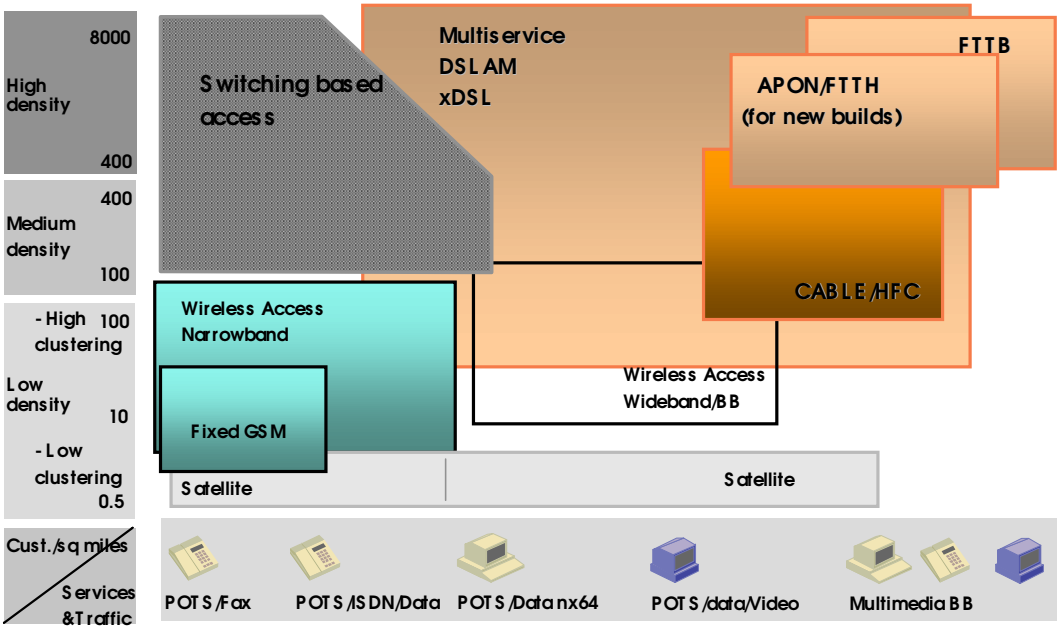


Chart based on typical spectrum allocations and assignments today.

**Figure 8: No One Solution Fits All Markets and Services** *Source:* **Alcatel**

To ultimately to meet the FCC's goal of broadband available to all of Americans, we're going to need a mix of technologies and some of the technologies are much more cost-effective in low densities (or high density areas). No real surprise here in this depiction based on some very specific studies done by Alcatel.

The bottom line relative to whether there really is viable competition across modalities seems to be that for Internet access there is viability between DSL and cable modem for the 60% of the country that is DSL addressable. Also, for multivideo programming services, there's cable vs. satellite competition for essentially 90% of the country. But in both cases, we're talking about just a duopoly. Beyond that, several technologies, particularly wireless and power line communication, have the *potential* for competition in the future. But that doesn't mean the competition will ever develop. Once there is a fully deployed incumbent, it's hard to be an attacker. And, lot of technologies just don't make it in the market. That's part of what the commission has to think through very carefully as they develop their policies over the next year or so in the broadband arena.

Today, in the USA, in terms of proportion, cable is getting two out of every three subscribers against DSL. The Telcos seem to be making a fairly focused capital deployment by exploiting DSL where loops are short enough, and are investing in fiber feeds primarily in attractive suburbs. In many other countries of the world, like Korea, government money initiatives have put the US in an ever diminishing position in terms of broadband access per capita. Of course, other countries like Korea have a lot of high population multidwelling units so it's an easier problem for them than for us. Several meetings back we heard about condominium and municipal fibering initiatives. It may be that this stratagem deserves a closer look given the telecom crash and the availability of capital to promote broadband.

Another piece of analysis that would be useful would be to compare broadband availability with broadband adoption. It is clear that many people who have the opportunity to connect have chosen to abstain. It would be interesting to dig deeper into this phenomenon. Possibly this work and more general extensions of this survey could be continued by some university group.

**9.0 Access to Telecommunications by Persons with Disabilities**

The FCC was given the task of creating, maintaining, and enforcing regulations to ensure accessibility to telecommunications services by persons with disabilities. Congress deemed legislation and regulations were necessary in this area most likely because it was not expected that normal market forces would lead to a timely and acceptable outcome. With rapidly advancing technologies the Commission's duties are likely to get more complicated. In advancing the FCC's accessibility charge, we need to consider which evolving technologies are most likely to create new barriers that the FCC will be asked to address. At the same time, it would be smart to take advantage of new technologies to simplify required regulations, and also to foster new technologies that might even reduce the need for regulations. It would generally be best if disability access could be achieved using mainstream technologies especially in places where access currently requires assistive technologies (AT).

Some examples of the technology areas that the FCC should be prepared to act on in the future voice over IP, satellite, and new wired and wireless transmission technologies because compression is likely to be used and may distort signals, used per persons requiring special access. TTY, captions, descriptions, and added semantics may be especially vulnerable to compression. Speech distortion may interact in unfavorable ways with assistive voice aids.
Transmission technologies are particularly important for FCC to address because there is little or nothing consumers or even individual vendors can do individually. Packet transmission could become a key issue if poor operation results from packet loss. With a growing aging population, hearing aid interference, as might result from being situated in the path of a strong radio beam, takes increasing importance. Most likely signal levels are probably too low to be a problem, but who is responsible for asking the question?

New technology may interfere with assistive technologies where the old technology did not, for example, when digital wireless replaced analog. New technology may not work with existing AT, and sometimes the difference is a simple incompatibility, but often the problem is more complex and beyond ability of the AT to cope with the change. Many of these problems are caused by a lack of awareness on the part of designers of the issues of the AT community and are preventable. Often, they are even preventable at low or no cost if done up front – and often with unexpected benefits to everyone. Sometimes new technologies require special solutions that are not predicted far in advance but only identified at the emergent stage when there is not enough time to develop a solution. We have an obligation to citizens who require AT to not disenfranchise them from the same set of options available to the rest of the world.

Sometimes when new technology which performs the same ultimate function as old technology appears, it becomes unclear (because of its new form) if it is covered by regulations with respect to the disabled. As an example, closed captioning capabilities are addressed for broadcast receivers, but what about digital broadcasting over the Internet? What role does the FCC have?

Looking toward the future, some areas to explore might include the practicality of defining unified solutions as opposed to using a different approach for each platform. Gateways, especially gateways in the network, can provide powerful transition support solutions and might be directly encouraged by the FCC. Some basic principles are that new technology must provide the same essential functionality and guarantees as the old, must be stable, and not saddle one portion of the population with a disproportionate cost to maintain disability access. We want a level playing field for those implementing access yet encourage the implementation of technology advances while ensuring the interoperability, forward/backward compatibility, availability and reasonable cost. An objective would be to make all designers of new mainstream systems aware of the special needs of the disabled so that not only could we reduce the need for special formats and devices but we could provide an added functionality that everyone could use. We should use the closed captioning of television as a good example of a technology that was introduced for AT purposes but is now widely used by many other communities.

## 10.0 Robustness, Reliability, Integrity and Security of the Network

An important issue for this work area is that of content protection and rights management. As was described above, this item is addressed by the Consumer and Home Networking group. Many of the other items originally directed to the working group proposed for this topic are being adequately covered by other groups sanctioned by the Commission. We need not duplicate the work being done by the NRIC (Network Reliability and Interoperability Council). The TAC monitors and has liaison to the FCC NRIC. Because of this evolution, the work of this group has been absorbed into the other four working groups.

## 11.0 The Future of the TAC

Wednesday December 4, 2002 was the last formal meeting of TAC II. The TAC is chartered for two year intervals, and we understand that the Commission now wishes this activity to continue. The process has begun to approve of another two year cycle and invite industry experts to serve. As a reference, at the end of the first instantiation of the TAC there was a natural rotation of members with about half of the original participants remaining for continuity.

**Annex 1: Official Meeting Minutes**

A VHS videotape of the Wednesday December 4, 2002 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, nor does it, per se, necessarily represent the final recommendations of the TAC as a whole.

**Annex 2: Addresses of Current TAC Members**

| Name | E-Mail Address |
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**Annex 3: FCC staff**

***FCC staff associated with the TAC are:***

Edmond J. Thomas, Chief of the Office of the Engineering and Technology
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Paul Kolodzy, OET Senior Spectrum Policy Advisor; Chair, FCC Spectrum Policy Task Force
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Peter Tenhula, Senior Legal Advisor, Office of Chairman Michael Powell,
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***FCC staff available to address questions from the TAC:***

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


Paula Silberthau: Attorney, Office of General Counsel
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Additional FACA information is at the Office of Government Policy web page at:

http://www.policyworks.gov

**Annex 4: Working Groups**

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

Ongoing TAC information is posted at http://www.fcc.gov/oet/tac/

**Spectrum Management/ SDR/ Noise Study:**

Website: http://www.seas.gwu.edu/~cjackson/TAC/

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
Stevens, Jessica

**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:**

Website: http://trace.wisc.edu/docs/fccadv/disability.htm

Goldberg, Larry, CHAIR
Bellisio, Jules
Liao, Paul
Vanderheiden, Gregg