Technical Advisory Council
Federal Communications Commission
Summary of Meeting
March 28th , 2012

The Technical Advisory Council (TAC) for the FCC was convened for its sixth meeting at 1:00 P.M. on March 28th , 2012 in the Commission Meeting Room at the FCC headquarters building in Washington, DC. A full video transcript of the meeting is available at the FCC website at http://www.fcc.gov/encyclopedia/technology-advisory-council together with a copy of all materials presented at this meeting. In addition, all materials presented at this meeting are included in electronic form in an Appendix to this document.

In accordance with Public Law 92-463, the entire meeting was open to the public.

Council present:

Richard Currier, Loral Space and Communications	Milo Medin, Google, Inc
Shahid Ahmed, Accenture	Anthony Melone, Verizon
Mark Bayliss, Visual Link Internet	Geoffrey Mendenhall, Harris Corporation
Nomi Bergman, Bright House Networks	Randy Nicklas, XO Communications
Peter Bloom, General Atlantic	Mark Richer, ATSC
Greg Chang, YuMe, Inc.	Dennis Roberson, IIT
kc claffy, UC at San Diego	Jesse Russell, incNetworks
David Clark, MIT	Marvin Sirbu, Carnegie Mellon University
Lynn Claudy, National Association of Broadcasters	Kevin Sparks, Alcatel-Lucent
Marty Cooper, Dyna LLC	Paul Steinberg, Motorola
Brian Daly, AT&T	Harold Teets, Time Warner Telecom, Inc.
Charlotte Field, Comcast Corporation	David Tennenhouse, New Venture Partners
Mark Gorenberg, Hummer Winblad	Glenn Tindal, Juniper Networks
Dick Green, Liberty Global, Inc	Charlie Vogt, GENBAND
Russ Gyurek, Cisco Systems	Jack Waters, Level 3 Communications LLC
Dale Hatfield, Silicon Flatirons Center	Joe Wetzel, EarthLink, Inc.
Kevin Kahn, Intel Corporation	Tom Wheeler, Core Capital Partners, LLC
Brian Markwalter, CEA	
John McHugh, OPASTCO	

FCC staff attending in addition to Walter Johnston and Julius Knapp included:

Michael Ha, FCC	Daniel Kirchner, FCC
Chris Helzer, FCC	Henning Schulzrinne, FCC
Gregory Intoccia, FCC	

Tom Wheeler, Chairman of the TAC began the meeting by introducing the new TAC members. These were:

- Greg Chang – Yume
- Marty Cooper – Dyna
- Adam Drobot – OpenTechWorks
- Milo Medin – Google
- Mark Richer – ATSC
- Kevin Sparks – Alcatel Lucent
- Glen Tindal – Juniper Networks
- Joe Wetzel - EarthLink

Tom Wheeler noted that 2011 had been a successful year, setting a high bar for 2012. He suggested that the reasons for success included picking the right questions to ask, good leadership with the work groups, and hard and dedicated work. Discussion proceeded to proposed objectives for 2012 (a copy of the proposed work groups and questions for each work group is attached).

There was discussion on the PSTN questions focused on copper plant retirement. Kevin Kahn noted that it was not for the TAC to discuss whether copper has a role in a future broadband environment. Evolution should be focused on architecture and not media. In addition, the PSTN groups should focus not only on voice but other service requirements as well.

Discussing interconnection issues, it was noted that the recent Commission order on this changes the rules, and that incumbents are required to negotiate interconnection. Tony Melone noted that the industry is starting to develop models with Peter Bloom suggesting that models exist from other sectors that may aid in this evolution. A problem noted with interconnection for the future is the complexity for 'asymmetric services' e.g. text to video or voice to video. Shahid Ahmed suggested that the TAC should look at some of these issues from a supply side/demand side model. It was also noted that with two groups focused on PSTN issues, their working boundaries should be carefully defined and there will be a need for coordination between these groups.

Regarding number plans, Dave Tennenhouse suggested that discussions should move beyond 'numbers'. The future network will also have to deal with Quality of Service requirements. It was noted that there are different levels of service providers and it was question how QOS maps across them. Peter Bloom raised the issue of how QOS is treated in other countries. Lynn Claudy suggested QOS should be better than today with Russ Gyurek noting that QOS is complex with tradeoffs. Joe Wetzel suggested that QOS should be focused at the network or service level and that it is different for fixed versus mobile networks. The challenge noted by Tony Melone is to take different technologies and make them work together to provide the needed service at the lowest cost. Brian Daly emphasized that overall it is the quality of the user experience and QOS is only part of this.

Regarding discussions of receiver performance, Richard Currier asked how do bands with different allocations (e.g. Satellite/ Terrestrial) affect receiver performance requirements? Lynn Claudy raised the issue of the GAO report on this issue and how it should fit into the TAC work. Julie Knapp suggested that more questions on policy should be considered by the receiver performance workgroup with Geoffrey Mendenhall adding that you needed to look at the total equation, transmitter as well as receiver performance.

Dale Hatfield noted that the recent FCC workshop on receiver performance teed up specifying performance versus specifying an interference environment. Jesse Russell agreed, noting that the industry can evolve receiver standards for performance. Brian Markwalter asked the question of who is 'we' in defining standards; the FCC? He noted that we need to be clear concerning the environment and that policy should determine the consequences of not designing to this environment. Dennis Roberson partly concurred, noting that there is not interest in the FCC developing standards, but real interest in standards themselves with discussions diverging between performance standards versus environment standards. Lynn Claudy noted that the FCC can't fully step aside on this issue.

The Multiband group was discussed next. Marvin Sirbhu noted that LTE will necessarily operate on multiple bands. Marty Cooper suggested that the solution will be easy when all radios are able to tune to all bands. Jesse Russell noted that in terms of commercial handsets, power is the determining factor driving design. Kevin Sparks added that economics, efficiency and other tradeoffs exist with Chris Helzer suggesting that limiting factors also include the number of supported bands as well as cost.

The Wireless Apps and Services group was discussed with Peter Bloom stating that the US can do more in this domain with potential to increase jobs. There was some concern noted with regard to regulatory and foreign ecosystem impacting this area. Peter Steinberg suggested that a roadmap of evolution would be useful for this work group. Jesse Russell agreed but added that the foundation should be IPv6 with Henning Schulzrinne adding to this and also noting that M2M must also be fit with legacy.

Shahid Ahmed stressed the need to define the work group mission statement and scope and to define the key mega-questions. Deliverables should include workshops. Brian Daly responded to Henning's point on addresses by noting there is ongoing work on this issue in ATIS and 3GPP. Dale Hatfield noted that this is an area where people with disabilities have particular challenges. To this point, Tom Wheeler noted that the Chairman wanted us to have a broad role.

The Security Work group was discussed last. Dennis Roberson noted that this is a huge issue and the work group needed to define the breadth of the issue and develop a roadmap. Glen Tindall noted that applications can change privileges on a phone and Kevin Kahn noted that there is a particularly unique aspect of privacy with wireless since it is available to all; it is difficult to mask who you are. Dennis Roberson noted that technology creates privacy issues we have yet to think about. Peter Bloom suggested that education may be the principle output of this group. Kevin Sparks noted the group will

need to be focused to address the broad generic privacy concerns and that for the group to make progress; the scope needs to be kept in bounds. Shahid Ahmed noted that there is an intersection with the M2M work and privacy.

At the conclusion of the meeting, Tom Wheeler urged that the groups will need to focus on their topic and identify the issues the broader TAC group will need to discuss. In particular, he asked how do we identify recommendations to the Commission?

The work groups were asked to meet over the next two weeks. In addition, requests for changes to participation in specific groups should be done over the next week. By next week, a final list of work group participants would be emailed to all.

Walter Johnston, Chief/ECD
FCC

3-28-12 Presentation with Work Group Assignments

Technological Advisory Council Meeting

March 28th 2012

New TAC Members

- Greg Chang – Yume
- Marty Cooper – Dyna
- Adam Drobot – OpenTechWorks
- Milo Medin – Google
- Mark Richer – ATSC
- Kevin Sparks – Alcatel Lucent
- Glen Tindal – Juniper Networks
- Joe Wetzel - EarthLink

2012 TAC Representation

Accenture	Comcast	Hummer Winblad	NAB	Verizon
Alcatel-Lucent	Core Capital Partners	incNetworks	New Venture Partners	Virginia ISP Assoc
Apple, Inc.	Dell Inc.	Insight Venture Partners	OPASTCO	VON Coalition
ARRL	Dyna LLC	Intel Corporation	Qualcomm	WildBlue
AT&T	EarthLink, Inc.	Juniper Networks	Subject Matter Experts	WNRC
ATSC	GENBAND	Level 3		XO
Bright House Networks	General Atlantic	Liberty Global	Silicon Flatirons	YuMe, Inc.
Caida	Google, Inc	Loral	Subject Matter Expert	
CEA	Harris	Microsoft	Time Warner Telecom	
Cisco Systems	Home Box Office	Motorola	Tiversa	

2011: A Success Story

- Recommendations Made to Chairman on broadband deployment:
    - 'Race to the Top'
    - EO for broadband use of federal land and buildings
    - Fast-track deployment on existing towers
    - Educational outreach on deployment best practices
    - Development of common tools for coordination of planned infrastructure projects
    - Develop new broadband metrics beyond speed
    - Develop knowledge on legacy transition issues
    - Commission should focus on evolution to all IP network and its effect on consumers and end users

- Commission engaged on recommendations

2011 Accomplishments

- Workshop: Small Cell Technology
- Workshop: Telephone Network In Transition
- Workshop: DAS & Small Cell Technology Education Workshop
- Proposed IPv6 tracking metrics
- Created CEA IPv6 Work Group
- Recommended ongoing IPv6 industry/government monitoring group
- Issued white paper on Spectrum Efficiency
- Recommended focus on PSTN transition
- Met with industry, trade groups, academia, government experts
- HR 3609 incorporated TAC language on tower siting and right of way
- HR 3609 requires GAO to undertake study on receiver performance and spectrum efficiency

2011 Success Factors

- Picking the 'right questions'
  - Joint interest between Commission and TAC members on the subject
- Effective leadership within work groups
- Ongoing discussion of work group results and adjustments of objectives at TAC meetings

2012 TAC Objectives

Work Groups

- PSTN Transition Issues Work Group

- PSTN Successor Infrastructure Work Group

- Receivers and Spectrum Work Group

- Multi-band Devices Work Group

- Wireless Apps and Services Work Group (M2M)

- Wireless Security Work Group

PSTN Transition Issues Work Group

The *PSTN Transition Issues* Work Group will focus on identifying and evaluating issues that arise out of the shift in voice service usage patterns. As consumers and businesses use different networks and infrastructures to meet needs traditionally served by the PSTN, a variety of challenges emerge…

Leader: Nomi Bergman (Brighthouse)/Russ Gyurek(Cisco)

Ahmed, Shahid	Accenture	Sirbu, Marvin	Carnegie Mellon University
Bergman, Nomi	Bright House Networks	Teets, Harold	Time Warner Telecom, Inc.
Gyurek, Russ	Cisco	Waters, Jack	Level 3 Communications LLC
McHugh, John	OPASTCO	Wetzel, Joe	Earthlink
Melone, Anthony	Verizon		

FCC Liaison: Dan Kirschner

PSTN Successor Infrastructure Work Group

The *PSTN Successor Infrastructure* Work Group will focus on identifying key elements essential to an IP-based real-time communications infrastructure. As consumers and businesses turn to other networks to replace functionality previously provided by the current voice network, questions arise as to how those networks can replicate the best characteristics of the circuit-switched network while taking advantage of their advanced technological underpinnings…

Leader: Brian Daly (AT&T)/Tom Evslin(VON Coalition)

claffy, kc	UC at San Diego	Field, Charlotte	Comcast	Teets, Harold	TW Telecom
Bayliss, Mark	Visual Link	Gyurek, Russ	Cisco Systems	Tennenhouse, David	New Venture Partners
Clark, David	MIT	Kahn, Kevin	Intel	Vogt, Charlie	GENBAND
Daly, Brian	AT&T	Reed, Dan	Microsoft	Wetzel, Joe	Earthlink
Evslin, Tom	VON	Russell, Jesse	incNetworks	Zitter, Robert	HBO
Nasielski, Jack	Qualcomm				

FCC Liaison: Henning Schulzrinne

Receivers and Spectrum Work Group

The *Receivers and Spectrum* Work Group will tackle the issue of the role of receivers in ensuring efficient use of the spectrum and how to avoid potential obstacles to making spectrum available for new services…

Leader: Dennis Roberson

Claudy, Lynn	NAB	Roberson, Dennis	IIT
Currier, Richard	Loral	Gorenberg, Mark	Hummer, Winblad
Green, Dick	Liberty Global	Lapin, Gregory	Amateur Radio
Hatfield, Dale	Silicon Flatirons	Markwalter, Brian	CEA

FCC Liaison: Julius Knapp

Multi-band Devices

Leader: _

		Nasielski, Jack	
Chapin, John	DARPA	Nasielski, Jack	Qualcomm
Cooper, Marty	Arraycomm	Richer, Mark	ATSC
Markwalter, Brian	CEA	Russell, Jesse	incNetworks

FCC Liaison: Michael Ha/Chris Helzer

Wireless Apps and Services (M2M)

The *Wireless Apps and Services* Work Group will continue and build upon the good work of the previous TAC's Sharing Work Group on reducing application friction points…

Leader: Shahid Ahmed

Sparks, Kevin	Alcatel Lucent	Tindal, Glen	Juniper
Bloom, Peter	General Atlantic	Tribble, Bud	Apple
Chang, Greg	Yume	Parekh, Deven	Insight Venture Partners
Evslin, Tom	VON	Clark, Wesley	WKC Assoc.
Mendin, Milo	Google	Zitter, Robert	HPB

FCC Liaison: Walter Johnston

Wireless Security and Privacy

The *Wireless Security and Privacy* Work Group will examine the security vulnerabilities of the air interfaces used by commercial wireless networks, how they are being addressed and what role, if any, the Commission should play on this issue…

Leader: Kevin Sparks

Kahn, Kevin	Intel Corporation	Nicklas, Randy	XO
Sparks, Kevin	Acatel Lucent	Reed, Daniel	Microsoft
Mendenhall, Geoffrey	Harris Corporation	Steinberg, Paul	Motorola

FCC Liaison: Gregory Intoccia

Work Group Questions Presented at 3-28-12 TAC Meeting

PSTN Transition Issues

1. Copper Retirement
   - What services remain dependent upon the existing twisted-pair copper plant? What services may no longer be available if twisted pair copper is no longer offered from customer premises to the wire center? What non-voice services and features will not work without modification in an all IP-based network?
   - What substitutes exist for services that may not be able to transition from the analog circuit-switched network? What is the cost or technological impact of the substitute?
   - As landline voice service decreases, what fraction of copper loops is left idle, rather than serving as DSL loops or being put to other use? How is non-voice demand for copper loops expected to change over 5-10 years?
   - Are there practical uses of abandoned copper and if so, what are the uses, and what are the costs (or cost drivers) and technological impediments to putting such copper to use?

2. PSTN Users
   - What technologies might encourage or ease transitions to IP-based networks for consumers, especially those who might otherwise find a transition disruptive?
   - For consumers who only want to pay for a fixed voice connection, are there cost-effective mechanisms for supplying that connection if there is no circuit-switched last mile, such as standalone managed VoIP service over DSL or fixed wireless service? What are potential issues when running VoIP over (fixed) LTE, whitespace wireless, or other fixed wireless access solutions?

PSTN Transition Issues

1. Interconnection Group A

    –   What methods have evolved for the exchange of traffic in the hybrid IP-based/circuit-switched network? How will those methods transition as the network shifts to being wholly IP-based?

    –   How might interconnection requirements and provisioning evolve as consumers adopt new communications technologies, such as HD voice or video?

2. Database Transition Group A

    –   What legacy databases will need to transition to a future all-IP environment?

    –   How will databases that are essential to the operations of the PSTN need to evolve to operate in an IP-based network?

PSTN Successor Infrastructure

1. Interconnection Group B
   - Do technological interconnection issues exist at higher protocol levels, e.g., SIP?
   - What architectures might evolve to support VoIP interconnection and interconnection of advanced communications services? How would architectures function at different network layers (e.g., MPLS, IP, SIP)?
   - Develop a detailed matrix of technical issues that need to be worked out for an IP interconnection framework, the entities who would need to be involved in each aspect, and preliminary thoughts on possible technical solutions.

2. Numbering Group B
   - What changes might be expected in a numbering plan optimized for IP-based communications services? (For example, current numbering systems are tied to physical resources, such as lines, and are often service specific, e.g., SMS short codes.)
     - What are the obstacles to assigning numbers to users, analogous to how domain names are assigned, rather than to service providers?
     - Should number assignment need to retain a geographic component? For example, do numbers still need to be assigned to specific rate centers in an all-IP world?
     - How can the receiver of a call validate that the caller is authorized to use the number or other identifier ("caller ID validation")?
     - What role is ENUM going to play as a number mapping service as the numbering system evolves? Is there a need for additional or alternate solutions?
   - How might technological changes drive signaling requirements and number translation capabilities?

PSTN Successor Infrastructure

3.   Database Transition Group B

– What new databases or database architectures will be necessary or helpful in an all-IP network?

– To what extent are these new databases already developing? Who is developing them? What challenges does their development face?

4.   Quality of Service

– How will the use of end-to-end IP connectivity impact QoS? Is there a need for defined call quality metrics? How can we properly measure and assess the difference in QoS in IP service relative to circuit-switched service? What are the complexities associated with measuring IP QoS?

– What entity or entities can best perform reliable, unbiased and comprehensive QoS testing? Can this be done by industry and/or government groups or labs and if so, do such groups/labs exist already?

– Can end-to-end QoS be provided across service providers? What models seem possible (e.g., DiffServ, resource reservation, separate physical, or L2 networks)?

– How would the use of multiple media (high-quality audio, video) impact QoS considerations?

PSTN Successor Infrastructure

5.   Robustness and Public Safety
  – How will the transition affect network robustness?
  – What will robustness likely improve or degrade in the transition?
  – What technologies can improve network survivability? How effective are these technologies likely to be compared to existing PSTN survivability?
    • Wireless
      – Backup power at base station and handsets?
      – Capacity vs. footprint tradeoffs
    • Wireline
      – Backup power for both the network and home or small business environments?
  – What, if any, additional capabilities are needed from the underlying broadband network to enable 911 or other emergency services functionality that is at least equivalent to that offered by the existing system?

Receivers and Spectrum

1. What resources are available on the performance of receivers, particularly relative to adjacent channel rejection?
2. What are the gaps in what is known about receiver performance, particularly relative to particular services that rely on reception of weak signals such as radar and satellite services?
3. What work should be undertaken to close these gaps?
4. Who should perform this work and what role should the FCC play relative to closing the knowledge gaps relative to receiver performance?
5. How can information about receiver performance be made more transparent to prospective users of spectrum that is a candidate for repurposing?
6. To what extent is it important to have access to such information for federal systems?

Receivers and Spectrum

7. To what extent do national security concerns come into play in making information available about receiver performance for both federal systems and non-federal public safety and critical infrastructure systems?

8. What particular parts of the spectrum are of greatest priority for study of receiver performance and how it might affect access to spectrum for new services?

9. How might the FCC best approach receiver performance from both a technical and policy perspective?

10. If performance metrics were established for receivers, what parameters should be subject to these metrics and how should criteria for performance be derived?

11. What approaches should be taken relative to receivers that do not conform to the metrics?

12. How should the Commission address situations where there is a significant issue relative to legacy equipment? For example, should the FCC establish transition periods based on the full expected life of most legacy equipment or take steps to enable faster deployment of new services?

Multi-band/Multi-mode Devices

1. What are the challenges that face commercial wireless service providers and equipment manufacturers in providing service across multiple frequency bands and multiple mode of operation?

2. How are they approaching these challenges? For example, are the carriers and equipment manufacturers forced to choose which bands they will cover in any particular area or device based on technical limitations? How is interoperability managed for multiple-mode of operation?

3. How will these challenges become more difficult or easier in the near term and long term future?

4. What are the challenges relative to filter technology both from a transmitter and receiver standpoint?

5. What are the challenges relative to antenna technology?

Multi-band/Multi-mode Devices

6. How do these various factors affect performance and quality of service? For example, does the need to operate across multiple bands necessarily lead to compromises in the ability to receive weak signals or reject interference?

7. Are challenges mostly on hardware? Any firmware challenges such as preferred system acquisition?

8. What is the impact on battery life?

9. What are the limitations today on the frequency range that can be covered by a multi-band device? How might they change in the future?

10. How would the availability of frequency bands above 3 GHz for small cell deployment such as the 3550 – 3650 MHz band or the 5 GHz Wi-Fi bands affect the availability and use of multi-band devices covering these frequency ranges?

Multi-band/Multi-mode Devices

11. How will the availability of new spectrum in the 600 MHz range recovered through a voluntary incentive auction affect the design and availability of multi-band devices?

12. What is the process of Multi-band/Multi-mode device certification and type approval process? Is there a room for improvement?

Wireless Apps and Services

1. What is the experience thus far in the development of wireless apps and services?

2. What obstacles have been encountered by carriers, innovators and users in the introduction of these services?

3. What are the current friction points relative to the availability of wireless apps and devices for health care? For energy? For education? Public safety?

4. What specific steps can be taken to reduce or remove these friction points?

5. What are the principal M2M applications today?

6. What impact are those M2M applications having on the networks?

7. What is the projected growth of M2M applications and what impact are they expected to have on the networks in the future?

Wireless Apps and Services

8. Are particular M2M data hungry applications such as video surveillance and monitoring anticipated to have a particular impact on the networks? If so, how will they be dealt with?

9. How does the current industry process work for approval of new apps and M2M services & devices?

10. Do the carriers have any pre-defined boundaries or parameters necessary to obtain approval of wireless apps, services and devices?

11. Are there things the industry can do to improve this process?

12. What can the FCC and other federal agencies do to improve the availability of new wireless apps, services and devices?

13. What privacy issues exist in the introduction and operation of wireless apps and services? What existing regulations affect such issues? How should industry standards and practices be developed to ensure that the rights of users are protected?

14. What capabilities exist in the design of standard application platforms such as IOS, Android, and Windows 8 to ensure appropriate privacy of end user data?

Wireless Security and Privacy

1. What are the chief areas of concern relative to the security of commercial wireless networks, and how would you prioritize them and why?

2. Recognizing that today's mobile communication devices house multiple transceivers operating on multiple bands – each operating independently from one another – what are the security vulnerabilities associated with of each of those RF transceivers?

3. What are the most significant privacy issues from a wireless technology point of view, and how should the Commission begin to address them?

4. Is the air interface the most appropriate area in which to focus? If not, what areas are most appropriate?

5. What are the security features of today's wireless networks?

6. What are the security features that will be introduced for the next generation of wireless technology?

7. What is the scope of potential vulnerabilities? For example, could security vulnerabilities lead to service outages? Hacks of private information?

Wireless Security and Privacy

8. How does the industry identify breaches in security?

9. What response systems are in place for dealing immediately with security attacks?

10. Are different levels of security available to users depending upon the type of application? For example, can public safety or critical infrastructure applications be provided with greater security than an ordinary smart phone?

11. To what extent is jamming a concern and what has the experience been thus far? What is and can be done about this?

12. To what extent is theft of service a concern and have there been instances where this has occurred already? What can and is being done about this?

13. To what extent is the industry addressing concerns about privacy?

14. What roles should the FCC and other federal agencies play in this area?