

Technical Advisory Council
Federal Communications Commission
Summary of Meeting
April 12, 2018

The Technical Advisory Council (TAC) for the FCC was convened for its twenty-sixth meeting at 12:30 A.M. on April 12th, 2018 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, 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:

John Barnhill, SME	Mark Hess, Comcast Corporation
Mark Bayliss, Visual Link Internet, Lc	Steve Lanning, Viasat, Inc
Nomi Bergman, Advance Newhouse Communications	Kevin Leddy, Charter Communications
John Chapin, Roberson & Associates Consulting	Tom McGarry, Neustar
Marty Cooper, Dyna LLC	Milo Medin, Google, Inc
Brian Daly, AT&T	Lynn Merrill , Monte R. Lee & Company
Adam Drobot, OpenTechWorks	Dennis Roberson, Illinois Institute of Technology
Lisa Guess, Juniper Networks	Marvin Sirbu, Carnegie Mellon University
Russ Gyurek, Cisco Systems	Paul Steinberg, Motorola
Dale Hatfield, Silicon Flatirons Center for Law, Technology, and Entrepreneurship University of Colorado at Boulder	David Tennenhouse, VMWare
Stephen Hayes, Ericsson North America	Melanie Tiano, CTIA

Attending Remotely:

Lynn Claudy, National Association of Broadcasters	Jane Kelly, FCC
Jack Nasielski, Qualcomm, Inc.	Kevin Sparks, Nokia

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

Eric Burger, FCC	Michael Ha, FCC
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NTIA Staff attending:

Rangam Subramanian, NTIA

Meeting Overview

Dennis Roberson, TAC Chairman, began the meeting by noting that the first TAC meeting had been held in April 1999 making this the 19th year of the TAC. He also noted that this was the first meeting of the TAC in 2018. He explained the process of selecting the work groups with the direct input of the Chairman while having the benefit of the FCC Chairman's involvement, had delayed the start of this first meeting. He also introduced Melanie Triano as the new representative for CTIA. He discussed the 2018 work groups, noting that he was especially enthusiastic regarding the group focused on antennas, a special interest of his. In addition, he noted that while we had 6 work groups defined, the power work group had not yet started due to the difficulty of getting a chair with the appropriate expertise, though we were still following some leads to a possible chair. He next allowed the attending TAC members to introduce themselves.

The TAC workgroups next proceeded to review their work objectives. A copy of all presentations is attached herein.

At the end of the presentations, the TAC Chairman discussed the challenge of the coming year's schedule and the need to make final recommendations for the December year end meeting. Dennis thanked all the co-chairs and liaisons for initiating the work groups and helping to ensure the overall success of the program. He further thanked all the participants in the program. The meeting was then concluded.

Walter Johnston, Chief EMCD-OET
FCC

Technological Advisory Council

Antenna Technologies

Working Group

April 12, 2018



Antenna Technology Working Group

- **Chairs:**
 - Greg Lapin, ARRL
 - Marty Cooper, DynaLLC
- **FCC Liaisons:**
 - Martin Doczkat, OET
 - Michael Ha, OET
 - Bahman Badipour, OET
 - Kamran Etemad, WTB
- **Participants / Contributors:**
 - Mark Bayliss, VisualLink
 - Nomi Bergman, Advance Newhouse
 - John Chapin, Natl Spectrum Consortium
 - Lynn Claudy, NAB
 - Pierre de Vries, Silicon Flatirons
 - John Dobbins, Windstream
 - Adam Drobot, Open Tech Works
 - Jeff Foerster, Intel
 - Dale Hatfield, Univ of Colorado
 - Stephen Hayes, Ericsson
 - Farooq Khan, PHAZR Inc
 - Kevin Leddy, Charter Comm
 - Bob Miller, incNetworks
 - Sven Petersson, Ericsson
 - Sudhir Ramakrishna, PHAZR Inc
 - Hamidreza Memarzadeh, Samsung
 - Jesse Russell, incNetworks
 - Charlie Zhang, Samsung



Antenna Technology Developments

This work group is tasked to report on the state of development of antenna technologies and their implications for FCC policies, technical standards, regulatory and technical issues. The tasking is intended to cover as broad a scope of radio services as feasible as well as fixed and mobile applications.

- Adaptive phased array antennas have the ability to dynamically focus signals creating new forms of interference avoidance and possibly necessitating new technical standards and rules.
- Metamaterials offer another option to produce more efficient antenna elements for devices and arrays at lower cost.
- Massive MIMO, Multi-User MIMO And other technologies promise increased spectrum efficiency but may require rule changes.
- Necessity for large numbers of frequency bands present challenges for phone designers.



Antenna Technology Developments [cont]

- Wearable antennas to support health care applications.
- Disguised antennas to permit dense deployments of millimeter wave antennas.
- Free access to poles and street lights in municipalities.

Antenna Technology Topics To Investigate

- Array Antennas
 - Electronically Steered Antennas
 - Reflect Arrays
- Metamaterials
 - Electronically Steered Antennas
 - Small Antennas for Long Wavelengths
- mm-wave Antenna Technology
 - Small Cell Antennas
 - Satellite Antennas

Antenna Technology Topics To Investigate

- Antenna and Propagation Modeling Tools
- Near Field Interactions
- Antennas in Interference Rejection
- Human Exposure Compliance – especially for wearable devices
- Filtering Antennas

Antenna Technology Speakers

- Ryan Stevenson, Kymeta, Corp
 - Metamaterial satellite antennas
- Ted Rappaport, NYU
 - Smart antennas for 5G
- Joe Carey, Trimble Corp
 - Beam forming antennas
- Rick Ziolkowski, Univ of Arizona
 - Metamaterials for reduced size antennas
- Marty Cooper, DynaLLC
 - Smart antenna tutorial

Antenna Technology Speakers

- Jeff Shamblin, Ethertronics
 - Cell phone antenna design
- Jim Nevelle, Kathrein
 - Small cell antenna solutions
- Kevin Linehan, Commscope
 - The difference between sub 6GHz massive MIMO and mmWave beamforming antenna technology
- Antonio Forenza, Artemis Networks
 - pCell technology; adaptive antennas with central processing
- David Helfgott, Phasor
 - Antennas for low-cost satellite terminals

Possible Deliverables

- Recommendations for rule changes to accommodate new antenna technologies
- White Papers
 - Spectral Efficiency
 - Interference Rejection
 - Regulatory Implications, e.g. Spectrum Sharing
 - Direction Finding Antennas for Enforcement
- Workshop
- NOI

THANK YOU



Communication Strategies for Unmanned Aircraft Systems (UAS)

Chair: John Chapin, Roberson & Associates

FCC Liaisons: Robert Pavlak, Office of Engineering and Technology
Brian Butler, Office of Engineering and Technology
Tim Maguire, Wireless Telecommunications Bureau
Anita Patankar-Stoll, Public Safety & Homeland Security Bureau

Date: April 12, 2018



Working Group Members

- Shahid Ahmed, PwC
- Reza Arefi, Intel
- John Barnhill
- Mark Bayliss, Visualink
- Nomi Bergman, Advance
- John Chapin, Roberson & Assoc.
- Brian Daly, AT&T
- Pierre De Vries, Silicon Flatirons
- Jeffrey Foerster, Intel
- Lisa Guess, Juniper
- Steve Lanning, Viasat
- Greg Lapin, ARRL
- Brian Markwalter, CTA
- Young-Han Nam, Samsung
- Jack Nasielski, Qualcomm
- Mark Richer, ATSC
- Dennis Roberson, Roberson & Assoc.
- Michael Tseytlin, Facebook
- David Young, Verizon



Stakeholder Priority Topics

- Study the spectrum issues for UAS
 - Including control, payload, identification, monitoring, collision avoidance
- Address the following specific questions:
 - What frequency bands are available today, and are they sufficient?
 - o Consider payload needs as part of this
 - Which UAS activities can be carried out using existing systems or services (CMRS, Land-mobile, Satellite, Aviation, GNSS, etc.)?
 - What are the trade-offs for the various alternative frequency bands?
 - To what extent has loss of communications been a major contributor to loss of UAV?
 - What are the issues of harmful interference to systems on the ground?
 - What new requirements and roles for radar arise from UAS?

Stakeholder Priority Topics (continued)

- Specific questions (continued):
 - What is an appropriate requirement for station ID in UAS transmissions?
 - What is an appropriate requirement for radio certification?
 - What testing facilities are available to evaluate these concepts?
- Make recommendations including:
 - What taxonomy should the FCC use in its regulatory approach?
 - What should the FCC study or do to meet the various spectrum needs for UAS?
 - Considering the need to make efficient use of the spectrum

Work Plan for the UAS-WG

- Active Topics

- Current situation and trends
- Communications spectrum for UAS operations
 - Called Control and Non-Payload Communication (CNPC) by FAA
- Spectrum for UAS payload activities
- New spectrum management approaches

- Potential Topics

- Spectrum implications of UAS detect & avoid methods
 - Radar or communications based
- Other uses of radar for UAS
- Spectrum implications of UAS detection and interdiction methods
- Other FCC regulations for UAS
- Test Facilities and Innovation

Current UAS Situation and Trends

- Taxonomy/Categories of UAS, UAV, operators and usage
- Use cases, number in operation, users, density of operation
- UAS traffic management
- Spectrum dependent activities
 - Control and Non-Payload Communications (CNPC)
 - On-board and ground Radar – Detect and Avoid (DAA), other
 - Payload Communications
 - UAS Detection and Interdiction
- Ongoing experiments
- Anticipated technical innovations relevant for regulation



Communications Spectrum for UAS Operations

- Map the current and near-future bands, regulations
- Communications reliability: requirements, evidence of impact
- Air-ground & ground-air interference analysis methodology
- Use of existing systems or services for UAS operations
 - Survey relevant spectrum bands, 3GPP and ITU activities
 - Impact analysis of: system coverage, advanced antennas, etc.
 - Requirements needed for safety of flight, and ability of current/planned systems to satisfy those requirements
 - Impact of airborne use on coexistence issues and on system support of terrestrial users
- International harmonization issues

Spectrum for UAS payload activities

- Categorization of anticipated payload activities
- Quantification of spectrum requirements for payload use
- Potential interference to ground systems
- Use cases being studied in depth by the community
- ITU and 3GPP activities

New spectrum management approaches

- Integrated system combining spectrum management and UAS traffic management
 - Potential to restrict density (via traffic management) to assure sufficient spectrum for safety of flight
 - Potential to improve spectrum sharing while ensuring safety of flight
- Technical support for enforcement / forensics / safety
 - Station ID requirements for transmissions
 - Black box recording spectrum utilization by UAS operations
 - Real-time feedback from UAS when interference is detected
 - Report statistics on loss-of-link events to a safety database

Potential topics

- Spectrum implications of UAS detect & avoid (DAA) methods
 - Do new usage patterns require modifications to airborne Radar regulations?
 - Implications of communications-based DAA methods
 - FCC actions needed to support
- Other uses of radar for UAS
 - Assess usage, needs, regulations
 - FCC actions needed to support
- Other FCC regulations for UAS
 - Equipt. certification, Operator licns.
- Spectrum implications of UAS detection/interdiction methods
 - Survey of mechanisms proposed for detection, tracking, mitigation
 - FCC actions needed to support
- Test Facilities and Innovation
 - Survey test facilities
 - What UAS related regulatory issues require new facilities?
 - Modifications to FCC experimental license policies appropriate?
 - Opportunities to accelerate innovation?



Mobile Device Theft Prevention WG Report to the FCC TAC

April 12, 2018



WG Participants

- Co-Chairs:
 - Melanie Tiano, CTIA
 - TBD
- FCC Liaisons:
 - Walter Johnston
 - Charles Mathias
 - Elizabeth Mumaw
 - Michele Wu-Bailey
- FCC TAC Chair:
 - Dennis Roberson
- Document Editor: TBD
- Jason Novak, Apple
- Timothy Powderly, Apple
- Maria Kirby, Apple
- Ogechi Anyatonwu, Asurion
- Jay Barbour, Blackberry
- Brad Blanken, CCA
- John Marinho, CTIA
- Jamie Hastings, CTIA
- Mike Carson, ebay
- Mike Rou, eBay
- David Mersten, ecoATM
- Max Santiago, ecoATM
- Christian Schorle, FBI
- James Moran, GSMA
- Craig Boswell, Hobi
- Chris Drake, iconectiv
- Chip Stevens, iconectiv
- Sang Kim, LG
- Gunnar Halley, Microsoft
- Joseph Hansen, Motorola
- Joe Heaps, National Institute of Justice
- Thomas Fitzgerald, New York City Police Department
- Jack McCartney, Recipero
- Les Gray, Recipero
- David Dillard, Recipero
- Mark Harman, Recipero
- Maxwell Szabo, City and County of San Francisco
- Gary Jones, T-Mobile
- Samir Vaidya, Verizon Wireless
- Samuel Messinger, U.S. Secret Service

Thank You!



MDTP WG

- The MDTP Work Group has focused on analyzing the theft of mobile devices in the US, working with industry and law enforcement to increase the anti-theft security of mobile devices, facilitate coordination of theft related data between industry, law enforcement and the consumer, and tracking trends.
- Prior work has led to alignment of theft prevention features among smartphone manufacturers and initial development of an industry information portal to coordinate theft data among stakeholders.
- Stolen Phone Checker was officially launched in May 2017. In this first year, over 250,000 devices have been checked using the database.

Focus Areas for 2018

- For 2018, the work group is tasked to build on this early work.
 - Study future mobile device threats and trafficking across international borders and make further recommendations.
 - Continue to work with law enforcement to assess the benefits of the information portal to relevant stakeholders (i.e. stolenphonechecker.org) and identify recommendations for the continued industry collaboration with law enforcement for prevention efforts and analyzing the ongoing effectiveness.
 - Develop baseline statistics on device theft based on data from directed consumer surveys and law enforcement to help track long-term progress and identify theft scenarios.

CTIA Stolen Phone Checker, stolenphonechecker.org

Stolen Phone Checker x +

mdsp.venusgeo.com/v1/3

STOLEN PHONE CHECKER

Consumer

Commercial

Law Enforcement

CTIA's Stolen Phone Checker – powered by [the GSM Device Check service](#) – is a public service designed to limit the resale of lost and stolen mobile devices in the United States and to help consumers, businesses, and law enforcement agencies make informed decisions about the status of a mobile device.

CTIA's Stolen Phone Checker lets consumers and commercial users know if a mobile device is reported lost or stolen before they make a purchase. In addition, law enforcement can check – and hopefully return – found mobile devices to their rightful owner.

Working together, consumers, commercial users and law enforcement, in partnership with the U.S. wireless industry, can help stop the sale of stolen phones.

About Us | [FAQs](#) | [Contact Us](#)

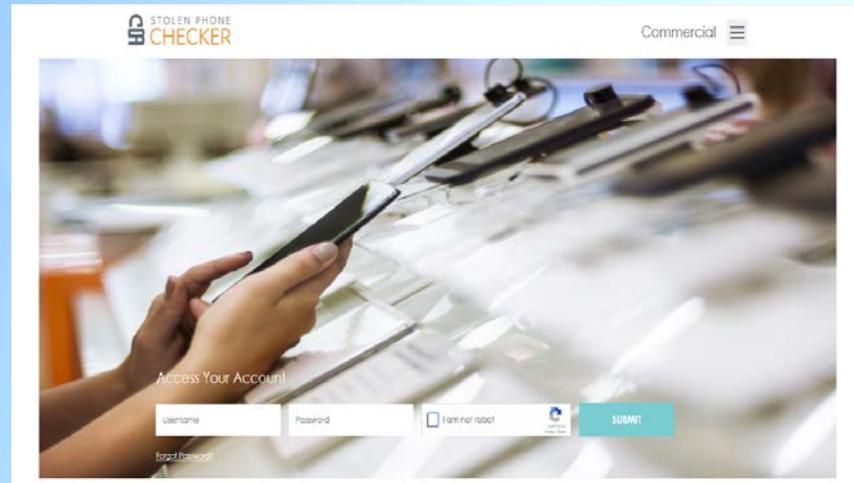
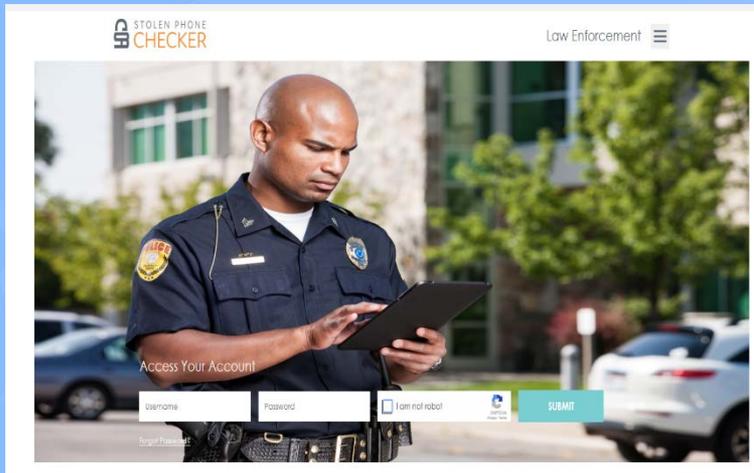
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ctia everything Wireless

powered by Device Check

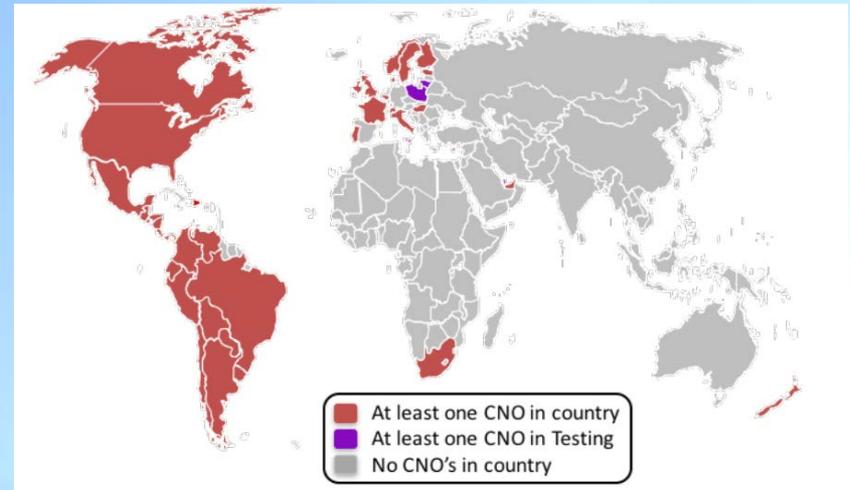
Law Enforcement & Commercial

Stolenphonechecker.org



GSMA Stolen Device Data Sharing Reports

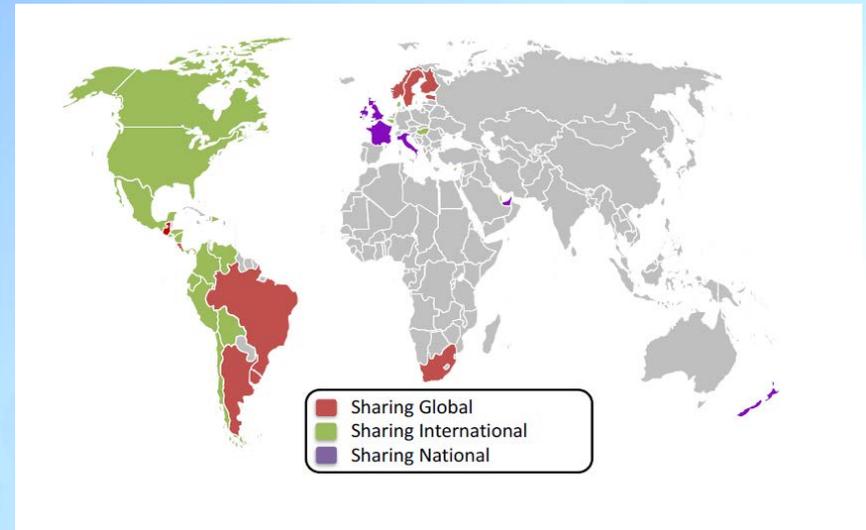
- Describes the network operators participating in the exchange of IMEI data concerning devices reported lost or stolen
- Data is taken from the GSMA IMEI database and relates to operators with active live or test user accounts
- GSMA provides the blacklist information on a 24/7 basis to the operators that have established connections to the IMEI Database for them to download and use within their own networks for device blocking purposes



Key Take-away: There are many countries currently not participating in lost and stolen blacklisting and/or lost and stolen data sharing not taking place between operators, Especially Asia, Africa, Middle East

U.S. Operator Participation in GSMA IMEI Database

- Connected Network Operator & Data Sharing Coverage
 - Verizon Wireless: Global
 - T-Mobile USA, Inc: North America
 - Sprint: Canada, USA
 - AT&T Mobility: North America
 - US Cellular: Global
 - NewCore Wireless LLC: USA



Next Steps for 2018

- Efforts to combat theft and trafficking of stolen mobile devices across international borders and identify where stolen devices end up.
 - International collaboration.
 - Engagement with law enforcement.
 - Analyze future threats and consequences of mobile phone theft solutions.
 - Identify additional studies to address the challenges of tracking where stolen devices go – with an emphasis on international collaboration.
- Compile data statistics on whether mobile device theft continues to decline since the implementation of all of the various tools developed.
 - Review annual CTIA surveys & results.
 - Refresh law enforcement statistics.
 - Select sample list of cities to refresh stolen phone statistics to see trends post implementation of on-device mobile theft solutions and stolenphonechecker.org.
 - Develop procedure to obtain regular updates of the data.
- Identify recommendations for future improvements to the Stolen Phone Checker.
 - Assess the impact of the first year since the launch in May 2017.
 - Identify enhancements to the Stolen Phone Checker (i.e. contraband phones)

Additional Areas for Consideration in 2018

- Engage more operators – both domestically and internationally.
- Analyze what 5G may offer in terms of additional solutions.
- Continue discussions with Federal/State/Local/Tribal law enforcement.
 - Providing the Police Chiefs with a briefing on the Stolen Phone Checker.
 - Soliciting feedback from the Police Chiefs on the Stolen Phone Checker.
 - Request the Police Chiefs to advertise the Stolen Phone Checker with Enforcement colleagues.
 - Request updated smartphone theft statistics in order to evaluate the effectiveness of the theft prevention measures implemented to date.



5G/IoT Working Group

Chairs: Brian Daly, AT&T
Russ Gyurek, Cisco

FCC Liaisons: Walter Johnston, Padma Krishnaswamy

Date: April 12, 2018



2018 Working Group Team Members

- Shahid Ahmed, Independent
- John Barnhill, Independent
- Mark Bayliss, Visualink
- Marty Cooper, Array Comm
- John Chapin, Nat'l Spect. Consort.
- Pierre de Vries, Silicon Flatirons
- John Dobbins, Earthlink
- Adam Drobot, OpenTechWorks
- Jeffrey Foerster, Intel
- Dick Green, Liberty Global
- Lisa Guess, Juniper
- Dale Hatfield, Silicon Flatirons
- Stephen Hayes, Ericsson
- Tim Kagele, Comcast
- Farooq Khan, Phazr
- Robert Kubik, Samsung
- Steve Lanning, Viasat
- Kevin Leddy, Charter
- Brian Markwalter, CTA
- Tom McGarry, Neustar
- Lynn Merrill, NTCA
- Jack Nasielski, Qualcomm
- Mark Richer, ATSC
- Jesse Russell, INC Networks
- Kevin Sparks, Nokia Bell Labs
- David Young, Verizon



Simplified Working Group Mission

- *The purpose of this working group is to study and report on the state of development of 5G era IoT applications across various market sectors*
- *Goal: Are there things that the Commission or other government agencies can or should do relative to 5G and IoT to facilitate such developments?*

Definition: 5G & IoT

- 3GPP specifications will be labelled “5G” from Release 15 onwards
 - More than just NR, also includes Next Gen Core and LTE evolution
 - Also includes a variety of service aspects, e.g. V2X, AR/VR, etc.
- ITU key 5G performance requirements for IMT-2020
- LTE-M and NB-IoT were finalized in 3GPP Release 13
- IoT is more than connected devices
 - Describes an entire ecosystem that communicates with other objects and connects to the Internet, related orchestration
- LTE → catalyst for large-scale IoT deployments
- Ultimate 5G Expectations
 - Will spur further IoT innovation as well as enable improvements to solutions on the market today



Work Group Area of Investigation

pg 1

- **Clarify/Address relationship between 5G and IoT**
 - Categorize broad classes, summarize
 - Perf and throughput requirements for services. Some can only be done with 5G, some don't make the biz model cut for 5G
 - Tie to use cases
- **Market Progress**
 - Coexistence and migration of 4G(LTE) to 5G
 - Opportunities
 - Barriers



Work Group Area of Investigation

pg 2

- **USA comparison to WW 5G**

- What countries are leading (example deployments, what is US slice of mkt)
- Why are others moving faster/slower
- Research and eco-system development
- Economic models- the business case for 5G
- Spectrum differences globally

- **5G era IoT Applications- is there a “killer app(s)”**

- Traffic impact
- Spectrum impact

- **Spectrum use policy:**

- How to encourage app development that is mindful of efficient use of spectrum
- How to monitor services/sources that have high impact to network traffic



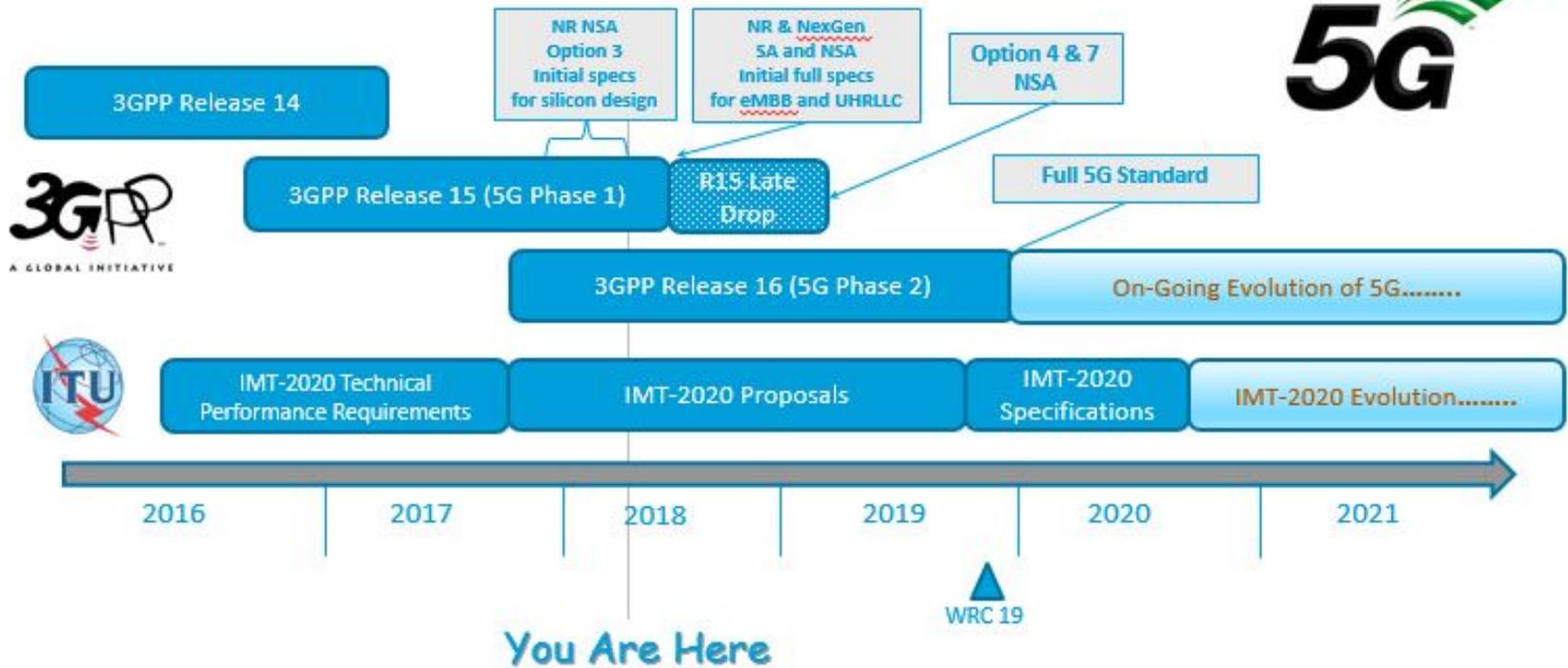
Work Group Area of Investigation

pg 3

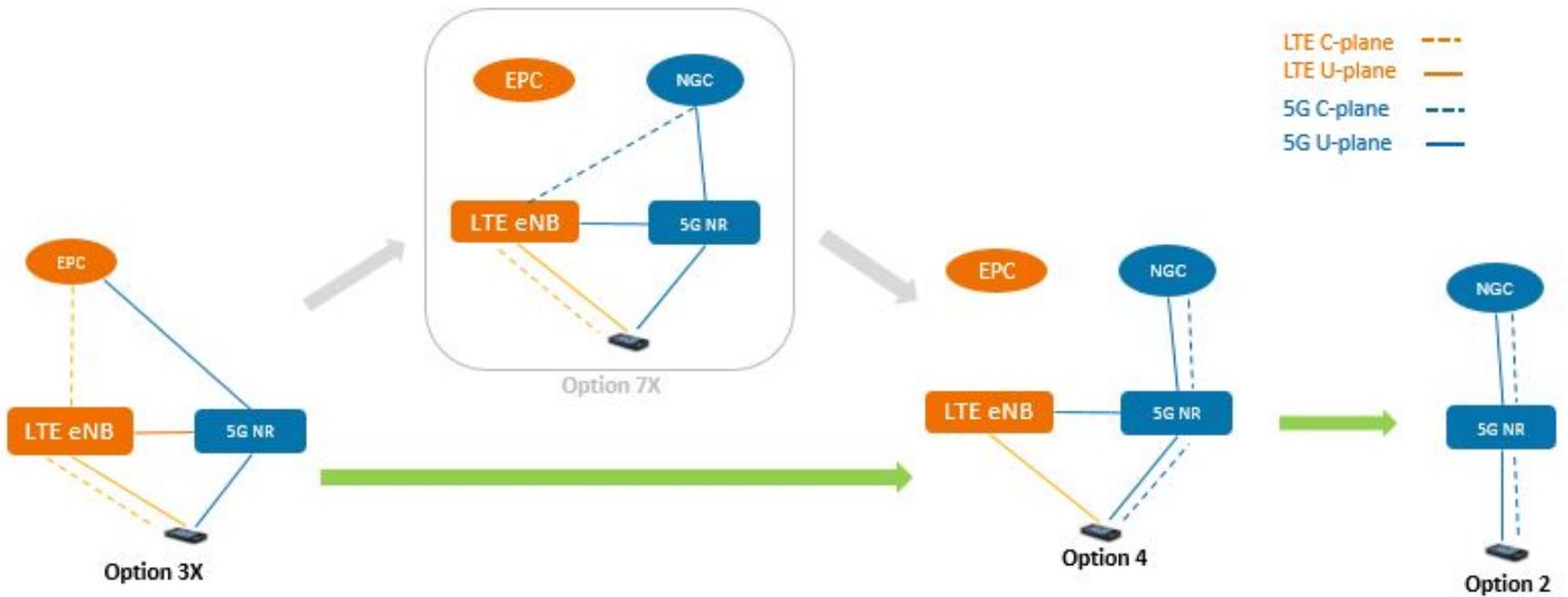
- **Other Government agencies**
 - Where is synergy
 - What are (emerging) best practices
- **Standards & Consortia**
 - Progress and timing: impact to deployments
- **Network impact/evolution**
 - Densification: Economic models
 - Edge/fog/cloudlet compute
 - Open source management & orchestration
 - Analytics & AI
 - RAN, Packet core, x-haul (front, mid, back)



Projected Timelines for Industry 5G



Possible 5G Architecture Evolution Paths



Industry Engagements: Stakeholder Organizations



Possible Key Data to get to 5G

- Network densification creates fiber backhaul investment which is significant
- Deep Fiber supports national infrastructure needs and competitiveness
- New monetization models needed to incent the massive investment needed
- Eliminate barriers which prevent SPs from operating a single IP network, impede fiber investments or restrict types of services offered
- Avoid regulation on innovative approaches to infrastructure: Conduit, trenches, RoW for cell sites
- Spectrum policy
- “Network connectivity is essential for the IoT and there are many wireless access technologies currently in use. However, no single connectivity technology or standard can adequately serve all use cases, so this is where development of multiple 3GPP cellular technology standards can cater to the future. 3GPP is keeping up with the growth of IoT to address the market demand” (5G Americas)
- “Mobile IoT Set to Move From Deployment to Monetization in 2018”

(<https://www.lightreading.com/iot/nb-iot/mobile-iot-set-to-move-from-deployment-to-monetization-in-2018/a/d-id/741324>)



Initial Thoughts & Next Steps for WG

- Deep fiber is very expensive
 - Other backhaul options may help
 - Deployments will most likely be surgical to start
 - Take advantage of existing fiber first
 - How to address densification?
 - Rural is challenging
 - How to remove regulatory policies to accelerate deployments
- What and where are the revenue opportunities
 - Existing and new applications that will drive business model
 - Work to be done on “new business models” to support investment
 - Explore new revenue streams – *work in process*
 - Is IoT the main app? What other applications & services?

Help Us
Build the Plane While We're Flying!



THANK YOU!



FCC TAC CPSN-WG

Computational Power Stress on the Network

Chairs: Lisa Guess, Juniper Networks
Adam Drobot, OpenTechWorks, Inc.

FCC Liaisons: Walter Johnston, James Miller, Aalok Mehta

Date: April 12, 2018



2018 Working Group Team Members

- Shahid Ahmed, Independent
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- Brian Markwalter, CTA
- Tom McGarry, Neustar
- Lynn Merrill, NTCA
- Marvin Sirbu, SGE
- Kevin Sparks, Nokia Bell Labs
- David Tennenhouse, VMware



Computational Power Stress on the Network Mission

- Big Data Analytics, Artificial intelligence, Augmented Reality, and Virtual Reality have emerged recently as a critical tool in many fields.
- This can involve the exchange of massive amounts of data across communications networks, often in real time, in ways perhaps not anticipated only a few short years ago.
- The task of this work group is to study how Big Data Analytics, Artificial Intelligence, Augmented Reality, Virtual Reality, and applications such as Block Chain, Bitcoin mining, Gaming, etc. may be affecting network performance

Computational Power Stress on the Network - Mission

Some parties estimate an increase in data traffic of several hundred percent in just the next few years leading to the natural questions:

- What strategies are network operators, both wireline and wireless, employing to monitor the growth of big data?
- How are the networks planning to accommodate this growth?
- How are operators meeting the needs of big data relative to factors such as available bandwidth, latency, reliability, security, resiliency, etc.?
- To what extent are big data analytics and distributed computational resources able to improve the performance of networks?

The working group is encouraged to explore these and other technical matters that may be relevant to informing the Commission about the impact of big data on IT and communications network infrastructure.



Computational Power Stress on the Network Organization

- SWG1 – Identify and Prioritize Important Applications.
- SWG2 – Examine Consequences for the Network and Network Architectures.
- SWG3 – Implications and Impacts on the FCC, and Recommendations.



Computational Power Stress on the Network - Approach

- SWG1 – Identify and Prioritize Important Applications.
 - End User Type
 - Public
 - Industrial
 - Consumer
 - Type of Data
 - Volume, Velocity, and Variety
 - Time Sensitivity
 - Level of Criticality
 - Other Requirements (Security, Privacy, Reliability, Availability, Coverage,..)



Computational Power Stress on the Network - Approach

Organizing Principles

- Type of Application

- Voice
- Data
 - Structured
 - Unstructured
 - Streaming
 -
- Video
- Sensor

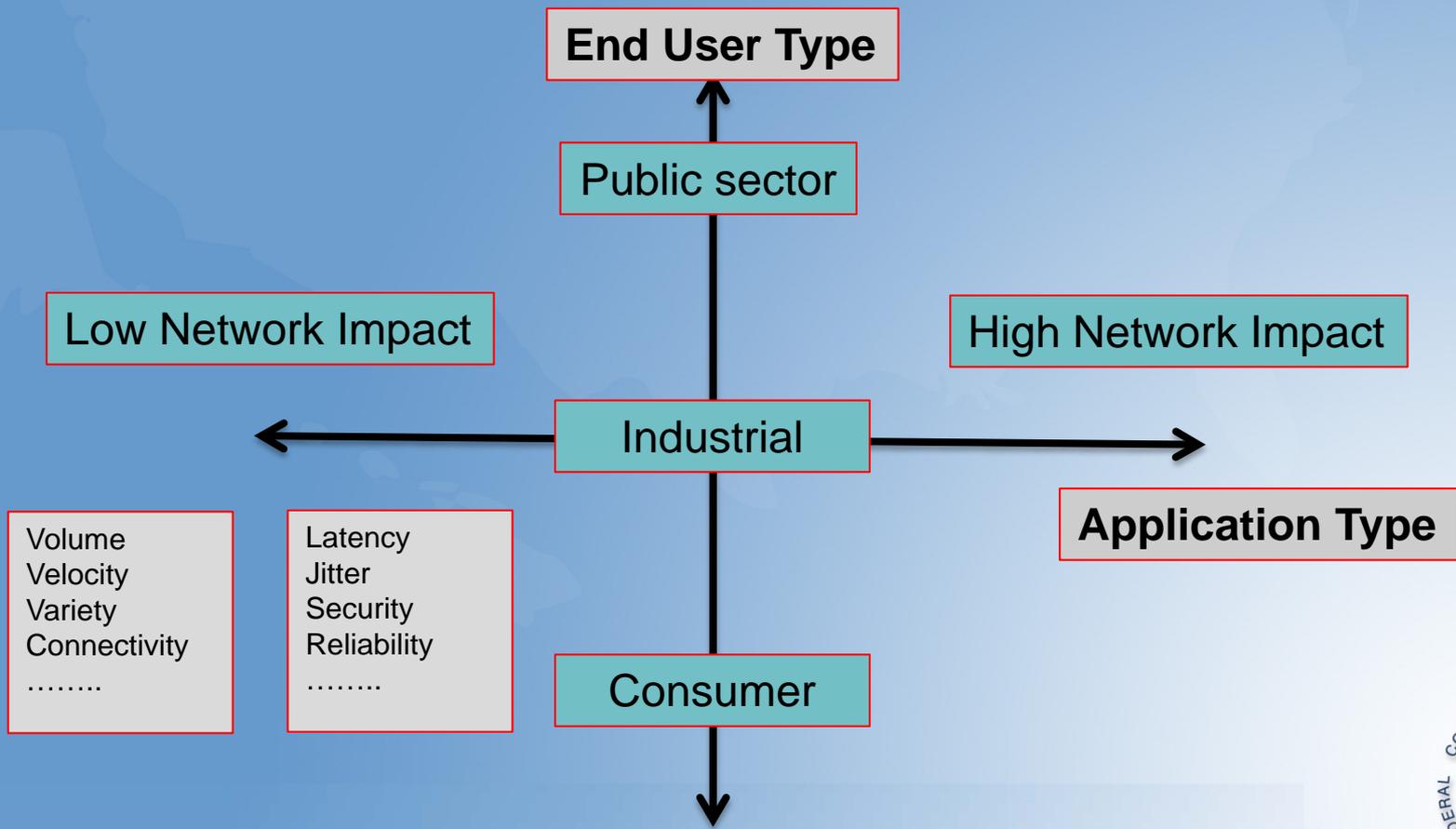
- Underlying Technology
 - Artificial Intelligence
 - Autonomy
 - Augmented Reality
 - Virtual Reality
 - Embedded Video
 - Edge Computing
 -

Computational Power Stress on the Network - Approach

Organizing Principles

- Where do the Applications Contribute to Traffic?
 - Public Networks
 - Core
 - Regional
 - Access
 - Local
 - Private Networks
 - Intra-cloud Networks

Organizing Principles: SWG1 – An Application view



Computational Power Stress on the Network - Example

	Banking and Securities	Communications and Media Services	Education	Government	Healthcare Providers	Manufacturing and Natural Resources	Insurance	Retail	Transportation	Utilities	Wholesale Trade
Data											
Volume	Very Hot	Very Hot	Very Low	Very Hot	Moderate	Very Hot	Moderate	Low	Low	Low	Very Low
Velocity	Very Hot	Low	Very Low	Low	Very Hot	Very Hot	Moderate	Low	Low	Low	Very Low
Variety	Very Low	Very Hot	Very Low	Very Hot	Low	Low	Moderate	Moderate	Moderate	Moderate	Very Low

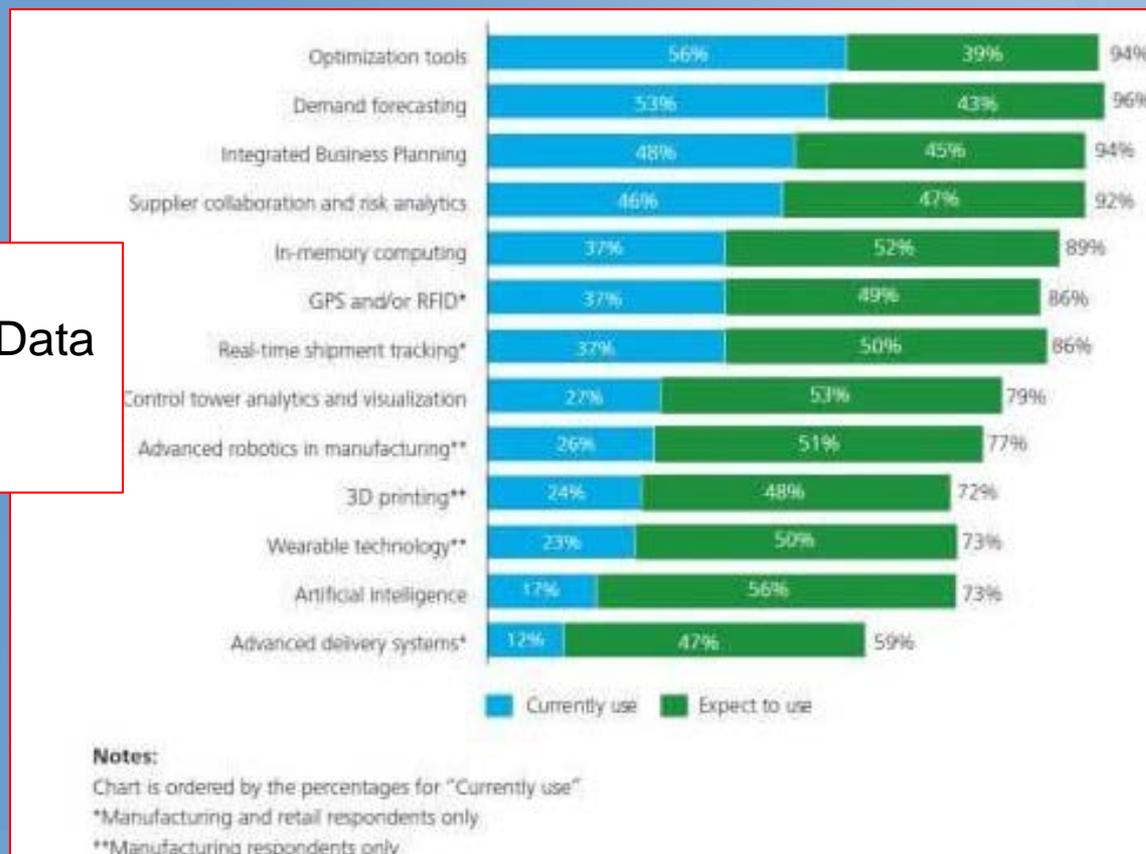


Source: SimpliLearn 20th December, 2017



Computational Power Stress on the Network - Example

An example:
Penetration of Big Data
Applications
In Supply Chains



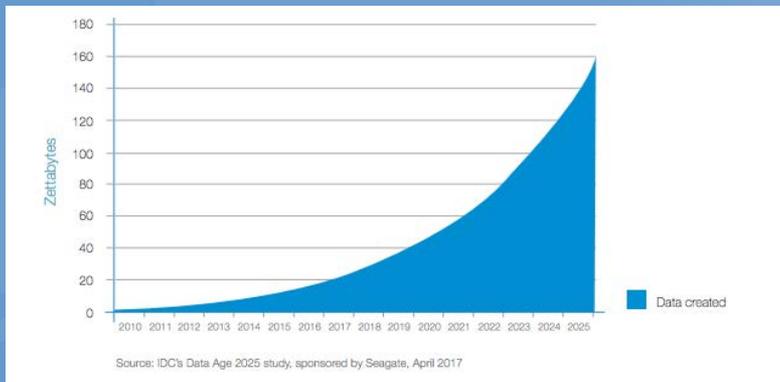
Source: Deloitte Survey 2018



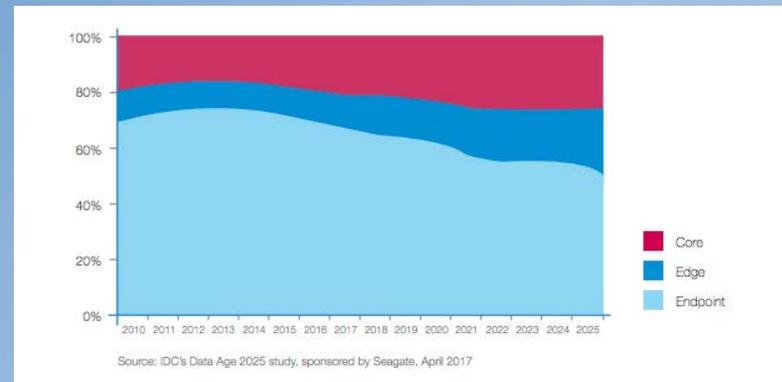
Computational Power Stress on the Network - Approach

- SWG2 – Impacts on the Network and Network Architectures
- Two Aspects to consider:
 - How will the “computational” and “big data technologies” change:
 - Network demand for moving data (volume, velocity, criticality,.....)?
 - Traffic patterns that affect Network Designs?
 - How Solution will be influenced by tradeoffs in Network, Computing, and Storage?
 - How will the “computational”, “storage”, and “big data technologies” be exploited in the design and deployment of Networks and Network Architectures?

Computational Power Stress on the Network - Example

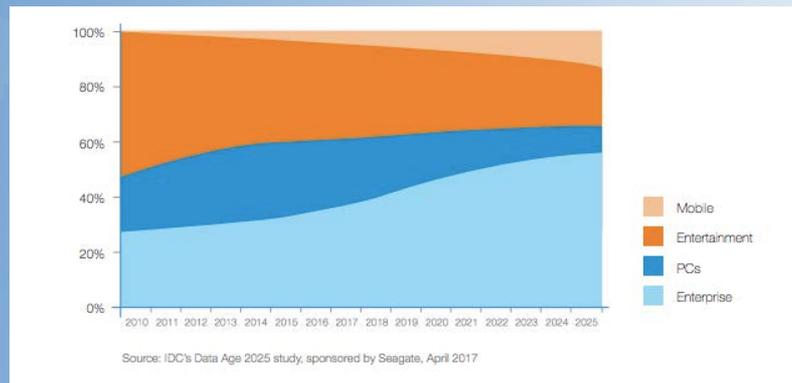


Volume of Data



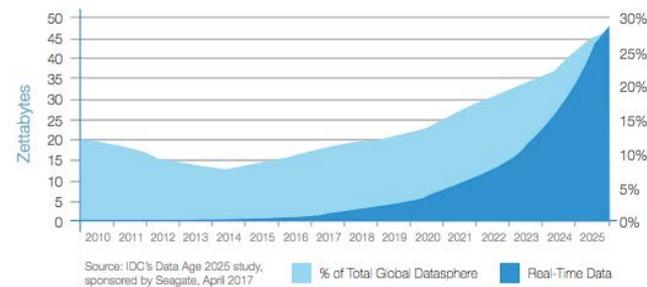
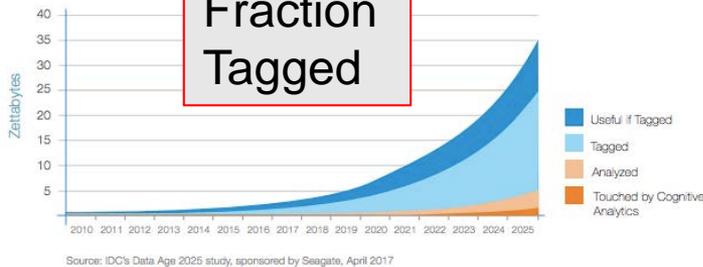
Source of Data – Where Generated

Location of Data Where it is Stored

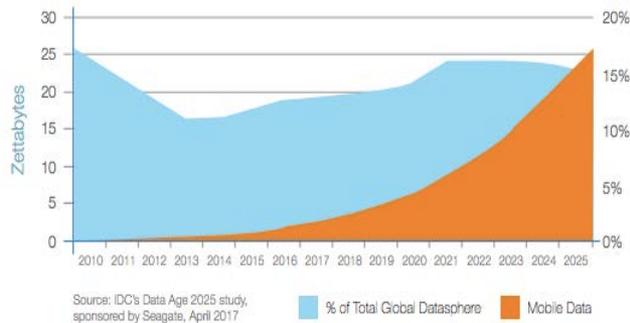


Computational Power Stress on the Network - Example

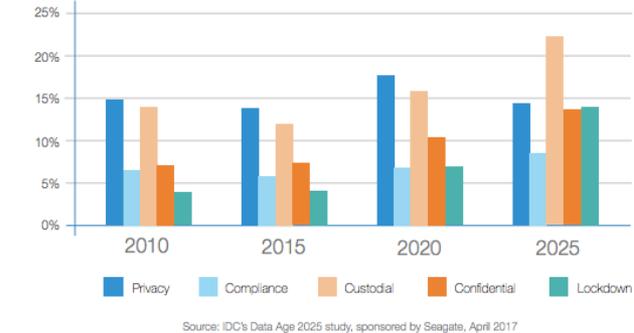
Fraction Tagged



Real Time



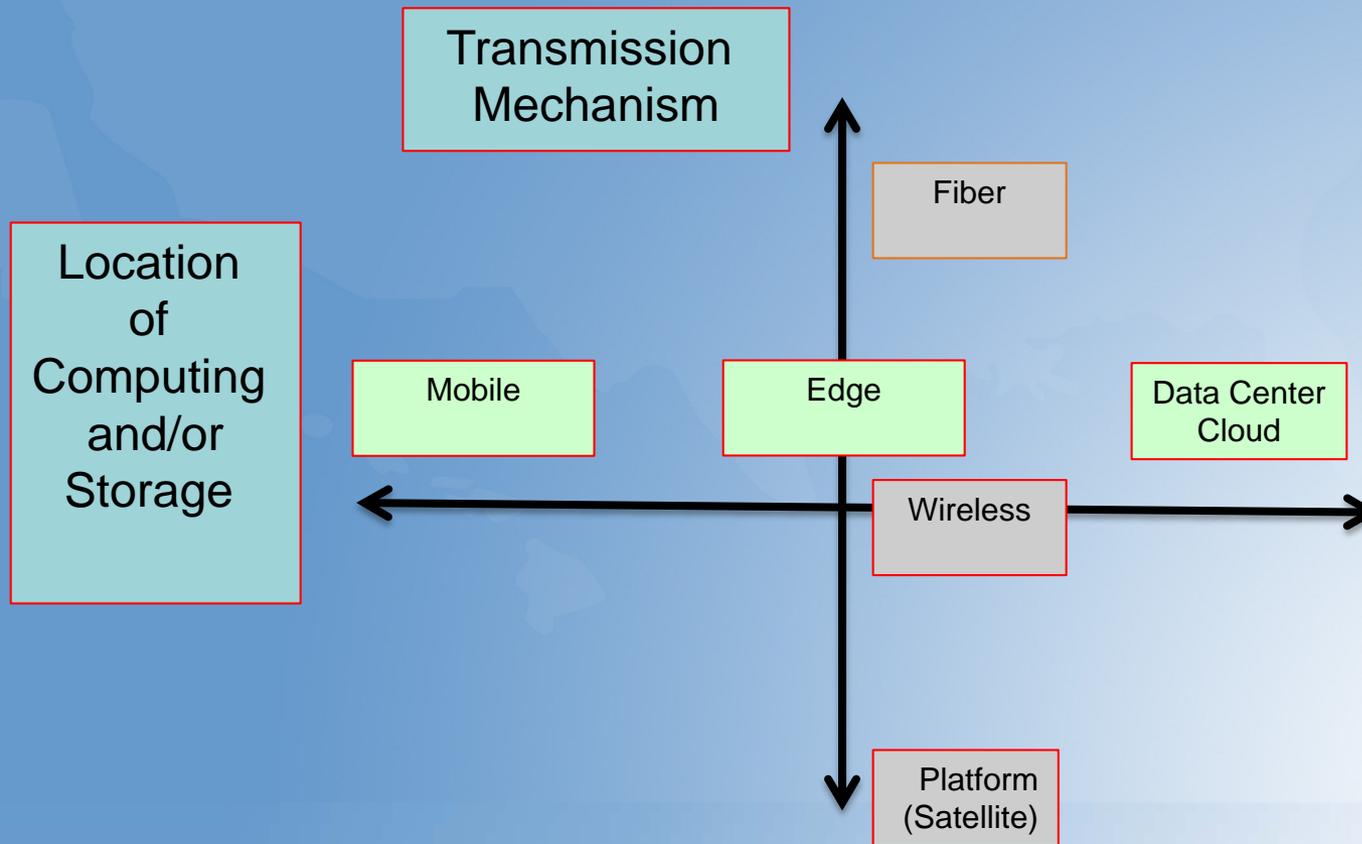
Mobile Origin



Secure



Organizing Principles: SWG2 – A Network view



Targeted Guest Speakers for SWGs and WG (Examples)

- Large Data Center and Cloud
 - IBM, Microsoft, Amazon, Google, Equinix, Switch, and Service Providers
- Lead Researchers – from Academia and Industry
- Verticals:
 - Transportation
 - Supply Chains
 - Smart Cities
 - Government
 - Media and Entertainment
- Startups in:
 - Edge/Fog Computing
- Industrials
 - Agriculture
 - Manufacturing
 - Mining and Natural Resources
 - Energy and Utilities
 - Construction



Computational Power Stress on the Network

The WG is early in its deliberations – our next steps are:

- Select Chairs/Co-Chairs for SWG1 and SWG2
- Consider issues for SWG3 by the complete WG
- Complete a Work Plan
 - Consensus on Approach
 - Deliverables (Presentations, White Papers,..)
 - Schedule



Thank you!

