NDIA ATC Meeting
Commercial Liaison Report

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National Instruments

September 11, 2016

AGENDA

- News (Mergers/Acquisitions/Spin Offs/Announcements)

- Advancing Instrumentation in the 5G Era

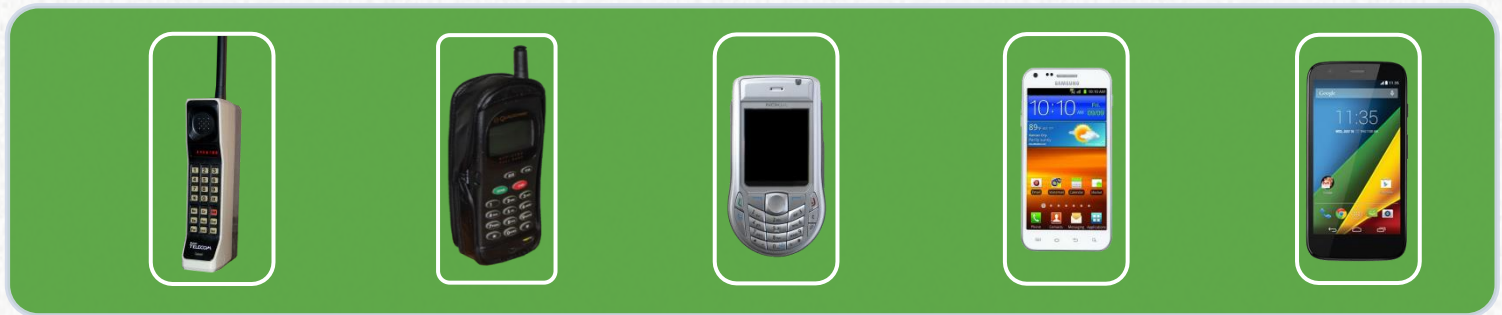- PXI, VXI, AXIe, LXI Refresh

- Better Buying 3.0

News

- National Instruments – Jan 1, 2017. Dr. James Truchard retiring as CEO, remaining active on Board of Directors. New CEO will be Alex Davern, current COO.

- Fortive – Jul 5, 2016. First day on NYSE after spin out from Danaher. HQ = Fluke campus in Everett. Professional instrumentation, automation, sensing and transportation technogies conglomerate

- MTS Systems Corp. – Jul 5, 2016. MTS acquires PCB Group Inc. with the goal of creating more complete Internet of Things (IoT) applicaiton test and development services.

- Rohde & Schwarz – Jul 1, 2016. Manfred Fleischmann retired as CEO/Pres. New CEO/Pres. Is Christian Leicher

- Astronics Test Systems – Jun 23, 2016 ATS purchases ASCOR ATEsignal switching line from Giga-tronics. Product line list found here: http://astronicstestsystems.com/news/astronics-purchases-key-switching-technology-integrated-test-systems

- Platinum Equity – May 31, 2016. Acquired Electro Rent.

- Keysight Technologies and GA Tech– May 18, 2016. New facility in Atlanta to develop software centric solutions

From 1G to 5G

How Moore's Law is Advancing Instrumentation in the 5G Era

Wireless Evolution

Year	1984	1991	2001	2009	2015
Technology	1G	2G	3G/3G+	3.9G/LTE	4G/LTE-Adv
Bitrate	N/A	300 kbps	42 kbps	129 Mbps	300 Mbps
Ch. BW	30 kHz	200 kHz	5 MHz	20 MHz	100 MHz
Price	$4K*		$400	$ 0†	$ 0†
Chip	$20 1983		$5 1999		$1 2015

*≈ $10K in 2016 $

†with service contract

The Proliferation of Wireless Adds Complexity

AMPS

GSM through EDGE

UMTS through HSPA+

LTE

5G

802.11-1997

802.11a/b

802.11g

802.11n

802.11p

802.11ac

802.11ad

802.11ax

Bluetooth

Bluetooth Extended Data Rate (EDR)

Bluetooth High Speed (HS)

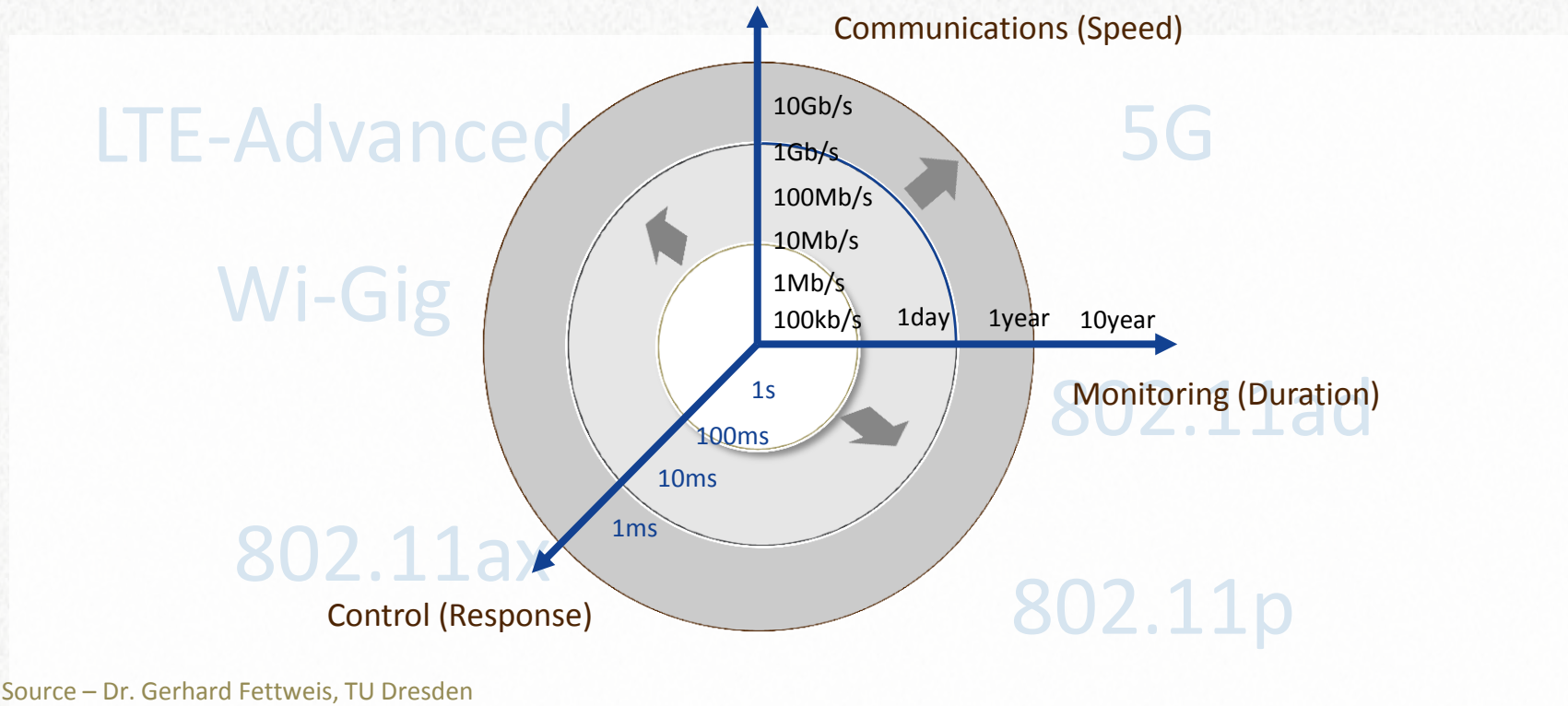Bluetooth Low Energy (LE)

1980   1990   2000   2010   2020

The Next Frontier of Wireless

Communications (Speed)

LTE-Advanced

5G

10Gb/s
1Gb/s
100Mb/s
10Mb/s
1Mb/s
100kb/s

Wi-Gig

1day   1year   10year

Monitoring (Duration)

802.11ad

1s
100ms
10ms
1ms

802.11ax

Control (Response)

802.11p

FCC Embraces mmWave

FCC issued a Notice of Proposed Rule Making (NPRM) that proposes new flexible service rules among the 28 GHz, 37 GHz, 39 GHz, and 64-71 GHz bands.

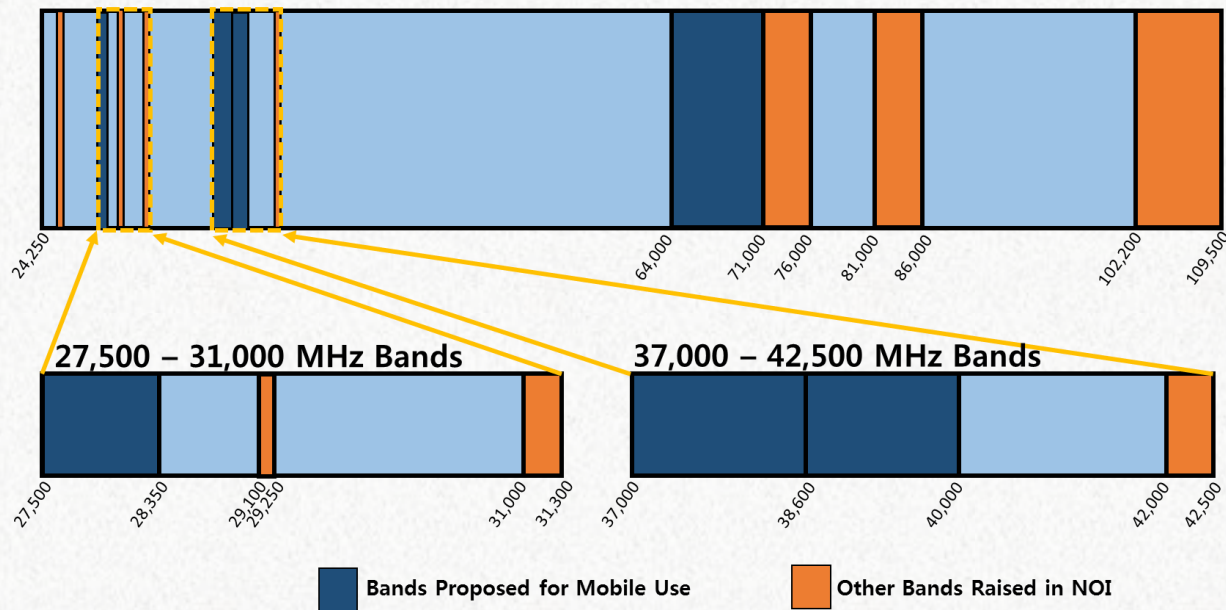

Bands Above 24 GHz for Possible Mobile Use

27,500 – 31,000 MHz Bands

37,000 – 42,500 MHz Bands

Bands Proposed for Mobile Use   Other Bands Raised in NOI

Oct 23, 2015

6x the Commercial Spectrum for 5G

"… Let me just put in perspective what's going on here. We are talking about **3850 megahertz of spectrum** that we are proposing today. **That's six times all of the commercial spectrum that this agency has ever authorized**."
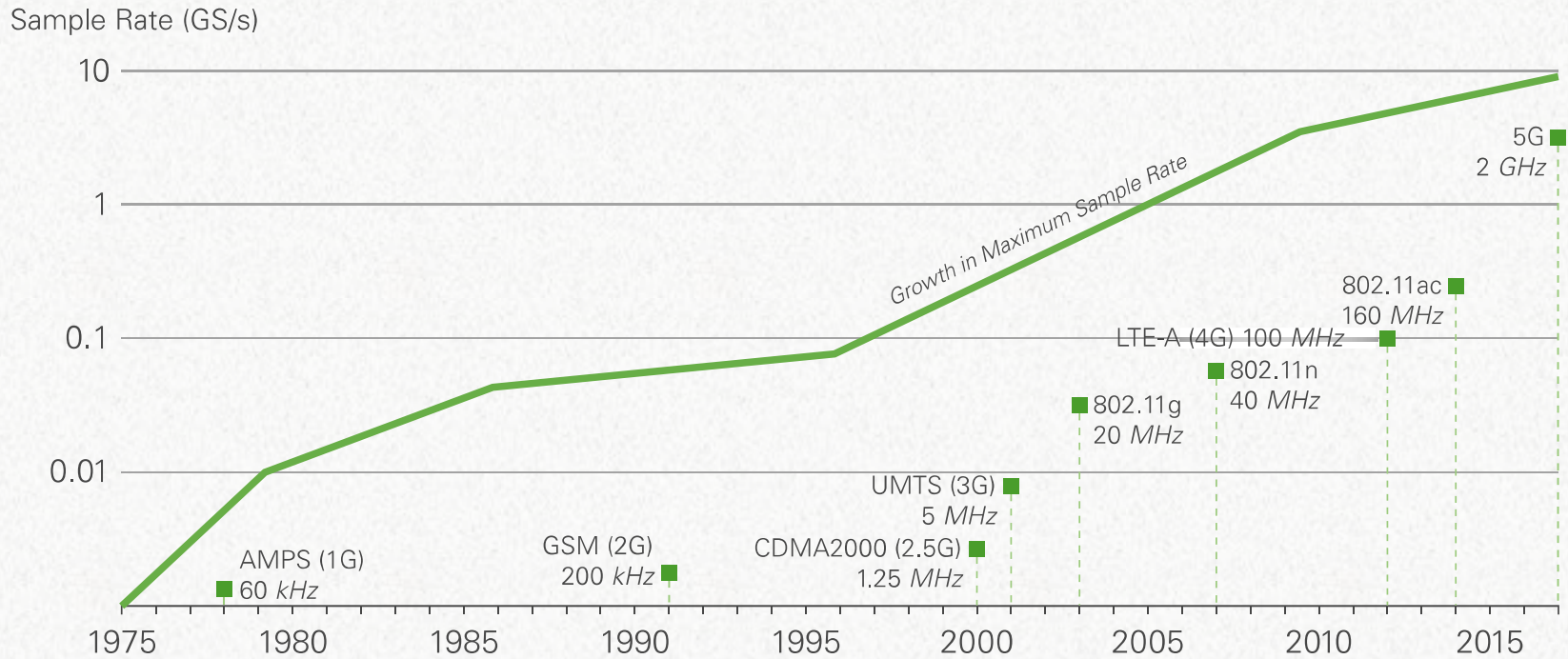
Tom Wheeler, FCC Chairman

"With the [5G] race on, today's rulemaking gets us out of the gate."

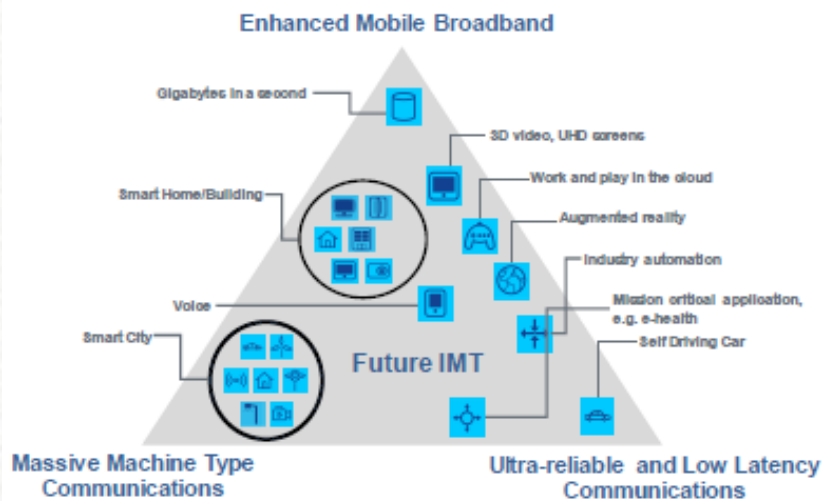**Jessica Rosenworcel, FCC Comissioner**

From 1G to 5G

Sample Rate (GS/s)

Growth in Maximum Sample Rate

5G
2 *GHz*

802.11ac
160 *MHz*

LTE-A (4G) 100 *MHz*

802.11n
40 *MHz*

802.11g
20 *MHz*

UMTS (3G)
5 *MHz*

CDMA2000 (2.5G)
1.25 *MHz*

AMPS (1G)
60 *kHz*

GSM (2G)
200 *kHz*

10
1
0.1
0.01

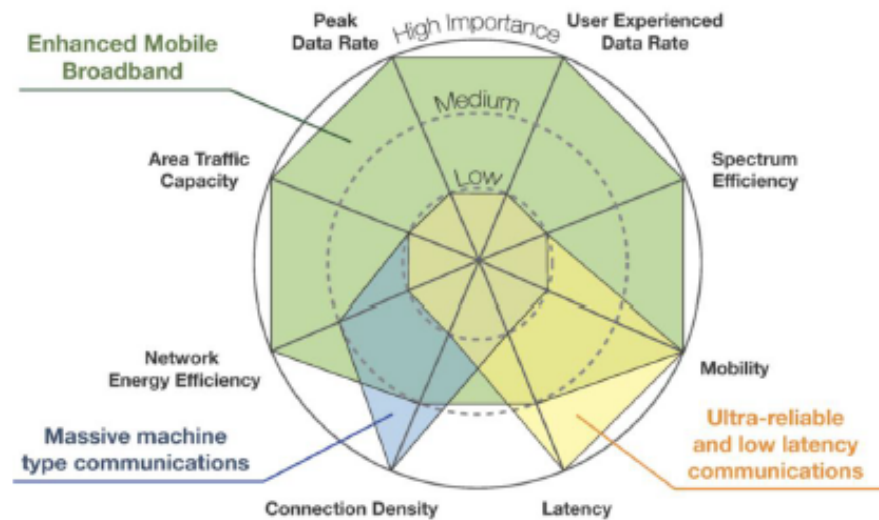1975   1980   1985   1990   1995   2000   2005   2010   2015

5G Defined| 3 Use Cases, 8 Key Capabilities

ITU-R vision for IMT*-2020 and beyond

Three use case categories
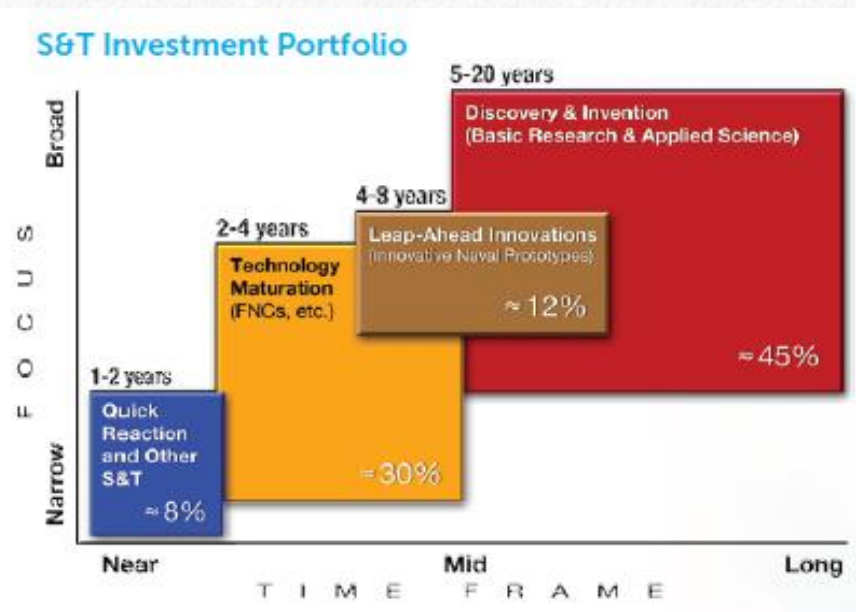
Eight Key Capabilities

"Framework and overall objectives of the future development of IMT for 2020 and beyond"

*International Mobile Telecommunications

Source: ITU-R M.[IMT.VISION]

S&T Investment Priorities
What ONR Does Now Affects Test in the Future

- Quick Reaction S&T - war fighter centric technology responsive to the immediate needs of the fleet.
- Technology Maturation - delivers critical technologies to programs.
- Leap-Ahead Innovations - higher risk / higher payoff.
- Discovery & Invention - fundamental science with a long time span needed to mature discoveries.

Consortia ATC Events

What: <u>VXI, PXI, IVI, LXI and AXIe Standards Improve ATE Systems Design</u>

When: September 12, 2016

13:00 – 17:00

Where: Magic Kingdom 4 or B

(Notices on PXI SA website conflicting and also come with "Check signs in case of change warning/disclaimer)

What: <u>2016 Outlook for MI in the T&M Industry Panel</u>

When: September 14, 2016

15:30 – 17:00

Where: Magic Kingdom 4

("Check signs in case room is changed" warning/disclaimer)

VXI & PXI Refresh

- VXI Bus Consortium:
  - 13 Members
  - > 1500 Products
  - 394 Mfg. ID's issued
  - VXI 4.0
  - http://www.vxibus.org
    - Products at http://vxibus.org/products.html
  - Annual Meeting
    - ?

- PXI Systems Alliance (PXISA):
  - 68 Members (10/2/2015)
  - PXI-7: PXI Multicomputing HW Spec, Rev 1.0
  - PXI -8: PXI Multicomputing SW Spec ,Rev 1.0
  - PXI-9: PXI & PXI Express Trigger Management Spec ,Rev 1.0
  - www.pxisa.org
    - New products
    - Annual Meeting
      - ATC –Outpost in Adv. Tower
      - Date: SEP 14 (Wed.)
      - Time: 5:30-6:30 PM

AXIe & LXI Refresh

- AXIe Consortium:
  - 11 Members (10/2/2015)
  - 29 Products (10/2/2015)
  - AXIe 1.0 Base Arch Spec, Rev 2.0
  - AXIe 2.0 Base Software Spec, Rev 1.0
  - AXIe 3.1: Semiconductor Test Extension,Rev 1.0
  - AXIe-0: Low Cost Instrumentation and Switch Architecture
  - AXIe Wide PCI Express available soon
  - www.axiestandard.org for overview presentation

- LXI Consortium
  - 53 Members (10/2/2015)
  - 2728 products(10/2/2015)
  - LXI 1.4 (Core + 7 Extended Functions)
  - New LXI Reference Design
    - Soon to be released
    - Available to members only
  - http://lxistandard.org
    - PlugFest 2016
      - Date: 10/17 – 10/19
      - Place: Boston, MA

Better Buying Power 3.0

"To make the most of the research dollars, DoD plans to rely heavily on the **concept of rapid prototyping**."

Objectives with strong alignment to Test & Measurement Industry

Incentivize Innovation in Industry and Government

- Increase the use of prototyping and experimentation
- Emphasize technology insertion in program planning
- Use Modular Open Systems Architecture to stimulate innovation

BBP implementation is 5 years old

Annual growth rate of contracted costs on major programs:

2011	9.1%
2015	3.5%

Decrease attribute to BBP (April 27 testimony of Ash Carter to Congress)

Questions/Discussion?