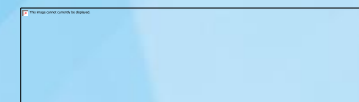


IEEE 5G and Beyond Initiative

Ashutosh Dutta, Gerhard Fettweis, Tim Lee, Rob Fish, Harold Tepper

January 29, 2018



IEEE Future Directions Initiatives



SMART MATERIALS

Symbiotic Autonomous Systems



Incubation

Phase 3



Maturity Level

ieee.org/futuredirections





Search IEEE 5G

Search



Join the IEEE 5G Technical Community

Home About What's New Conferences Education Publications Standards Tech Focus Roadmap 5G Summit Podcasts Testbeds



IEEE 5G World Forum 2018 (WF-5G)
9-11 July 2018
Santa Clara, California, USA

Call for Papers now available!
 Click here for more information



What's New

IEEE 5G Webinar Series:
5G mmWave Revolution and New Radio
 Wednesday 20 September 11:00am EDT
Presenter: Amitabha (Amitava) Ghosh, Nokia Fellow and Head, Small Cell Research at Nokia Bell Labs
[Click here](#) to learn more.

IEEE 5G Testbed Workshop
 Co-located with VTC 2017
 Sunday 24 September

Feature Article



Will Wireless Connections Between Autonomous Vehicles Make Them Safer?

With vehicular deaths in the United States

Technology Spotlight



Rutgers WINLAB ORBIT Testbed
 Now Available for Use by the IEEE 5G Community

Click to learn more.

Useful Links

- Join the IEEE 5G Initiative Team - Call for Volunteers
- IEEE 5G Summit
- IEEE Talks 5G: Read Q&A Interviews with IEEE experts
- Infographic: On the Road to 5G



Search IEEE 5G

Search

[Join the IEEE 5G Technical Community](#)

Home
About
What's New
Conferences & Events
Education
Publications
Standards
Contribute
Tech Focus
Roadmap
5G Summit

Click here to view the Special Report on 5G in The Institute

5G The New Wireless Frontier

Home

IEEE International 5G Summit

CONNECTED THINGS

5G Summits in 2017

Lisbon, Portugal Thursday, January 19, 2017	Kolkata, India Friday, March 17, 2017	Reston, Virginia August 19, 2017	Casablanca, Morocco Thursday, May 11, 2017	
Bhubaneswar, India July 27, 2017	Dallas, Texas June 8, 2017	Trivandrum, India July 1, 2017	Honolulu, Hawaii Monday June 5- Tuesday 6, 2017	Istanbul, Turkey June 5, 2017
Thessaloniki, Greece July 11, 2017	Shanghai, China July 27, 28, 2017	Kingston, Jamaica July, 2017	Taipei, Taiwan September 12-13, 2017	
Helsinki, Finland Monday, September 18, 2017	Dresden, Germany Tuesday, September 19, 2017	Tokyo, Japan Friday, September 22, 2017	Montreal, Canada Monday, October 9, 2017	
Nanjing, China Saturday, October 14, 2017	New York, NY November, 2017	San Antonio, Texas Fall 2017	Pretoria, South Africa Wednesday, May 3, 2017	

Advancing Technology for Humanity

3

Welcome to the Innovation Revolution

5G is an enabler of exciting use cases that will transform the way humanity lives, works, and engages with its environment.

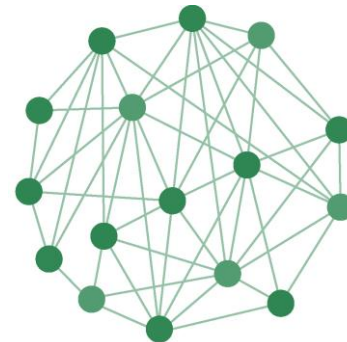
5G will be



**Bandwidth
100s of Mb/s**



**Latency less
than 1ms**



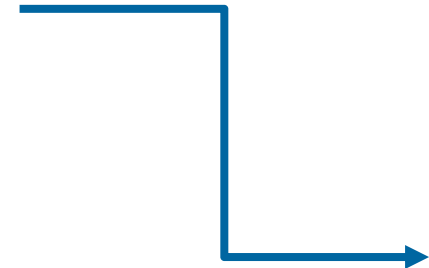
**>30Gbps throughput
and >1 million
connected devices**



**Massive broadband
that delivers
gigabytes of
bandwidth on
demand**



**5G will be the backbone
enabling the industrial IoT...**



...assisting our transportation needs...



**INTER-VEHICLE
SENSING**



**INTER-VEHICULAR
COMMUNICATION**



**DRIVERLESS
TRANSPORT**

...and completely improving our daily lives.



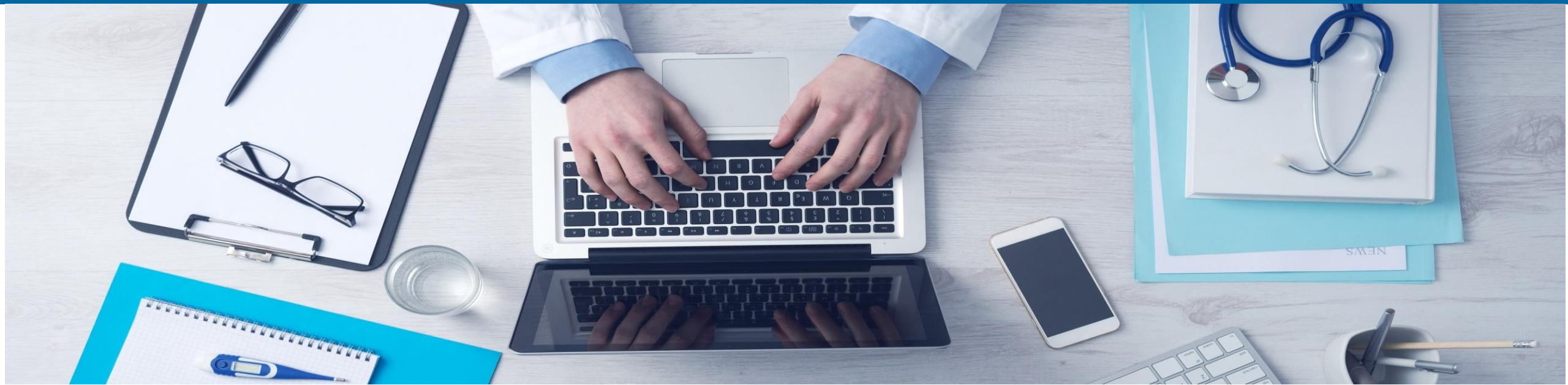
**SMARTER
TRAFFIC SIGNALS**



**SMARTER
POWER GRIDS**



**EVEN SMARTER
HOMES**



ZERO DISTANCE
from patient to accessible
healthcare



**CONTAGION
CONTAINMENT**
Fast awareness and
global collaboration



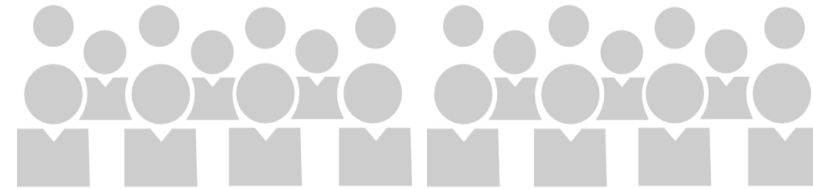
MOBILE ER
Real-time response to
trauma anywhere



will impact every industry



...and spark the innovation of unforeseen industries for decades to come



The global team of experts involved in IEEE 5G are producing programs and activities including...

The 5G Technology Roadmap

short-term (~3 years), mid-term (~5 years), and long-term (~10 years)
research, innovation, and technology trends

Publications

IEEE 5G Transmissions podcast series
IEEE Tech Focus
IEEE Talks 5G Q&A article series

Conferences & Events

1st Annual IEEE 5G World Forum in 2018
5G-related IEEE conferences
5G Summits

Education

IEEE 5G Learning Series
IEEE Live Online Courses
Webinar series

Expert Articles

Published on IEEE 5G web portal and in industry media

Standards

Global, open, and collaborative

5G Initiative Structure



5G and Beyond Initiative Significant Achievement in 2017

Education

- ▶ Executed Three Tutorials
 - ▶ Bangalore, India; January 2017, Edison, NJ; April 2017, Shanghai, China; July 2017
- ▶ Conducted 4 Webinars
 - ▶ 5G - What is it and what new applications are driving it's formation
 - ▶ 5G mmWave Revolution and New Radio
 - ▶ A look at the companies and organizations working to make 5G a commercial success
 - ▶ 5G Technology Is Fantastic, But Can We Afford It?
- ▶ "Understanding 5G" eLearning Course in development

Publications

- ▶ Published four Issues of IEEE 5G Tech Focus Newsletter; 4 articles/issue
- ▶ Special report on 5G in March 2017 Issue of The Institute

Web Portal/Content Development

- ▶ Published 5 Q&A articles with IEEE 5G Experts
- ▶ Launched IEEE Transmissions Podcast Series – 3 completed to date

Roadmap

- ▶ Whitepaper Published; September 2017, More than 1000 views
- ▶ Roadmap Workshop conducted at ICC 2017

Community Development

- ▶ Web Portal traffic growing steadily at 15%/month – 5K+ visitors/10K+ page views monthly
- ▶ Collabratec Community increased to 8K+ members
- ▶ Technical Community, Twitter. Facebook growing at 10%/month

Conferences/Events

- ▶ Announced Initial IEEE World Forum on 5G conference July 9-11, 2018 in Santa Clara, CA.
 - ▶ Call for Papers; December 2017
- ▶ Collaborated with ComSoc on 10+ 5G Summits Worldwide YTD
- ▶ IEEE 5G and Beyond Testbed Workshop in Toronto

Standards

- Creation of 5G standards database across multiple societies
- First 5G Standards Forum Meeting (October 9)

Industry Engagement

- ▶ Conducted 5G Industry panels at WOCC 2017 and ISIE 2017
- ▶ Delivered talks and keynotes at multiple conferences, Section Congress

5G Initiative Plans for 2018

Education

- ▶ Conduct additional Tutorials around the world
- ▶ Continue with Monthly Webinars

Publications

- ▶ Publish four Issues of IEEE 5G Tech Focus Newsletter
- ▶ Work with societies to publish special issues of society Magazines/Journals on 5G

Roadmap

- ▶ Develop Technology Roadmap
- ▶ Continue with Roadmap Workshops in ICC and Globecom

Community Development

- ▶ Continue to grow all communities and engage members

Conferences/Events

- ▶ Conduct 5G World Forum Conference in July
- ▶ Support/Collaborate on 5G Summits and other 5G Congress

Marketing/Re-Branding

- ▶ Publicize a new brand, logo, and messaging for the 5G Initiative

Standards

- ▶ Conduct Standards Forum workshops enabling all societies to propose new 5G standards projects

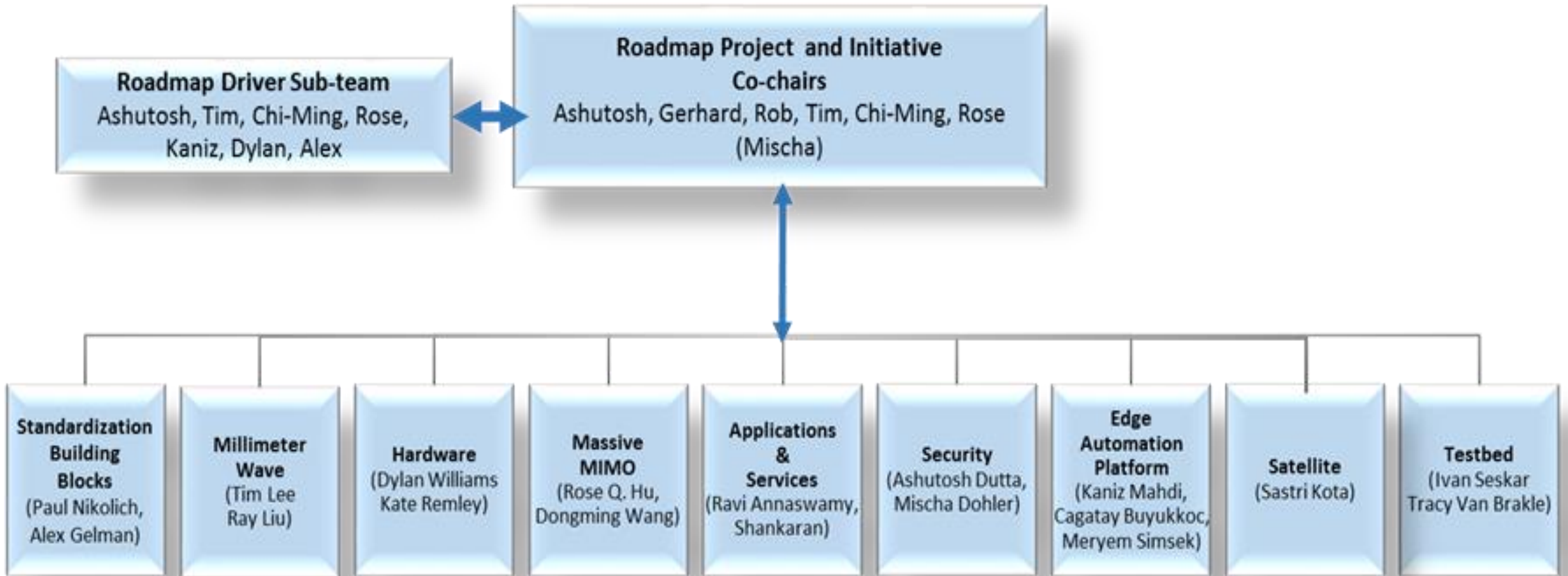
Industry Engagement

- ▶ Initiative sponsored panel at ITSC 2017

Testbed

- ▶ Rutgers WINLAB as pilot 5G testbed. Expand on it.

5G Roadmap Working Group



IEEE: Standards and Global Collaboration for 5G

IEEE provides a complete, end-to-end, collaborative framework today for accelerating the realization of 5G and its revolutionary use cases tomorrow.

Mobile Edge Cloud brings SDN/NFV frameworks and data path programmability to the proximity of end users as key enablers for service differentiation

SoftRAN is to create a SD RAN flexible enough to control applications with the wireline centric concepts of “fog” in a SD-controller

IEEE P1589/P1587.6/P1857.9/P3333.2.4 Industry Connections the integration of computer-generated sensory content with the physical world

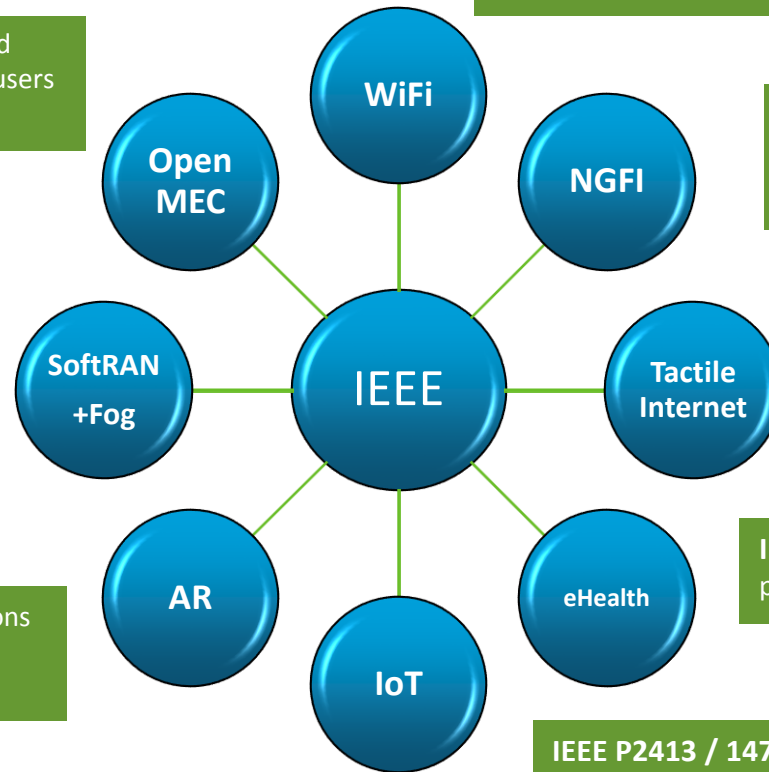
IEEE 802.11 standard supported by almost any mobile device in the market today

IEEE 1914/1904 flexible, efficient and scalable packet-based fronthaul transport networks

IEEE 1918 non/mission-critical applications (e.g. manufacturing, transportation, healthcare, mobility, edutainment, events)

IEEE 11073 provides a global platform for eHealth stakeholders

IEEE P2413 / 1471 / 42010



GLOBAL

IS

WHAT IS NEEDED

LOCALLY EVERYWHERE



39 Summits

IEEE 5G Summit Series – 2015 - 2018

(www.5gsummit.org)

30 5G Summits, More than 5000 attendees (onsite and online), 400 Speakers, Streaming and Recording Archived



4/22/2018

IEEE 5G Summit Series – 2015 – 2018 (www.ieee-5gsummit.org)

IEEE 5G SUMMIT

CONNECTED THINGS

IEEE International 5G Summit

5G Summits in 2015

Princeton Tuesday, May 26, 2015	Toronto Saturday, Nov. 14, 2015	Santa Clara Monday, Nov. 16, 2015
------------------------------------	------------------------------------	--------------------------------------

18 summits in 2017 8 summits in 2016 3 summits in 2015

3 IEEE 5G Summits in 2015

IEEE 5G SUMMIT

CONNECTED THINGS

IEEE International 5G Summit

5G Summits in 2016

Patna, India Tuesday, March 29, 2016	Aalborg, Denmark Friday, July 1, 2016	Austin, Texas Wednesday, August 3, 2016	Dresden, Germany Thursday, September 29, 2016
Tianjin, China Saturday, October 29, 2016	Berlin, Germany Wednesday, November 2, 2016	Seattle, Washington Saturday, November 5, 2016	New Delhi, India December 2, 2016

8 IEEE 5G Summits in 2016

IEEE 5G SUMMIT

CONNECTED THINGS

IEEE International 5G Summit

5G Summits in 2017

Lisbon, Portugal Thursday, January 19, 2017	Kolkata, India Friday, March 17, 2017	Pretoria, South Africa Wednesday, May 3, 2017	Casablanca, Morocco Thursday, May 11, 2017	
Honolulu, Hawaii Monday June 5- Tuesday 6, 2017	Istanbul, Turkey June 5, 2017	Dallas, Texas June 8, 2017	Trivandrum, India July 1, 2017	Thessaloniki, Greece July 11, 2017
Shanghai, China July 28, 2017	Bhubaneswar, India August 17-18, 2017	Reston, Virginia August 19, 2017	Taipei, Taiwan September 12-13, 2017	Helsinki, Finland Monday, September 18, 2017
Dresden, Germany Tuesday, September 19, 2017	Tokyo, Japan Friday, September 22, 2017	Montreal, Canada Monday, October 9, 2017	Nanjing, China Saturday, October 14, 2017	
Chennai, India November 16-17 2017				

19 IEEE 5G Summits completed in 2017

IEEE 5G SUMMIT

CONNECTED THINGS

IEEE International 5G Summit

5G Summits in 2018

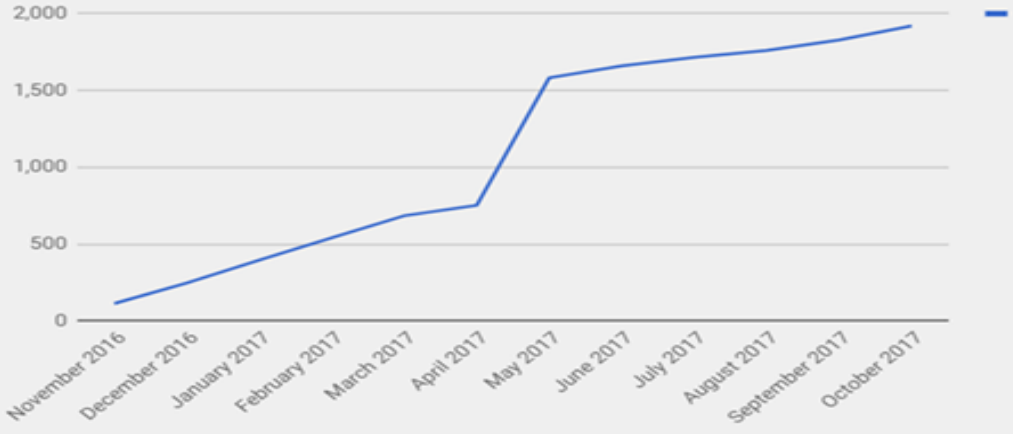
Santa Clara, California Thursday, February 8, 2018	Trento, Italy Tuesday, March 6, 2018	Brasilia, Brazil Wednesday, March 14, 2018	Hammamet, Tunisia Wednesday, May 2, 2018
Boulder, Colorado Tuesday, May 22, 2018	Philadelphia, USA Tuesday, June 12, 2018	Tangier, Morocco Wednesday, June 20, 2018	Dresden, Germany Tuesday, September 25, 2018
Marrakesh, Morocco Tuesday, October 19, 2018			

9 summits in 2018 19 summits in 2017 8 summits in 2016 3 summits in 2015

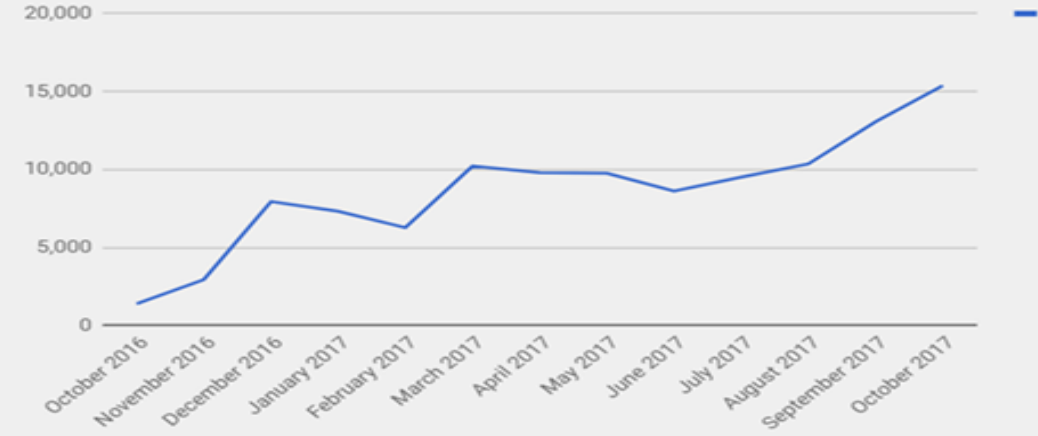
9 IEEE 5G Summits planned in 2018

Snapshots of Community Development for IEEE 5G Initiative

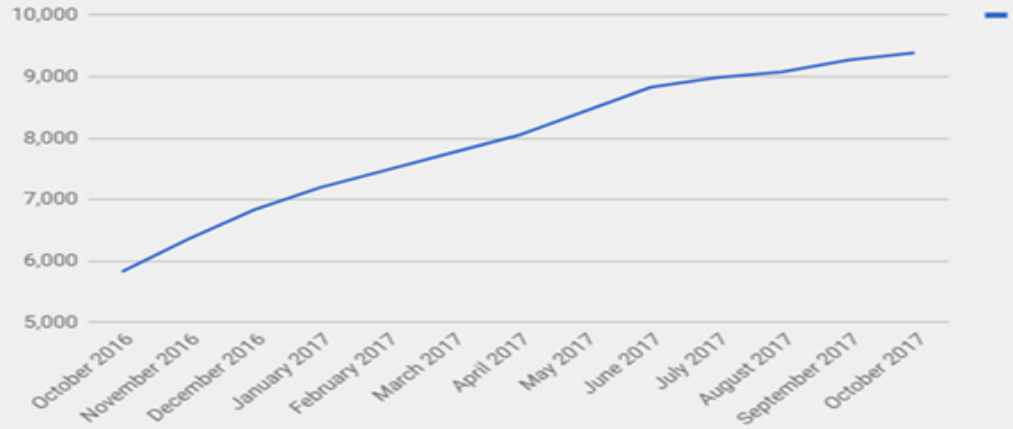
Technical Community Membership



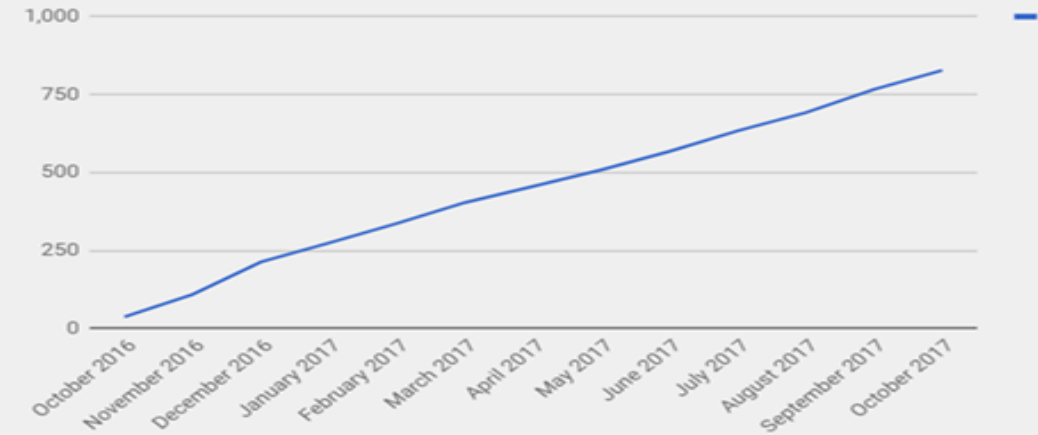
Web Portal Pageviews



Collabratec Membership



Twitter Followers



First 5G Summit Princeton University May 2015

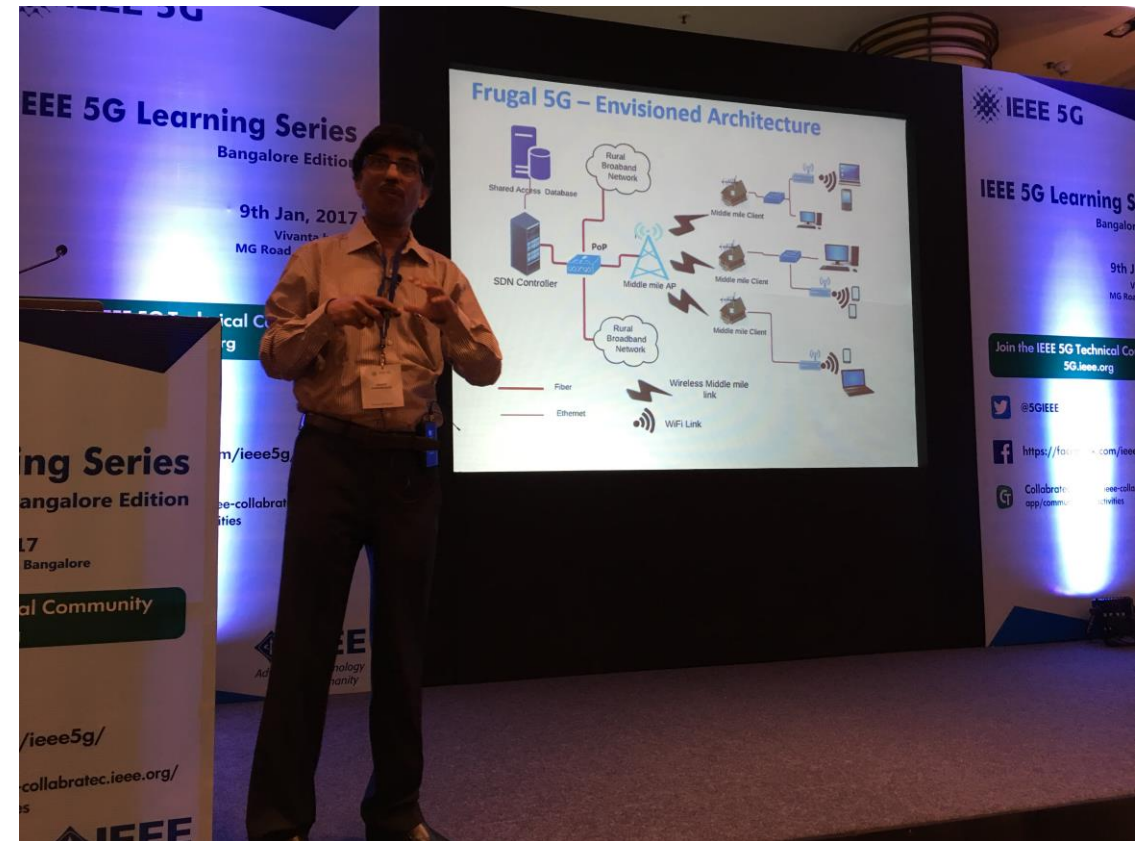
■ A successful event



SANTA CLARA SUMMIT, 2015



BANGALORE SUMMIT 2017



Whether you are a platform provider, operator, manufacturer, or service/content provider, there is a path for you and your business to be seen, heard, and make an impact in 5G



...contribute to the inaugural IEEE 5G World Forum conference. 9-11 July 2018 in Santa Clara, CA...

...contribute to our publication, IEEE 5G Tech Focus...

...lead an IEEE 5G use case or infrastructure project.

GETTING INVOLVED IS EASY...





WE NEED YOU!
**IEEE Beyond 5G
 Technology Roadmap**
 Innovation | Vision | Industry Dialogue
 

You're invited to participate in the **IEEE Beyond 5G Technology Roadmap** effort to help stimulate an industry-wide dialogue to outline a technology and innovation vision of the development and deployment of 5G and beyond in the short-term (~3 years), mid-term (~5 years) and long-term (~10 years). Your expertise as an industry subject matter expert is needed in the roadmap dialog regarding the evolution, the challenges faced, and identification of solutions and areas of innovation.

Based on the **IEEE 5G and Beyond Technology Roadmap Whitepaper** (October 2017):
<http://bit.ly/5GRoadmapWhitepaper>

Learn more about how to participate at:
<https://5g.ieee.org/roadmap/participate>

Consider joining one of the
**IEEE BEYOND 5G
 TECHNOLOGY ROADMAP TEAMS:**

- **Standardization Building Blocks**
- **Millimeter Wave**
- **Hardware**
- **Massive MIMO**
- **Satellite**
- **Edge Automation Platform**
- **Applications and Services**
- **Security**
- **Testbed**

**You're also invited to participate at the
 IEEE Beyond 5G Technology Roadmap Workshop:**

- 1½ day workshop
- **23-24 May 2018**, Kansas, USA
- Co-located with IEEE ICC in Kansas
- Complimentary, open to all
- Register: <http://bit.ly/5GRoadmapWorkshop>
- Day 1: Individual team meetings
- Day 2: Presentation of team findings





Visit
5G.IEEE.ORG
 to learn more,
 join, and get
 involved.

... ADVANCING 5G NEEDS YOU



You're invited to participate in the **IEEE Beyond 5G Technology Roadmap** effort to help stimulate an industry-wide dialogue to outline a technology and innovation vision of the development and deployment of 5G and beyond in the short-term (~3 years), mid-term (~5 years) and long-term (~10 years). Your expertise as an industry subject matter expert is needed in the roadmap dialog regarding the evolution, the challenges faced, and identification of solutions and areas of innovation.

Based on the **IEEE 5G and Beyond Technology Roadmap Whitepaper** (October 2017):
<http://bit.ly/5GRoadmapWhitepaper>

Learn more about how to participate at:
<https://5g.ieee.org/roadmap/participate>

Consider joining one of the
**IEEE BEYOND 5G
TECHNOLOGY ROADMAP TEAMS:**

- **Standardization Building Blocks**
- **Millimeter Wave**
- **Hardware**
- **Massive MIMO**
- **Satellite**
- **Edge Automation Platform**
- **Applications and Services**
- **Security**
- **Testbed**

**You're also invited to
participate at the
IEEE Beyond 5G Technology
Roadmap Workshop:**

- 1½ day workshop
- **23-24 May 2018**, Kansas, USA
- Co-located with IEEE ICC in Kansas
- Complimentary, open to all
- Register: <http://bit.ly/5GRoadmapWorkshop>
- Day 1: Individual team meetings
- Day 2: Presentation of team findings



THANK YOU

and

JOIN US FOR THE INNOVATION REVOLUTION



LEARN MORE AT
[5G.IEEE.ORG](https://5g.ieee.org)