RESILIENT & INTELLIGENT NEXT-GENERATION NETWORKS & SYSTEMS
INFORMATION AND COMMUNICATION NETWORKS IN THE POST-NEW NORMAL ERA

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A RESILIENT SOCIETY NEEDS RESILIENT NETWORKS

- CoVID-19 has been an eye-opener
- Networks are critical resources that cannot be taken for granted
- Digital services are going to be the norm in the future
- Continuous innovation in communication networks and services relying on such networks
  - Key to growth of society and economy
  - True in the analog era, and will remain true in the 21st century as well
- People expect networks to be omnipresent and 100% available
  - Like roads, water and electricity
- Yet ...
Applications that will emerge by the end of the 5G era

- AR/VR, Tactile Internet, Robo-taxis, Passenger Drones
- Direct Brain-to-Brain Communications and augmenting human-brain with storage implants
- Pervasive, continuous sensing driven by billions of IoT devices
  - Heterogeneous, low-cost, ultra low-power, software-driven device ecosystem
  - Extensive data generation, edge processing, data monitoring and alert systems
- Tight coupling between network, computer systems, data and humans
  - The cybernetic society will be upon us

Implicit is the assumption that these networks will be trustworthy, secure, reliable and safe

- Will we use any of the above applications even if they are 99.9% reliable?

2 minutes of failure a day is okay?
Resilient Systems

End-end Security

Adaptability

Autonomy

Integrate

Hardware (RF and Mixed Signal Circuits, Antennas and Components)

Algorithms (Spectrum sharing, management, resource optimization)

Scalable Device-to-Edge-to-Cloud continuum

Merging of digital/physical/virtual worlds
RINGS PROGRAM

Resilient & Intelligent NextG Systems

- $40M effort in Phase 1
- Augment current $100M/year investments in networking and computing research
- Target advances in both resilience & communication networks/systems
- Resilience-motivated designs
- Diverse partnerships
- Ready-to-use city-scale testbeds
- Awards in early 2022
Platforms for Advanced Wireless Research (PAWR)

- [https://advancedwireless.org](https://advancedwireless.org)
- Robust support for various 5G models/stacks
  - OpenRAN, O-RAN, vRAN, xRAN, Open Air Interface (OAI), srs5G, free5GC
  - Home for multi-vendor testing efforts
- Designed for NextG/Beyond-5G
  - Fully virtualized
  - End-to-end programmable
  - Remote operations and use
  - BYOD testing
- NSF + 35-member industry consortium
  - $100M program

**POWDER**
Salt Lake City, UT
Software defined networks and massive MIMO
[https://powderwireless.net](https://powderwireless.net)

**COSMOS**
West Harlem, NY
Millimeter wave and backhaul research
[http://cosmos-lab.org](http://cosmos-lab.org)

**AERPAW**
Raleigh, NC
Unmanned aerial vehicles and mobility
[https://aerpaw.org](https://aerpaw.org)

**Colosseum** – Boston, MA
*World’s largest RF emulator*

**Rural Broadband Platform**
TBD
*Coming June 2021*
JUNO PROGRAM: JAPAN-US NETWORK OPPORTUNITY

- NSF-NICT collaboration was established in 2010
  - The two agencies jointly funded the first set of Japan-US proposals in the area of Future Internet Design
  - The JUNO Program between NSF and NICT was formally established in 2013 with the signing of an MOU
  - Network Design and Modeling
  - Mobility
  - Optical Networking
  - Trustworthy IoT/CPS Networking
  - Trustworthy Optical Communications and Networking
- ... and beyond: opportunities for NextG collaboration
  - Resilient systems, open-source 5G/NextG, federated testbeds
SUMMARY

- The US is looking forward to NextG with resilience as its focus
- NSF has stood up an array of programs and testbeds to support NextG research and practice
  - With international, U.S. federal agencies and industry
- Healthy collaboration between NSF and NICT
- Openness and transparency will be NextG strengths
  - Networks, computer systems and data
- More opportunities to engage.