

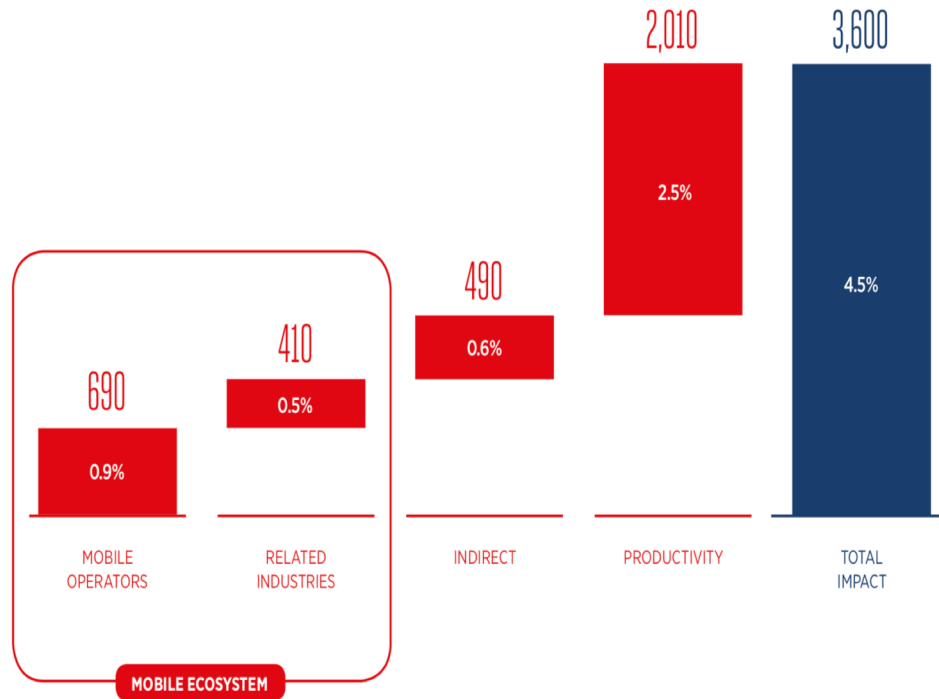
LEFT: LTE-Oriented Emulation- Instrumented Fuzzing Testbed

Economic impact of mobile communications

Source: GSMA Intelligence

Total (direct, indirect and productivity) contribution to GDP

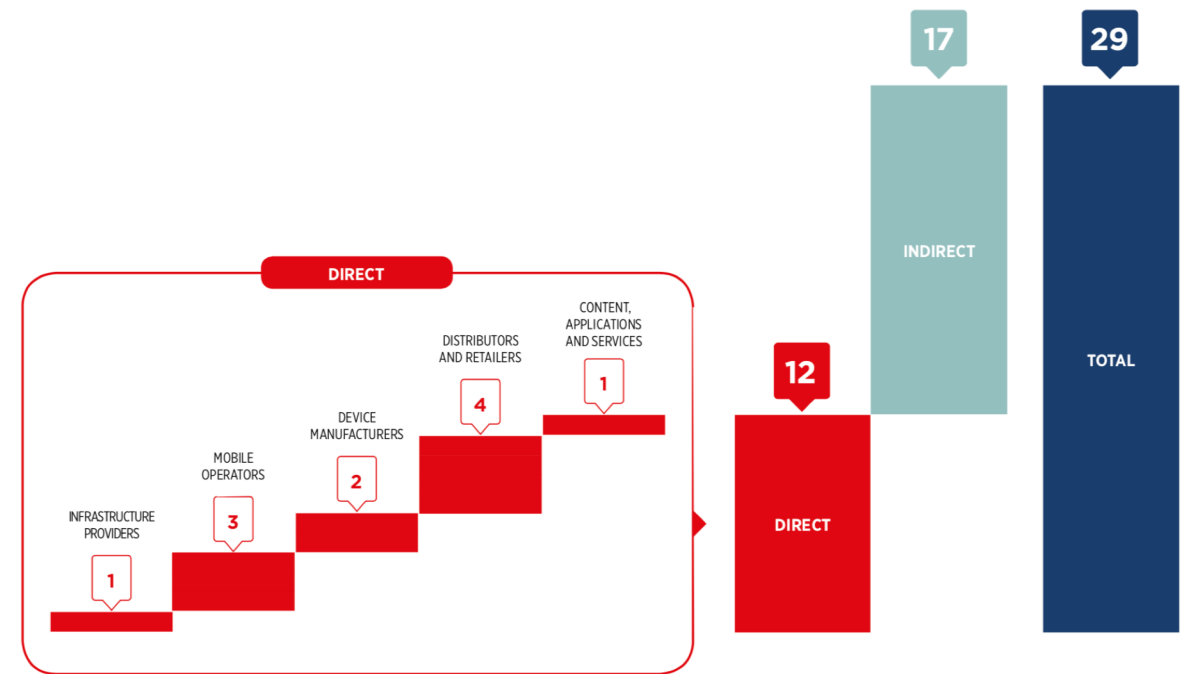
\$ billion, % 2017 GDP



Source: GSMA Intelligence analysis

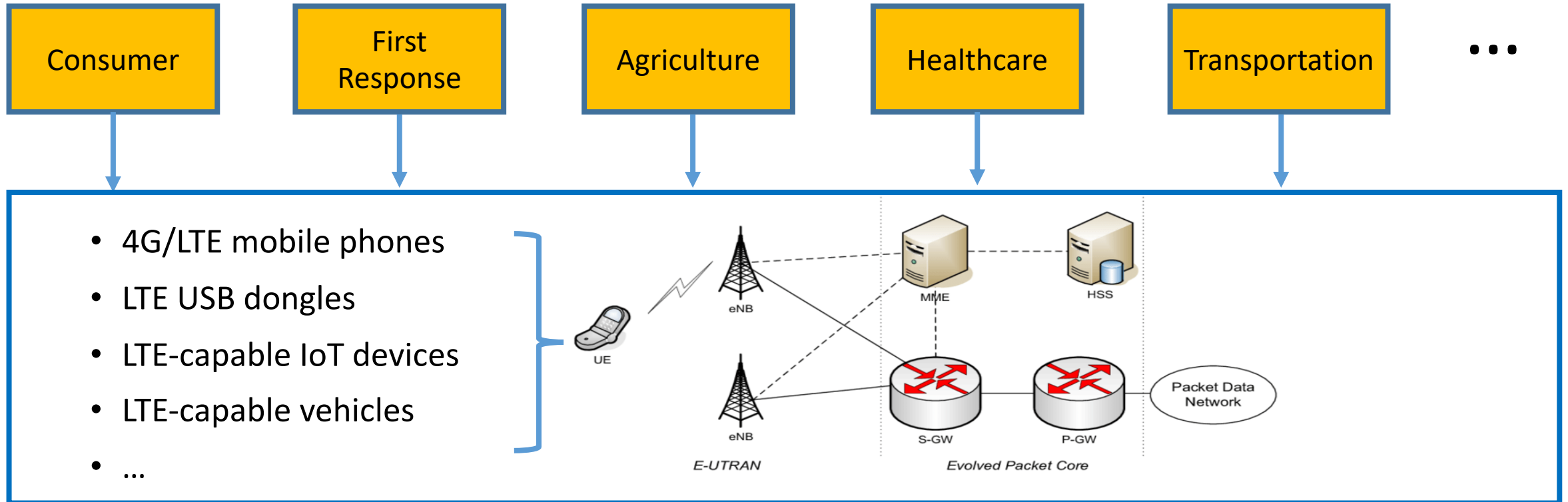
Employment impact

Jobs (million), 2017

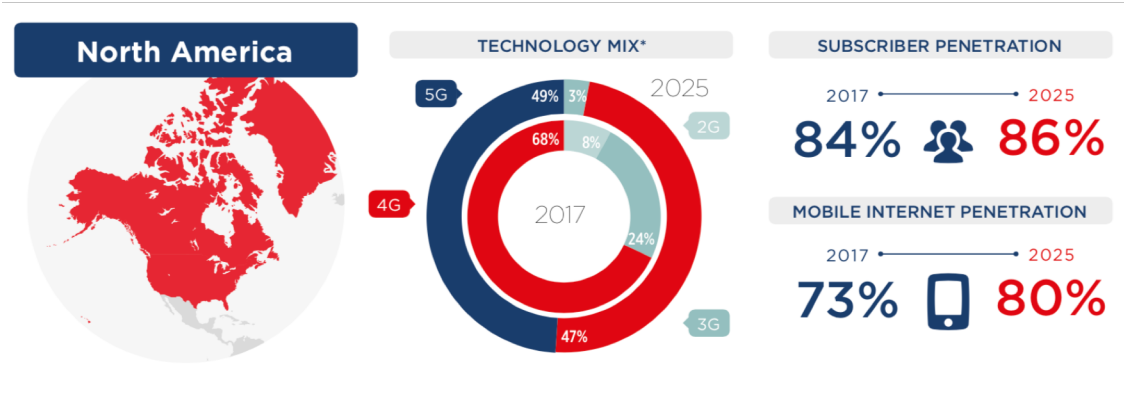


Source: GSMA

Key industries relying on 4G/LTE communications



Continued growth of mobile and IoT connections



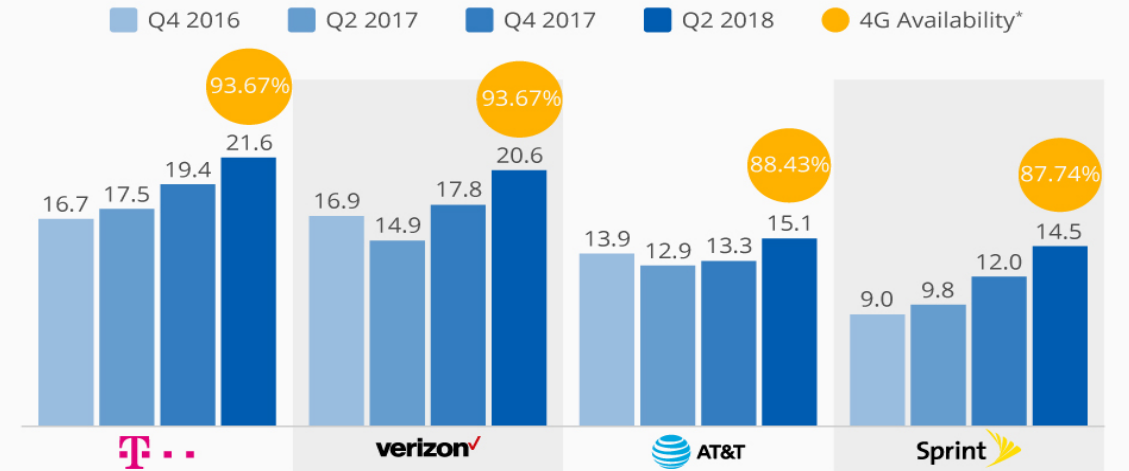
Source: GSMA Intelligence

IoT connections and growth by region

Region	2017 (Billions)	Increase (billions)	2025 (Billions)
Asia Pacific	2.8	8.1	10.9
North America	1.9	3.9	5.8
Europe	1.7	3.2	4.9
Latin America	0.4	0.9	1.3
MENA	0.3	0.8	1.1
CIS	0.2	0.4	0.6
Sub-Saharan Africa	0.1	0.2	0.3

U.S. 4G Networks Are Improving Across the Board

Average 4G (LTE) download speed on major mobile networks in the United States (in Mbps)



* This metric shows the proportion of time OpenSignal users have an LTE connection available to them. It's a measure of how often users can access a 4G network rather than a measure of geographic or population coverage.

All figures based on 4.5+ billion measurements across 150,000+ test devices
 Source: OpenSignal

statista

Risks posed to LTE communication infrastructure

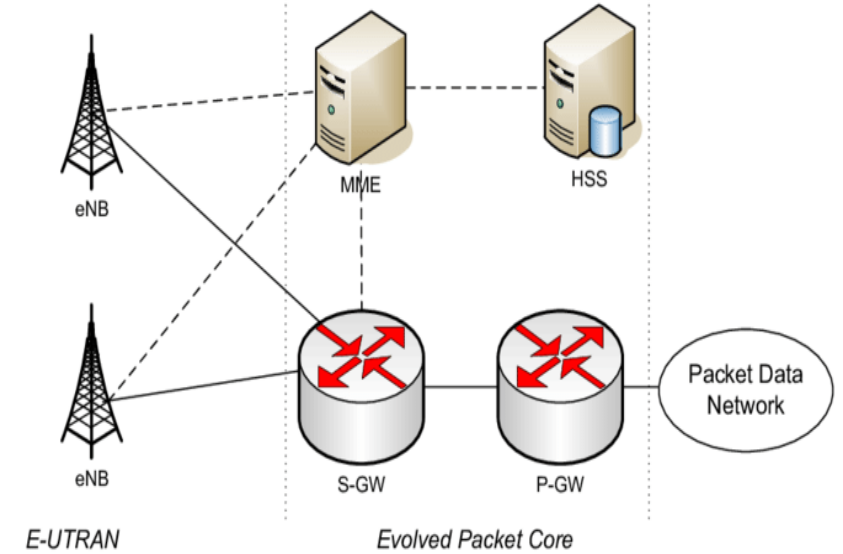
Mobile devices



Internet of Things

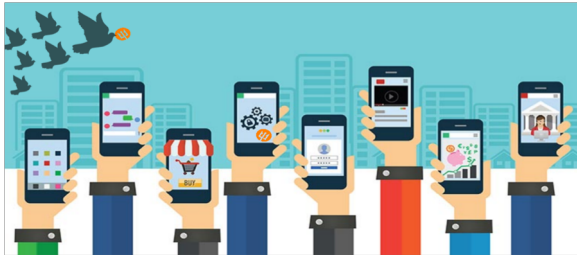


Connected Vehicles



Risks posed from LTE communication interface

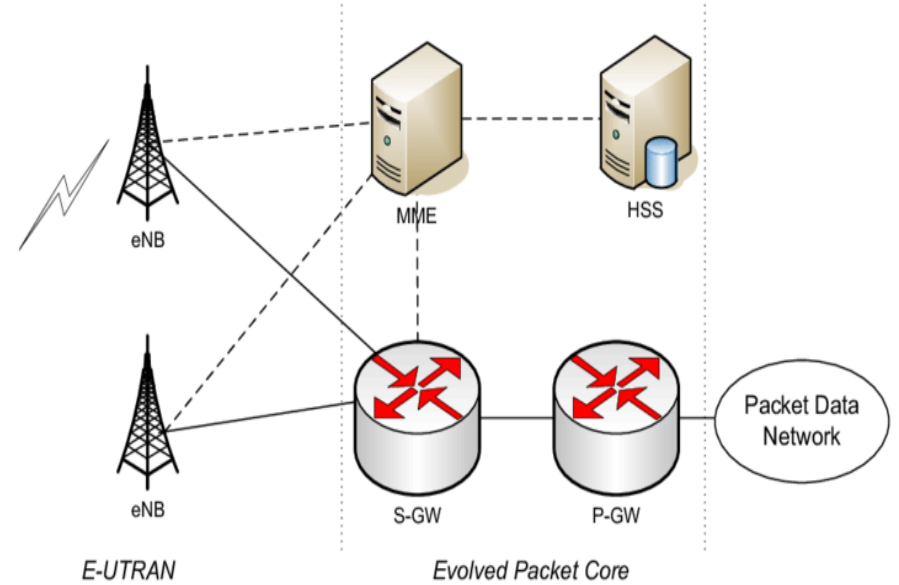
Mobile devices



Internet of Things



Connected Vehicles



Concern from mobile and IoT device vendor industry

- What kind of security risks does LTE communication interface expose to mobile or IoT devices?

Geotab G09 – The evolution of fleet tracking

Automate. Integrate. Innovate. The Geotab G09 is redesigned from the ground up and built to support the needs of your fleet now and into the future.

Near-real-time vehicle data

Get rich, accurate data on location, vehicle health, driving behavior and much more.

Compact, durable design
The small but mighty G09 is housed in flame retardant black ABS.

Over-the-air updates

New updates and improvements are sent to your device seamlessly. The G09 permits over-the-air initial provisioning and firmware updates for the device, GPS (G09-only), and select cellular modems (LTE only).

LTE connectivity

Communication on the LTE network delivers speed where you need it and longevity for peace of mind. LTE connectivity is available on select products.

Intelligent in-vehicle driver coaching

Improve driving habits with in-vehicle feedback. Set up rules to reduce unwanted driving behaviors like speeding, idling, or not wearing a seat belt. Advance driver safety further by adding a buzzer or Geotab GO TALK for in-vehicle verbal coaching.

Device expandability via IOX Technology

The IOX port lets you get even more from your device. Integrate with third-party providers that suit your needs. Add on hardware for Driver ID, hours of service (HOS), temperature tracking, asset tracking, satellite communication and more.

Breakthrough collision detection and notification

Collision alerts keep you in the know and provide a detailed summary of events. Detection of a suspected accident will prompt the automatic upload of detailed data from the device to allow for forensic reconstruction of the event.

Engine and battery health assessments

Extract valuable information on vehicle health and status. Record VIN, odometer, engine faults, seat belt and more.

End-to-end cybersecurity

Geotab platform security provides end-to-end data protection. Security methods include authentication, encryption, message integrity verification, unique ID and non-static security keys, over-the-air updates that use digitally-signed firmware to verify that updates come from a trusted source. Device security features are implemented using a FIPS 140-2 validated cryptographic module. Certificate #3371.

Built-in auto-calibrating accelerometer and gyroscope

Measure precise vehicle movements such as harsh braking and acceleration with the high quality accelerometer and newly added gyroscope.



Concern from mobile network operators

- What kind of security risks do vulnerable mobile or IoT devices pose to the LTE communication infrastructure?



The Hacker News



Hide.me

Problem statement from industry perspective

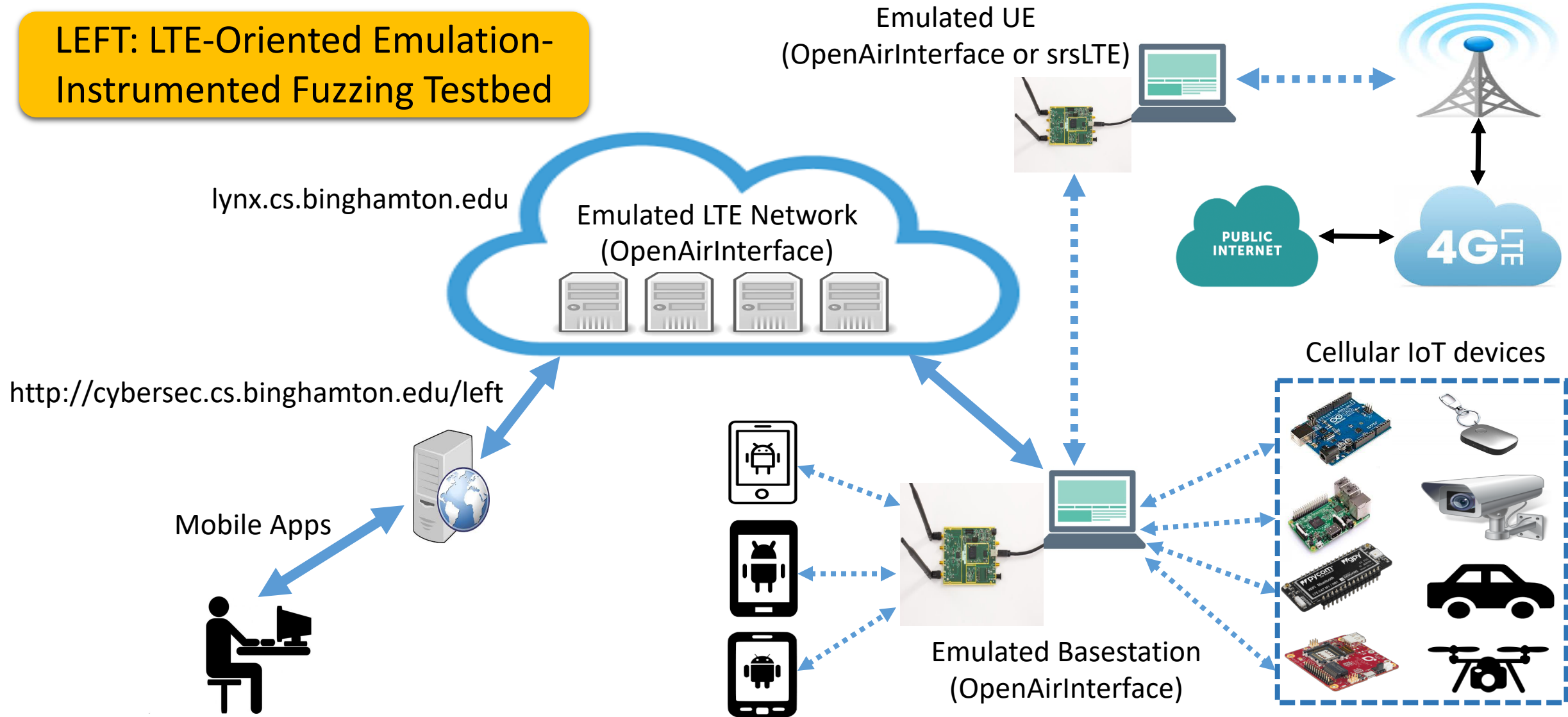
- **Mobile and IoT device vendors:**

- *Is there an integrated testbed that can assess the security risks posed to mobile/IoT devices from their 4G/LTE network interfaces?*

- **Mobile network operators:**

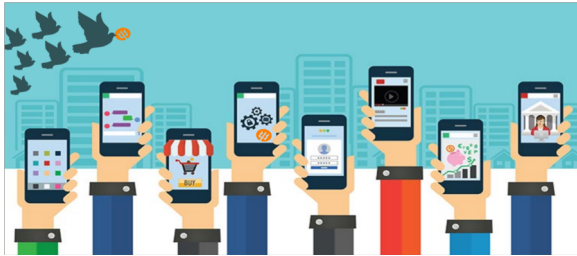
- *Is there an integrated testbed that can assess the security risks posed to 4G/LTE communication infrastructure from vulnerable mobile/IoT devices?*

**LEFT: LTE-Oriented Emulation-
Instrumented Fuzzing Testbed**



Research impact: resilient mobile communications (4G, 5G, ...)

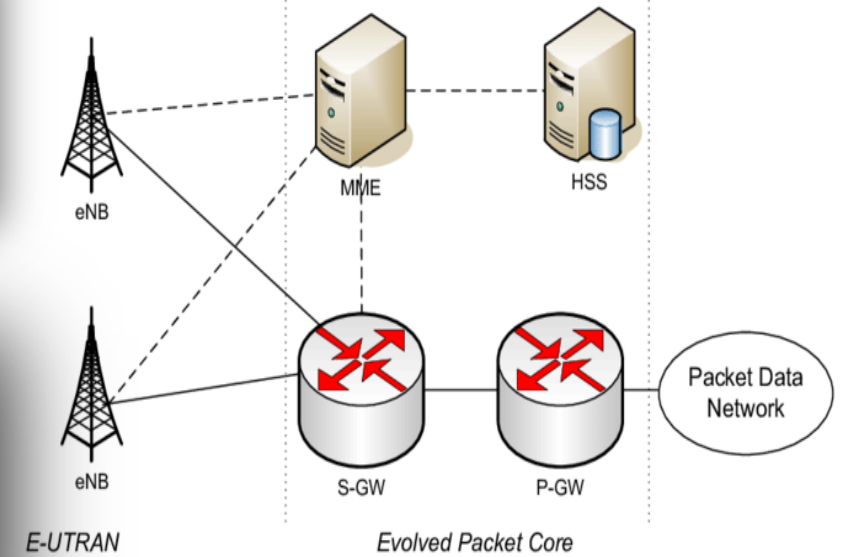
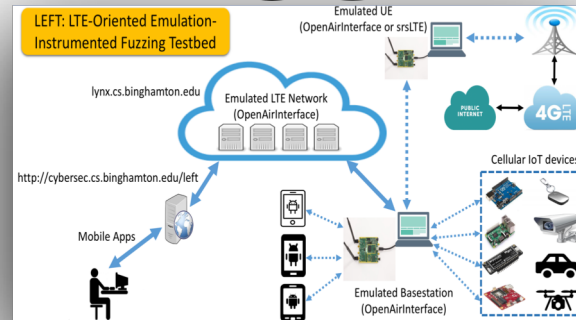
Mobile devices



Internet of Things



Connected Vehicles



Partnership

PI: How has working with your industry partner informed/impacted your work?

- Feedback from the industry helps prioritize our research efforts and improves usability of LEFT
- Information about the products for security assessment
- Possibility for additional funding

Industry: How did working with the researcher change or inform how you will address future problems in your field

- Exposed new security risks that the industry has not been aware of previously
- Help on effective mitigation of security risks exposed
- Community building on improving resilience of mobile communications

Unanticipated Challenges and Lessons Learned

Researcher

- Industry may be lukewarm to our initial efforts on customer engagement: exposed security risks may not be good PR for them.

Industry

- Dilemma: when external researchers are trying to find security risks of using our products, how much should we help them?

Trust building is key.

Guanhua Yan, Ph.D.
Department of Computer Science
Binghamton University, State
University of New York
ghyan@binghamton.edu

Industrial partners we have been
engaging with:

- Dr. Roger Piqueras Jover, Bloomberg
L.P. – CTO Security Architecture Team
- Dr. Michael Liljenstam, Ericsson
- Others

Acknowledgements

- **Funding and management by DHS/CIRI**
 - **UIUC:** Prof. David M. Nicol, Randy Sandone, Andrea Whitesell, Elaina Maria Buhs, Jose Alejandro Medina Cruz, and others.
 - **DHS:** Matt Coats, etc.
- **Hard work done by students at Binghamton University**
 - Ph.D. students: Kaiming Fang, Zhan Shu
 - Master students: Vladimir Beauge, Huanyi Qin
 - Undergraduates:
 - Anthony Muratore (Automated Financial Systems, LLC), Max Slocum (Assured Information Security, a contractor for AFRL), Kaiyik Nip (IBM)