Private LTE networks create new opportunities for industrial IoT

Qualcomm Technologies, Inc.
October, 2017
Transforming our world

Through intelligent connected platforms

Mobile

Last 30 years
Interconnecting people

IoT

Technology leadership in system on chip, systems design, and connectivity

Next 30 years
Interconnecting their worlds

*Qualcomm Technologies, Inc. data, as of Apr. 20, 2016; Includes products from Qualcomm Technologies, Inc. and Qualcomm Technologies International, Ltd.*
Megatrends in wireless interconnectivity, intelligence, automation create significant global economic value

- Health: ~$400-700B
- Home: ~$200-350B
- Office: ~$70-100B
- Retail: ~$400-500B
- Autonomous cars: ~$2.0-2.5T
- Smart cities: ~$1.0-1.2T
- Logistics: ~$500-800B
- Manufacturing: ~$1.4-1.7T

~$6-8 Trillion

2025-2030 potential economic impact

Note: Directional projections based on many long-term assumptions; estimates vary significantly based on adoption assumptions across verticals and use cases; Numbers may not sum due to rounding Source: World Economic Forum, McKinsey Global Institute, Economist Intelligence Unit, GSMA, Morgan Stanley, team analysis and estimates
The next industrial revolution is underway

Industrial trends
- Shift to selling products as services
- Predictive and preventative maintenance
- Reconfigurable factories with full mobility
- Big data analytics with increased automation

Connectivity requirements
- Keeping data local for better security
- Control and reliability of end-to-end system
- Global ecosystem with interoperability
- Advanced wireless devices: AGV, AR helmets...

Solution
- Private LTE networks
Robust connectivity is critical to the next industrial revolution

- Digital transformation of industrial processes
- Edge analytics keeping sensitive data local
- Wireless connected industrial IoT
- Connected workers with handhelds and AR/VR
- Increased automation with robotics, AGV, drones...
- Cyber security
- Big data analytics with cloud computing

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Private LTE networks offer key benefits for Industrial IoT

**Dedicated**  
Independent network with dedicated radio equipment, sensitive data stays local

**Optimized**  
Network tailored for industrial applications, e.g., quality-of-service, latency

**Readily deployed**  
Spectrum available, hosted or self-contained core network, self-organizing network
Private LTE networks for local and customized services

**Private LTE Networks**
- Managed locally
- Dedicated equipment
- Local coverage
- Optimized for local services

**Public LTE Networks**
- Managed by service provider
- Equipment shared with other traffic
- Wide-area coverage
- Generic voice/data services
LTE is the high-performance choice for industrial IoT

Capacity
Low to high data rate applications, large number of devices

Coverage
Superior range, both indoors and outdoors

Reliability and low latency
Industry grade reliability, customized quality of service, guaranteed latency

Cellular based security
Both SIM and non-SIM credentials, locally routed traffic for privacy

Seamless mobility
Seamless handovers, high mobility devices, service continuity with WAN

Future proof
Rich LTE roadmap and evolution to 5G, including ultra-reliable low latency comm.

Interoperability
Global standard and certification enable interoperability between suppliers
Scalable network architecture keeps local traffic on site

- Devices
  - Sensors
    - Wireless-HART
    - Wi-Fi
    - BLE
    - Wired
  - Machines
  - Access

- Local network
  - eNB
  - Gateway
  - Local gateway and apps
  - Local traffic stays on site

- Cloud services
  - Core network
  - IoT analytics and services
  - Network management
  - Device management
Ground/flight crew access

Updating aircraft logs

Interactive maintenance

Uploading engine data

Updating entertainment system
Wide area of industries addressable by private networks

Image provided by Harbor Research
Spectrum is available to deploy private LTE networks

1) MulteFire can be deployed in any unlicensed spectrum utilizing listen-before-talk and additional spectrum bands will be supported in the future.
Private LTE Networks—an opportunity for mobile operators

**Licensed spectrum assets**
- Dedicate a portion for private LTE networks
- Provides predictable performance
- Spectrum often under-utilized in industrial areas

**Expertise in mobile networks**
- Expertise in deploying and operating mobile networks
- Existing relationships with vendors
- Leverage existing mobile network assets

**Existing sales channels**
- Already provide services to many industrial customers
- Extend with private LTE network
- Multiple options, including selling private LTE network as a service
Citizens Broadband Radio Service
• 150 MHz shared spectrum in 3.5GHz USA
• Spectrum sharing with 3-tier priorities

CBRS Alliance
• 75+ members
• Promote LTE solutions for CBRS
• Multiple trials and certification in progress
• Deployments expected early 2018

www.cbrsalliance.org
CBRS introduces a 3-tiered shared spectrum in the US
Opens up 150 MHz spectrum for new use without interrupting incumbents

Tier 1
Incumbents

Tier 2
Priority Access Licenses (PAL)

Tier 3
General Authorized Access (GAA)

Incumbents are protected from interference from PAL and GAA

PAL has priority over GAA, licensed via auction, 10 MHz blocks, up to 7 licenses

GAA can use any spectrum not used, yields to PAL and incumbents

1) Wireless ISP transitioning from incumbent to PAL/GAA after 5 years; 2) Fixed satellite service - receiving only; 3) Citizen Broadband Radio Service (CBRS)
Private LTE-based networks already demonstrated

**Demo: Private LTE network in CBRS shared spectrum (Feb. 7, 2017)**

First demo of a private LTE network in CBRS providing a 360° race car experience

Industry collaboration: Qualcomm Technologies, Nokia, and Alphabet’s Access Group

Shows how venues and enterprises can deploy a private LTE network for customized services

**Demo: Private LTE-based networks for Industrial IoT (Feb. 22, 2017)**

MWC demo of private LTE network over CBRS for Industrial IoT

Industry collaboration: Qualcomm Technologies, Nokia and GE, demonstrating end-to-end IoT

Local control and optimization for industrial applications
MulteFire™

LTE-based technology
• Stand-alone in unlicensed spectrum
• Listen-before-talk (LBT)
• Supports 5GHz globally

MulteFire Alliance
• 35+ Members
• Release 1.0 published
• Trials expected early 2018
• Adding IoT enhancement in release 1.1

www.multefire.org
First MulteFire multi-node over-the-air demonstration

• Live over-the-air demonstration Feb. 2017
• Seamless handover in a multi-node deployment
• Shares the spectrum fairly with Wi-Fi
• Significantly longer range than Wi-Fi
Evolution to Private 5G Networks in 3GPP

NR will provide both enhanced and new capabilities, such as ultra-reliable and low latency communications.

More spectrum
Designed for all spectrum bands from below 1GHz to mmWave. Natively supports licensed, shared and unlicensed spectrum.

New study areas
3GPP started studies on NR operating in unlicensed spectrum, 5G for automation in vertical domains, and LAN support in 5G.
Private LTE network roadmap to 5G

- Global eco-system
- Single 5G/LTE network
- Licensed and unlicensed spectrum

Massive IoT
- Power efficient, low complexity, long range

Fiber-like speeds
- New devices, big data uploads

Ultra reliable and low latency
- Mission critical, Industry 4.0

Enabling Smart Industry
Private LTE networks for Industrial IoT

**Large addressable market with many verticals**

LTE is the high-performance choice for a wide range of industry verticals from factories, ports to power plants.

**Spectrum available with MulteFire and CBRS**

MulteFire in 5GHz globally, LTE-based CBRS in 3.5GHz USA, dedicated spectrum with operators.

**Path to private 5G NR networks**

Private 5G NR networks will enable Industry 4.0 with reconfigurable production, mobile robots and AR.

Learn more at [www.qualcomm.com/private-LTE](http://www.qualcomm.com/private-LTE)
Thank you

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