5G for the future economy: Opportunities and Challenges

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5G enables new IoT use cases

**Massive IoT**
- Smart Logistics
- Smart Agriculture
- Tracking
- Smart Cities
- Smart Meter

**Critical IoT**
- Factory Automation
- ITS
- Remote Operation
- Remote Surgery
- Smart Grid

**Enhanced MBB**
- Connected Car
- Home
- Enterprise
- 3D Camera/4K Screen
- E-Health
- VR/AR

**Characteristics**
- Low Cost, Low Energy
- Small Data Volumes
- Massive Numbers
- Ultra Reliable
- Very Low Latency
- Very High Availability
- More Capacity, Low Latency
One Network, Multiple Industries

A common network platform with Dynamic and Secure Network Slices

- 5X Lower Latency
- 1000X Mobile Data Volumes
- 10-100X End-user Data Rates
- 10X Battery Life
- 10-100X Connected Devices
- 10X Battery Life
- 1000X Mobile Data Volumes
Global 5G Spectrum Situation

Low Band

1 GHz

Mid Band

3 GHz

4 GHz

5 GHz

High Band

20 GHz

30 GHz

100 GHz

600/700 MHz

3.1–4.2 GHz

4.4–4.99 GHz

26/28 GHz

38/42 GHz

2018-2019

~2020

>2020
3GPP 5G Standards

Non-standalone NR
- MBB & low latency & high reliability
- Connected to Evolved Packet Core
- Standardization completed: December 2017

Standalone NR
- MBB & low latency & ultra reliability
- Connected to 5G Core Network
- Standardization completed: June 2018
Deployment scenarios for 5G

5G is expected to be deployed along the existing network infrastructure as well as standalone deployments based on different use cases. Illustration of how different frequencies and technologies can determine site deployment characteristics.

Non-Standalone 5G
4G and 5G in mid-low bands, same coverage area
Both technologies share the same radio site, connected to the existing Core network
Example of use cases: eMBB, FWA in wide areas

Non-Standalone 5G
4G in low bands and 5G in high-bands, different coverage areas
5G radios may be deployed in new site as needed, both technologies are connected to the existing Core network
Example of use cases: eMBB, FWA in selected areas

Standalone 5G
Initial 5G deployments in low bands, benefit from larger coverage areas
New 5G radio sites, connected to the new 5G Core
Example of use cases: eMBB, FWA, private network, Industrial IoT
5G Journey

New use cases

Evolved use cases

Existing use cases

- Secure robust 4G network with Gigabit LTE and 5G Plug-ins
- Launch 5G with 4G interworking
- 5G standalone deployments
- 5G densification
- 5G is mainstream
Technical expectations of 5G

- **Peak Data Rate**: 1 - 20 Gbps
- **User Experienced Data Rate**: 10 - 100 Mbps
- **Spectral Efficiency**: ×1 - ×3
- **Mobility**: 350 - 500 km/h
- **Latency**: 1 - 10 ms
- **Connection Density**: 10k - 1m devices / km²
- **Network Energy Efficiency**: ×1 - ×100
- **Area Traffic Capacity**: 0.1 - 10 Mbps / m²
- **Availability**: 99.999% (of time)
- **Reliability**: 99.999% (of packets)
- **Position accuracy**: 10m - <1m
- **Security**: Strong subscriber authentication, user privacy and network security

*For low power IoT devices

Source: ITU-R, NGMN, 3GPP
Potential use cases

- **SMART HOME**
  - Building Automation & Security
    - Alarm Monitoring
    - Lighting/Heating Control

- **SMART BUILDING**
  - Building Automation & Security
    - Security/Fire Alarms
    - Lighting/HAVC Control
    - Connected Elevators

- **INDUSTRY**
  - Smart Agriculture
  - Connected Supply Chain
  - Construction Equipment Monitoring
  - Manufacture & Processing

- **CONNECTED HEALTH**
  - Assisted Living
  - Clinical Remote Monitoring

- **ENERGY & UTILITIES**
  - Smart Metering
  - Connected Microgeneration

- **SMART CITY**
  - Connected Public Services
  - Road Traffic Management
  - Environmental Monitoring

- **CONNECTED CAR**
  - Stolen Vehicle Recovery
  - Usage Based Insurance

- **CONSUMER ELECTRONICS**
  - Pet/Child/Asset Tracking

Source: Machina 2017
It is all about use case evolution with supporting technologies

<table>
<thead>
<tr>
<th>Enhanced mobile broadband Automotive</th>
<th>Screens everywhere</th>
<th>On demand information</th>
<th>New tools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing</td>
<td>Process automation</td>
<td>Flow management and remote supervision</td>
<td>Real-time information vehicle to vehicle</td>
</tr>
<tr>
<td>Energy &amp; utilities</td>
<td>Metering and smart grid</td>
<td>Resource management and automation</td>
<td>Autonomous control</td>
</tr>
<tr>
<td>Healthcare</td>
<td>Connected doctors and patients</td>
<td>Monitoring and medication e-care</td>
<td>Immersive experience</td>
</tr>
</tbody>
</table>

**Technologies**
- Multi-standard network
- Cat-M1/NB-IoT
- Cloud optimized functions
- VNF orchestration
- Gigabit LTE (TDD, FDD, LAA)
- Massive MIMO
- Network slicing
- Dynamic service orchestration
- Predictive analytics
- 5G NR
- Virtualized RAN
- Federated network
- Distributed cloud
- Real-time machine learning/AI

On the road to 5G

- Cloud robotics and remote control
- Machine intelligence and real-time control
- Remote operations

5G experience
A new Ericsson survey on 5G

Primary Research

Based on phone interviews with C-Level and other executives during October and November 2017

Global Coverage

A global representation of respondents covering North America; Latin America; Asia Pacific; Europe; Middle East and Africa

10 Key industries

Energy & Utilities, Manufacturing, Public Safety, Healthcare, Public Transport, Media & Entertainment, Automotive, Financial, Retail & Agriculture

Large companies

Approximately 100 interviews for each of the 10 industries covered, representing large companies with a minimum of 1,000 employees
Global business insights, Industry adoption of 5G by 10 industries

3/4 expect their industry and own company to leverage 5G to improve offerings AND cost

73% have a strategy to leverage first mover advantages.

70% expect their first 5G use case to be in production by 2021

5 5G capabilities carrying tied to premium values across industries

>50% Expect to be in trials for their first use case in 2019

Operator implications
— Large pent-up demand from industries eager to leverage 5G trials already in 2019
— First mover advantage ambitions will make TTM critical
— 5G price premium for crucial attributes
Top-4 use cases in production by 2021, by industry sector

- Public Transport: 82%
- Public Safety: 78%
- Automotive: 77%
- Agriculture: 77%
- Energy & Utilities: 75%
- Financial services: 73%
- Media & Entertainment: 73%
- Retail: 73%
- Healthcare: 71%
- Manufacturing: 68%

On average, over 70% of companies aim to have use cases in production by 2021.

Source: The industry impact of 5G - Insights from 10 sectors into the role of 5G, Ericsson, January 2018
6 major findings in our survey

- Capability driven focus
- Industry reasons to move
- Known adoption barriers
- Trial & production timing
- Customer value & Efficiency
- Premium price potential

Top-4 Use cases

Identified for each industry, together with main pain points and timing for trials and production services
## 5 network capabilities in focus

<table>
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<tr>
<th>Receive input from large sensor networks</th>
<th>Enhanced Mobile broadband (speed/latency)</th>
<th>Accurately control remote equipment</th>
<th>Private network with exact properties</th>
<th>Higher security network</th>
</tr>
</thead>
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<tr>
<td><img src="sensor.png" alt="Sensor Network" /></td>
<td><img src="mobile_broadband.png" alt="Mobile Broadband" /></td>
<td><img src="remote_control.png" alt="Remote Control" /></td>
<td><img src="private_network.png" alt="Private Network" /></td>
<td><img src="security_network.png" alt="Security Network" /></td>
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- Energy & Utilities
- Manufacturing
- Public Safety
- Healthcare
- Public Transport
- Media & Entertainment
- Automotive
- Financial Services
- Retail
- Agriculture

**Source:** The industry impact of 5G - Insights from 10 sectors into the role of 5G, Ericsson, January 2018
Reasons for taking next step to 5G, strategic point of view

Major strategies

1. Create a first mover advantage
   - 73% First Mover Advantage

2. Position yourself as an industry innovator
   - 54% To be seen as an innovator

3. Leverage digital disruption enablers
   - 53% Critical to Digital Transformation

4. Build a solid base for IoT
   - 46% Fundamental to IoT projects

*TTM* expected remain strong driver for strategic agendas. Both for initial explorations and full fledged service launches.

Source: The industry impact of 5G - Insights from 10 sectors into the role of 5G, Ericsson, January 2018
Key barriers to adoption of 5G
Top-5 this year

- Concerns around data security and privacy: 78%
- Lack of standards: 76%
- Challenges of end-to-end implementation: 69%
- Too soon to know what the real benefits will be: 62%
- Lack of budget/investments: 61%

Source: The industry impact of 5G - Insights from 10 sectors into the role of 5G, Ericsson, January 2018
Key barriers to adoption of 5G
Additional in Top-10

- Senior stakeholder buy-in/concerns: 54%
- Lack of use cases: 47%
- Lack of platforms to take full advantage of 5G: 46%
- Lack of mature eco-system: 45%
- Opportunities related to current mobile network generations not yet fully exploited: 44%

3 of 5 issues have seen drops from the 2016 survey indicating issues outside Top-5 has progressed well in 2017.

Source: The industry impact of 5G - Insights from 10 sectors into the role of 5G, Ericsson, January 2018
Digital Engagement & Experiences
Legal & Regulatory Reflections

• "Implicit Consent / Knowing Consent / Quality Consent" - Whether it's been collected legally from individuals who have knowingly provided consent understand the implications of consent or has the owner essentially surrendered control of data in lieu for services provided

• "Transparency, Choice & Control" - Can obtain details of the data that the controller holds about them. And consumer must be able to withdraw consent previously given and to object to the processing of data relating to them

• "Purpose Limitation" - Data can only be collected for specified, explicit and legitimate purposes. These purposes must be defined before processing

• "Repurposed Data" - Knowledgeable consent to the primary requestor does not automatically imply consent for use of the data by third parties for reasons beyond those originally explained

• "Data Controller Transparency" – Identity of the controller, the purposes of the processing, the recipients of the data and the existence of data users rights.

• "Fair Collection & Usage" - The individual should be aware data is collected and how it is going to be used
New Revenue, Business Model & Ecosystem
Legal & Regulatory Reflections

- "Product Liability" – How to establish liability in a complex interconnected value chain involving multi party services & responsibilities with interdependencies for performance and security

- "Data Ownership" – Who owns what data? Establishing clear boundaries for data ownership, restricted use data licensing and address information asymmetry on contracted performance

- "Industry Vertical Regulations & Standards" – Application of relevant industry vertical rules & regulations, consumer protection / safety standards / rights

- "Intellectual Property & Copyright" – Protection of IPR in a platform economy; With multi component IoT solutions involving systems integration of multiple components, handling issues of patent infringement & indemnification

- "Cybersecurity in a Platform Economy" – Roles and responsibilities for cybersecurity management by different players in a complex digital value chain encompassing hardware, software and services

- "Baking Security & Privacy In Contract" - Ensure service creation and innovation does not expose their customers to more risk than is necessary
Legal & Regulatory Reflections

- “Personal Data Protection” – What data can be put on the public cloud? Issues of data controller & processors, involvement of ‘sub’ parties, legalities around data transfers, applicable law & competent court

- “Cloud Contracting” – Remember cloud is low barrier entry but can scale out very quickly
  1. Small contract, big liability
  2. Liability of hosting provider not in line with risk
  3. Exclusions related to service availability, service credits & other remedies for poor performance
  4. Direct, indirect, incidental, consequential damages for loss of profit & good will
  5. Vendor lock in issues - legal requirements for data export on cloud contract termination
  6. Unilateral termination possibility – Cloud provider often may reserve right to unilaterally terminate

- “Multi Party Contracting” - Multi parties increasingly involved with cloud brokerage & intermediaries in multi cloud setup. Establishing delineation of responsibility and E2E service levels

- “Auditing & Compliance” – Ability to audit cloud service provider, meeting compliance on data retention, taxation, electronic invoicing etc.
Big Data / Machine Learning & AI
Legal & Regulatory Reflections

- "Data Minimization" - Necessary data should not be collected, stored “just in case” or because “it might be useful later”. Personal data from a user should be deleted as soon as the user ends the subscription.

- "Sensitive Data Handling" - Some classes of data more sensitive than others. E.g. individual’s health.

- Lost Anonymity - Multi Source Aggregation / Single Source High Volume Data” – Data from different sources about an individual increase in voluminous, remaining anonymous becomes increasingly difficult.

- "Control Loss" - Where device connectedness results in personal data generation, storage and communication over which the user has no control.

- "Economic Interest" - Ruling on Google Spain established that economic interest itself is not sufficient grounds for legitimization of data collection & processing.

- “Emerging Issues – ML & AI” – Training data set quality for ML, ethical & fair application of AI, ML & AI Bias, AI black boxes vs decision reasoning.
Here are the things that need to be in place for 5G, things that are lacking today:

- **Regulatory conditions** – Harmful regulation such as net neutrality which is over interpreted, roam like at home, WiFi4EU, The European Electronic Communications Code, GDPR, e-privacy, and the litany of EU regulations which limit opportunities in 5G, particularly with small cells.

- **Value chain** – The Nordic region used to be the hotbed for mobile industry with research & development funded in large part by the telecom industry. When EU telecom investment dried up, so did the funding for R&D. Today 5G innovations is developed primarily in the US and Asia.

- **Business models** – 5G business models and monetization is still unclear to some extent. The uncertain regulatory environment reduces incentives for experimentation.

- **User adoption** – American consumers are already buying 5G products and services while the EU falls further behind on networks and innovation.

- **Network expansion** – Here are two things that must be in place, access to the required frequencies and conditions that allow the mobile mast and small cells to form a 5G network. In Europe, there are many countries where they have not started the process to create the framework conditions to build and operate 5G networks.
Thank you!