Agenda

• Defining what 5G is
• Key Drivers / Technology Requirements
• Use Cases
• What 5G isn’t
• Implications of 5G on Mobile Operators

• The IoT business background
• The IoT Ecosystem
• The IoT Data Flow

• Roadmap
• Define the major players
• Where do we stand from all of this?
What 5G is!!!

Evolution beyond mobile Internet

<table>
<thead>
<tr>
<th>Generation</th>
<th>Primary services</th>
<th>Key differentiator</th>
<th>Weakness (addressed by subsequent generation)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1G</td>
<td>Analogue phone calls</td>
<td>Mobility</td>
<td>Poor spectral efficiency, major security issues</td>
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<tr>
<td>2G</td>
<td>Digital phone calls and messaging</td>
<td>Secure, mass adoption</td>
<td>Limited data rates - difficult to support demand for internet/e-mail</td>
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<tr>
<td>3G</td>
<td>Phone calls, messaging, data</td>
<td>Better internet experience</td>
<td>Real performance failed to match hype, failure of WAP for internet access</td>
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<tr>
<td>3.5G</td>
<td>Phone calls, messaging, broadband data</td>
<td>Broadband internet, applications</td>
<td>Tied to legacy, mobile specific architecture and protocols</td>
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<tr>
<td>4G</td>
<td>All-IP services (including voice, messaging)</td>
<td>Faster broadband internet, lower latency</td>
<td>?</td>
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</tbody>
</table>

Source: GSMA Intelligence
What 5G is!!!

Two views of 5G exist today:

- **View 1 / The hyper-connected vision**
  - Blend of pre-existing technologies (2/3/4G, WiFi, etc.) for higher coverage and availability
  - Key differentiator being greater connectivity as an enabler for M2M and IoT
  - May include a new radio technology to enable low power, low throughput field devices

- **View 2 / Next-generation radio access technology**
  - More of a traditional ‘generation-defining’ view
  - Specific targets for data rates and latency being identified
  - Easier determination of whether a technology is 5G or not

However, the two views described are regularly taken as a single set and hence views are grouped together.
Technology Requirements

- 99.999% availability
- 100% coverage

- 90% reduction in network energy
- >10 Gbps peak data rates
- 10-100 x more devices
- M2M ultra low cost
- 10 years on battery
- 10 000 x more traffic
- <1 ms radio latency
- Ultra reliability

"Unlimited experience"
- 100 Mbps whenever needed

"For everything"

"Instant action"
Use Cases

The rate of adoption of 5G and the ability of operators to monetize it will be a direct function of the new and unique use cases it unlocks.
Use Cases

- Virtual Reality/Augmented Reality/Immersive or Tactile Internet
- Machine-to-machine connectivity (M2M)
- Autonomous vehicles
- Remote Robotics / Surgeries
- Industry control / automation
What 5G isn’t!!!

Some technologies deployments and infrastructure enhancements are being placed under the umbrella of 5G:

- LTE-Advanced technologies
- Network function virtualization (NFV)
- Software defined networks (SDN)
- Heterogeneous networks (HetNets)
- Low power, low throughput (LPLT) networks
Implications of 5G on Mobile Operators

Operators need to overcome a series of challenges if the 5G benefits are to be realized

- 5G spectrum and coverage implications
- <1 millisecond latency
From a gadget...
... to a true business enabler.
The outlook for 2019

Global IP Traffic & Service Adoption Drivers

By 2019:

- Faster Broadband Speeds: 2014 - 20.3 Mbps, 2019 - 42.5 Mbps

Source: Cisco VNI Global IP Traffic Forecast, 2014–2019
See for yourself
The IOT Paradigm

How do we get there?

HOW?
IOT Data flow

Site
Capture

Network
Transmit RAN
Transport IP, MPLS, etc.

Data Center/Cloud
Store
Analyze
Action

Big Data / Analytics / Application builders

IoT Enabler
Collecting data on a massive scale while preserving the sensor battery life is a challenge;
Ferocious competition for the Low Power Wide Area (LPWA) technology dominance;

The "LPWAR": lets look at the market alternatives in this area:

- Sigfox
- LoRaWAN
- LTE-M
- Wifi + 3/4G
- Zigbee + 3/4G
IOT Data flow

Transmitting the M2M chatter

Capture  Code  Transmit  Transport

Sensors  IoT nodes  IoT Gateways  IP Network

Technology decision factor

SIGFOX  LoRa  2.5G  3G  4G

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Fog Computing

Eliminating the unnecessary chatter on the radio

Capture → Code → Transmit → Transport → Store → Analyze → Action

Fog Computing

Preprocessing of data from sensors saves on transmissions costs.

Cloud Computing

Bringing some intelligence closer to the edge.

However, this does not work every time, every where, on every application

- Central decision applications
- Self Driving Cars
Finally

IOT

Information Technology → IOT → Operation Technology

System Integration

- Operation technology & Low Current
- Radio Access
- Networking
- Data Integration, software
- Data science

Business Outcome
# Roadmap

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<tbody>
<tr>
<td>5G in 3GPP</td>
<td>RI4 (start)</td>
<td>RI5</td>
<td>RI6</td>
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<tr>
<td>4G in 3GPP</td>
<td>RI2</td>
<td>RI3</td>
<td>RI4 (start)</td>
<td>RI5</td>
<td>RI6</td>
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<td>ITU</td>
<td>Vision</td>
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<td>Wkp</td>
<td>Proposals</td>
<td>Evaluation</td>
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<td>EC FP7</td>
<td>EC FP7 Pre-5G</td>
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<td>EC 5G PPP</td>
<td>5G PPP set-up</td>
<td>5G PPP Phase 1</td>
<td>5G PPP Phase 2</td>
<td>5G PPP Phase 3</td>
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<tr>
<td>SDN/NFV</td>
<td>ONF, Open Daylight, OPNFV, Open Stack...</td>
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<tr>
<td>Mobile Networks</td>
<td>Radio experiments</td>
<td>Trials</td>
<td>5G Deployment and commercialisation</td>
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**Note:** Other Region events under elaboration

- Winter Olympics in South Korea
- FIFA World Cup in Russia
- Summer Olympics in Japan

2 YEARS - Exploratory phase and specification
2 YEARS - Detailed research and optimization
2 YEARS - Experimentation and trials
Key Players

- ITU Radiocommunication Sector (ITU-R)
- NGMN Alliance
- European Commission
- National governments
- Individual operators and vendors (AT&T already announced its plans for field trials)
Where do we stand
Thank you!

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