5G for the Fourth Industrial Revolution
Isabelle Mauro - Head of Telecoms & Digital Communications Industry
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Why is 5G important for the fourth Industrial Revolution (4IR)?

Intelligent connectivity, enabled by 5G, will be the catalyst for the socio-economic growth that the 4IR could bring.
1. IMPORTANCE OF 5G FOR THE 4IR

Global 5G impact assessed by international studies

**Multi-trillion dollar socio-economic impact confirmed by various industry sources**

**IHS Economics 2017:** US$12.3 trillion and 5G global value chain supporting 22 million jobs by 2035

**European Commission 2016:** €141 billion with 2.3 million jobs in EU28 member states

Source: IHS Markit, European Commission
1. IMPORTANCE OF 5G FOR THE 4IR

Industry wide impact assessment

Multi-trillion dollar socio-economic impact confirmed by various industry sources

<table>
<thead>
<tr>
<th>Industry</th>
<th>Enhanced Mobile broadband</th>
<th>Massive Internet of Things</th>
<th>Mission Critical Services</th>
<th>5G Enabled output (2016$, M)</th>
<th>Percent of industry output</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manufacturing</td>
<td>$3,364</td>
<td></td>
<td></td>
<td>$3,364</td>
<td>4.2%</td>
</tr>
<tr>
<td>Info. &amp; Communications</td>
<td>$1,421</td>
<td></td>
<td></td>
<td>$1,295</td>
<td>11.5%</td>
</tr>
<tr>
<td>Wholesale &amp; Retail</td>
<td>$1,066</td>
<td></td>
<td></td>
<td>$1,066</td>
<td>6.5%</td>
</tr>
<tr>
<td>Public services</td>
<td>$742</td>
<td></td>
<td></td>
<td>$742</td>
<td>4.7%</td>
</tr>
<tr>
<td>Construction</td>
<td>$676</td>
<td></td>
<td></td>
<td>$676</td>
<td>4.6%</td>
</tr>
<tr>
<td>Financial &amp; insurance</td>
<td>$659</td>
<td></td>
<td></td>
<td>$659</td>
<td>5.6%</td>
</tr>
<tr>
<td>Transportation &amp; storage</td>
<td>$623</td>
<td></td>
<td></td>
<td>$623</td>
<td>3.7%</td>
</tr>
<tr>
<td>Professional services</td>
<td>$562</td>
<td></td>
<td></td>
<td>$562</td>
<td>4.8%</td>
</tr>
<tr>
<td>Hospitality</td>
<td>$510</td>
<td></td>
<td></td>
<td>$510</td>
<td>6.4%</td>
</tr>
<tr>
<td>Agriculture, Forestry &amp; fishing</td>
<td>$400</td>
<td></td>
<td></td>
<td>$400</td>
<td>2.4%</td>
</tr>
<tr>
<td>Real estate activities</td>
<td>$277</td>
<td></td>
<td></td>
<td>$277</td>
<td>3.5%</td>
</tr>
<tr>
<td>Education</td>
<td>$273</td>
<td></td>
<td></td>
<td>$273</td>
<td>4.5%</td>
</tr>
<tr>
<td>Utilities</td>
<td>$249</td>
<td></td>
<td></td>
<td>$249</td>
<td>4.1%</td>
</tr>
<tr>
<td>Mining &amp; quarrying</td>
<td>$119</td>
<td></td>
<td></td>
<td>$119</td>
<td>2.3%</td>
</tr>
<tr>
<td>Health &amp; social work</td>
<td>$65</td>
<td></td>
<td></td>
<td>$65</td>
<td>3.5%</td>
</tr>
<tr>
<td>Arts and entertainment</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>All industry sectors</td>
<td>$4,400</td>
<td>$3,600</td>
<td>$4,300</td>
<td>$12,300</td>
<td>Average: 4.5%</td>
</tr>
</tbody>
</table>

Source: IHS Economics and IIHSS Technology, 2017
1. IMPORTANCE OF 5G FOR THE 4IR

Types of impacts

Socio- Economic Impact analysis

<table>
<thead>
<tr>
<th>IMPACT CATEGORIES AND KEY IMPACT INDICATORS</th>
<th>ECONOMIC IMPACT</th>
<th>SOCIETAL IMPACT</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Employment (Payroll)</td>
<td>• Health</td>
<td>• Air Pollution</td>
</tr>
<tr>
<td>• Economic Output</td>
<td>• Education</td>
<td>• Greenhouse gases</td>
</tr>
<tr>
<td>• Profits</td>
<td>• Livelihood</td>
<td>• Land Use and Biodiversity</td>
</tr>
<tr>
<td>• Investment</td>
<td></td>
<td>• Waste</td>
</tr>
</tbody>
</table>

The business models will play an important role in coordinating efforts of the key stakeholders towards realizing the maximum socio-economic impact potential of the new vertical 5G use cases.

Factors promoting the need of socio-economic impact assessment

- Potential of 5G networks in early achievement of the SDG targets
- Goal to reduce the digital divide by connecting the unconnected
- Need of education and open communication with citizens
- Lack of knowledge about Health and electromagnetic compatibility
- Multi-stakeholder ecosystem trying to rapidly scale the deployments
What is the role of telecom operators?

The transformation of network technologies in terms of higher speed, lower latency or reliability will create unique opportunities for enterprises across mobility, manufacturing, healthcare, entertainment, energy and other sectors.
Enabling opportunities for other industries

2. ROLE OF TELECOM OPERATORS

Maturity of use cases enabled across industry verticals by evolving features of 5G

- **Selective Rural**
  - Reliability: >10 years battery
  - Devices: up to 1 m/ km²

- **Urban / Suburban**
  - Reliability: 99.999%
  - Latency: < 1ms
  - Devices: up to 1 m/ km²

- **Highly Dense Urban**
  - Reliability: 99.99%
  - Latency: < 5ms

- **Extreme Mobile Broadband**
  - Speed: 10 Gbps
  - Latency: < 10 ms

- **Fixed Wireless Access**
  - Speed: 1-5 Gbps
  - Latency: < 20 ms

- **Public Safety Comms.**
  - Speed: 10 Gbps
  - Latency: < 10 ms

- **Consumer AR/ VR (Retail)**
  - Speed: 10 Gbps
  - Latency: < 10 ms

- **Smart Factory (Real time remote control)**
  - Reliability: 99.99%
  - Latency: < 5 ms

- **AR/ VR in Healthcare**
  - Reliability: 99.999%
  - Latency: < 1 ms

- **Autonomous Cars**
  - Reliability: >10 years battery
  - Devices: up to 1 m/ km²

- **Real time banking**
  - Reliability: 99.999%
  - Latency: < 1 ms

- **Energy & Utility**
  - Reliability: 99.999%
  - Latency: < 1 ms

- **Widespread IoTs (Smart cities and Agriculture)**
  - Reliability: >10 years battery
  - Devices: up to 1 m/ km²

Coverage

Source: PwC Strategy& analysis
2. ROLE OF TELECOM OPERATORS

Emerging strategies for monetization

Ways to play: Emerging strategies for monetization

1. **Operator-led B2B or B2C**
   - **5G “connectivity provider” model**
   - Telco
     - Pricing dimensions: Speed, Allowance, Quality of service/reliability
   - Digital multichannels
   - Customer → Third Party
   - Flow of service, Flow of money

2. **Third party-led B2B2X**
   - **5G “solution enabler” model**
   - Telco
     - Pricing dimensions: Speed, Allowance, Latency, Quality of service/reliability
   - Digital multichannels
   - APIs
   - Customer → Third Party
   - Flow of service, Flow of money

   - **5G “solution creator” model**
   - Telco
     - Pricing dimensions: Speed, Allowance, Latency, Quality of service/reliability
   - Digital multichannels
   - APIs
   - Customer → Third Party
   - Flow of service, Flow of money

Source: PwC Making 5G pay
2. ROLE OF TELECOM OPERATORS

5G Flywheel with core elements and key actors

**IMPACT: Key actors/ stakeholders**
- Data providers on 5G traffic/usage (GSMA, industry analysts)
- Economic impact (World Bank, IMF, OECD, industry analysts)
- Data providers on Social/ Environmental impact (United Nations, UNFCCC, ACE, WHO, Our World in Data, etc.)

**SERVICES: Key actors/ stakeholders**
- Network operators
- Software service providers
- Operational technology providers
- Public service providers
- Governments/ Regulators
- Enterprises and End-users
- Industry associations (5G-ACIA, 5GAA, etc.)
- Public-Private partnership organizations (WEF, 5G PPP, etc.)

**SPECTRUM: Key actors/ stakeholders**
- ITU, GSMA, 3GPP
- Governmental regulators (e.g. FCC: US, European Commission: EU, MIIT: China, etc.)
- Network operators
- Enterprises considering acquisition of 5G spectrum licenses or using unlicensed 5G

**SECURITY: Key actors/ stakeholders**
- SIA, 3GPP, IEEE, Governments/ Regulators, Industry Associations (5G-ACIA, 5GAA, etc.), Public-Private Partnership organizations (WEF, 5G PPP, etc.), enterprises, end-users

**INFRASTRUCTURE & DEVICES: Key actors/ stakeholders**
- Network operators, GSMA, 3GPP, Network equipment providers, Tower companies, Enterprises considering the deployment of private 5G networks, Device and chip manufacturers

Source: World Economic Forum
Whether spectrum should be set aside for private vertical 5G networks?

Impact on the 5G flywheel components if the spectrum is set aside for the private verticals:

**Spectrum:**
- “Ringfencing” spectrum for industrial use cases would be inefficient
- Monitoring implementation of spectrum policy guidelines/standards

**Business models:**
- Challenge for telecos business models especially in the area of providing services to the enterprise market

**Infrastructure and Devices:**
- Different use cases to have very specific device and service requirements but may initially come at a rather small scale
- Manufacturers want to ensure SLAs and control of data
- MNOs may be dependent on one stakeholder in one location

**Security:**
- Need of highly customized security solutions
- Less risk as deployments by enterprises could be controlled and secured

Examples of enterprises procuring own local 5G networks:
- Volkswagen
- BASF
- Google Fi, an MVNO
- Siemens

Top German industrial companies are looking to acquire regional licenses to run 5G mobile networks, as they plan futuristic networked factories that could help Europe’s largest economy keep its export edge in the digital era.

Future networks will rely on a combination of mainstream and alternative technologies, and use both licensed and unlicensed spectrum, across different spectrum bands.

**KEY DESIGN PRINCIPLES**

- **Allocation:** standard for licensed and unlicensed spectrum
- **Harmonization**
- **Exclusive, shared and unlicensed models**
- **Pricing** favouring investments
- **Sharing** to ensure maximum geographical coverage
What role can the World Economic Forum Play?

The Forum is best suited to bring all stakeholders of the 5G ecosystem together, including the industry verticals, governments, telcos, academics. Objective is to advance on seven strategic objectives across Policy, Business and Society for the successful deployment of next generation networks.
5G-Next Generation Networks Programme

Programme overview: seven strategic objectives

The Forum aims to advance on these objectives for the successful deployment of next generation networks

**POLICY**

1. **Demonstrate socio-economic benefits**
   - **Action:** align ecosystem stake-holders to realize the value potential of 5G

2. **Redefine business models focused on vertical markets**
   - **Action:** engage cross-industry players to co-create a value generating ecosystem

3. **Support innovators building 5G use cases**
   - **Action:** stimulate market engagement encouraging pilots & test-beds

4. **Establish cooperative models for infrastructure investment**
   - **Action:** build the investment case and incentivize “co-opetition”

5. **Prepare for future cyber-security scenarios**
   - **Action:** develop scenarios, threat predictions and mitigation actions

6. **Create an enabling regulatory environment**
   - **Action:** align government objectives to industry requirements

7. **Prioritize sustainability and inclusiveness**
   - **Action:** define viable & environmentally sustainable deployments. Leverage new network technologies to bridge the digital divide
Conclusions

1. 4IR is expected to create enormous economic and societal value underpinned by ultrafast and ultra reliable 5G

2. A switch to 5G promises to catalyst various benefits, involving job creation, income growth/disparity, consumer cost/time savings, pollution/greenhouse gas reduction and quality-adjusted life years gained

3. By cementing strong relationships between vendors, operators and verticals, 5G will open the field to new business models and offerings

4. 5G Flywheel will propel sustainable transformation of industry verticals and society and hence there’s need to overcome blocking points

5. Collaborative proposition around ‘How to support regulators and other stakeholders to communicate on new technology impacts to broader society’
Isabelle Mauro
Head of Telecoms & Digital Communications Industry
World Economic Forum
Isabelle.Mauro@weforum.org

Rodrigo Arias
5G-Next Generation Networks Programme Lead, Global Leadership Fellow
World Economic Forum
Rodrigo.Arias@weforum.org