Mobile360 Digital Societies

APAC IoT INNOVATION SUMMIT

Kuala Lumpur 24-26 Sept 2019

#MOBILE360

Connectivity Sponsor: maxis
Session 6: IoT in the 5G Era
Session 6: Deployment of 5G Services in Japan

Takehiro Nakamura
SVP & GM of 5G Laboratories
NT DOCOMO
5G Deployment and Use Cases

Takehiro Nakamura
NTT DOCOMO, Inc.
Time schedule for 5G Commercial Launch by 2020

- 5G commercial services will be launched at 2020 Spring based on Non-Standalone of 3GPP specifications
- 5G Pre-Services have been launched on Sep. 20, 2019 taking the opportunity of RWC 2019

<table>
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<th>CY</th>
<th>2016</th>
<th>2017</th>
<th>2018</th>
<th>2019</th>
<th>2020</th>
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<tr>
<td>Event</td>
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<td>5G Trial Sites</td>
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<td>5G Trials for radio key technologies</td>
<td>Requirements</td>
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<td>Specifications</td>
<td>IMT2020 (Oct. 2020)</td>
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<td>5G Pre-Services</td>
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<td>Tokyo Olympics (July 2020)</td>
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<td>5G commercial system development</td>
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<td>Rugby WC (Sep. 20, 2019)</td>
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<td>5G commercial launch</td>
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<td>PyeongChang Olympics (Feb. 2018)</td>
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<td>Domestic regulatory clearance, etc.</td>
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<td>Information &amp; Communications Council, etc.</td>
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<td>Spectrum allocation</td>
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<td>3GPP compliant Trials</td>
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<td>5G Open Partner Program</td>
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<td>May</td>
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5G Pre-Commercial Service

5G pre-commercial service was launched taking the opportunity of Rugby World Cup 2019™

For consumers

For enterprises

Roll out 5G coverage in various locations across Japan

Regional vitalization Solution of social issues

Rugby World Cup 2019™

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Deliver new game viewing style at 8 stadiums & live viewing venues across Japan

To start Sept. 20
Co-creation with partners from a wide range of industries

3,000 Partners over

Medical, education, others 7%
Communications 3%
Financial, Insurance 4%
Logistics, Transportation 5%
Local Government 7%
Construction 7%
Media 7%

Co-work remotely using VR goggles and 3D Drawing Equipment via 5G
5G Spectrum Allocation Results

[3.7 GHz Band]

- 3600MHz to 3700MHz: NTT Docomo 100MHz
- 3800MHz to 3900MHz: KDDI 100MHz
- 4000MHz to 4100MHz: Rakuten 100MHz
- 4100MHz to 4600MHz: Softbank 100MHz

[4.5 GHz Band]

- 4500MHz to 4600MHz: NTT Docomo 100MHz

[28 GHz Band]

- 27.0GHz to 27.4GHz: Rakuten 400MHz
- 27.4GHz to 27.8GHz: NTT Docomo 400MHz
- 27.8GHz to 28.2GHz: KDDI 400MHz
- 29.1GHz to 29.5GHz: Softbank 400MHz

5G Migration Scenario

➢ **Initial Stage of 5G deployment:**
5G services will be provided by tight interwork between eLTE with existing frequency bands and 5G New Radio (NR) with new frequency bands, i.e. Non Stand Alone (NSA) and Option 3x

➢ **Later stage of 5G deployment:**
NextGen CN will be deployed to provide services flexibly by architecture suit for slicing. NR will be deployed for the existing and additional new frequency bands. Support stand-alone NR.
5G Open Partner Program

Expand activities for creating new use cases

New co-created services in various industries

Education | Construction | Finance

Services | Entertainment

media | Transportation | Manufacture

Demo Experiments for promote activities

Expand Partners

Num. of partners exceed 3,000
Participation from a wide variety of industries

Number of participants
Over 3,000

- Manufacturing: 17%
- Media (broadcasting, newspaper, publications, etc.): 7%
- Construction, real estate: 7%
- Local government: 7%
- Education, other organizations: 5%
- Transportation: 5%
- Finance, insurance: 4%
- Other: 4%
- Information services, providing contents: 24%
- Wholesale, retail, dining: 19%
DOCOMO 5G Open Partner Program

Initiatives in creating new businesses with a wide variety of business partners utilizing 5G

5G information sharing

Domestic and overseas 5G information, 5G lecture materials and videos, 5G verification testing reports

5G verification environment

DOCOMO’s 5G Open Lab™
Yotsuya, Osaka, Okinawa, Guam

DOCOMO Open Innovation Cloud™

Communication (matching)

2018
- 5G workshop
- Theme based workshops (AR/VR)
- Theme based workshops (production reform and creation)
- DOCOMO OpenHouse2018 Partner only event

2019
- 5G Business Camp
5G BUSINESS CAMP

Convened at 6 locations across Japan in Mar. - Jun. 2019. Efforts underway to convert the 33 exhibitions and other solutions into commercial business.

Image transmission
Remote monitoring
Remote medicine
Authentication/AI
xR
Robotics

DOCOMO 5G Open Partner Program
Over 170 trials

Create solutions that lead to various types of value and solve social problems

- Local creation
- Medical and nursing care
- Protection against disasters and crime
- Insufficient labor
- Primary industries

Over 150 trials
Remote operation system for construction machines

To realize a remote operating system for construction/mining machines leveraging the high-speed and low-latency characteristics of the 5G radio technology.
Remote Control of Humanoid Robot

- Remote control of humanoid robot utilizing low latency capability of 5G
- Physical strength (torque) and haptic perception can be shared between the operator and the robot (T-HR3)
- Operator can control the robot remotely and freely with the sense of avatar
- Use cases
  - Support household cares, care for old people and child, etc, remotely
  - Support constriction works and medical diagnostic by the robot
  - Extreme work at, e.g. disaster area, space

* T-HR3 and the control system was developed by Toyota
Remote doctor’s interview and diagnosis trials based on 4K high resolution video transmission over 5G to realize telemedicine services between the advanced medical hospital and the local medical clinic.
Demonstration targeting use of road traffic condition data employing 5G

Real-time data collection and analysis of road traffic conditions employing 5G

- Huge-amount of data from sensors embedded in the traffic infrastructures such as vehicles, roads and buildings transferred via 5G

- Grasping real-time and wide-range traffic conditions and providing advanced support for vehicles and pedestrians
Industry Private 5G Network

- High demand of industry network to provide specific and high performances, e.g.:
  - Relatively high minimum data rate (sometimes for many devices, sometimes uplink heavy)
  - High reliability to keep service quality
  - Low end-to-end latency
  - Easy temporary network deployment for events, construction sites, etc.

→ Private 5G network is a promising solution to address such requirements

- A technical issue – public/industry overlay deployment

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<thead>
<tr>
<th>Public NW (best effort)</th>
<th>Private NW</th>
<th>Guaranteed performance</th>
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</thead>
<tbody>
<tr>
<td>eLTE cell</td>
<td>NR cell</td>
<td>Best effort performance</td>
</tr>
</tbody>
</table>

- Spectrum
- Interference coordination
- Interworking
- SA vs. NSA
Co-operation with Industry Partners

Press Releases

September 2, 2019

DOCOMO Joins 5G Alliance for Connected Industries and Automation
— Aims to build industrial 5G networks supporting factory automation —

TOKYO, JAPAN. September 2, 2019 — NTT DOCOMO, INC. announced today that it has joined the 5G Alliance for Connected Industries and Automation (5G-ACIA) with the aim of further advancing the use of 5G technology in the manufacturing sector.

https://www.nttdocomo.co.jp/english/info/media_center/pr/2019/0902_00.html

September 10, 2019

DOCOMO to Commence 5G Trials at Manufacturing Sites in Partnership with OMRON and Nokia

TOKYO, JAPAN. September 10, 2019 — NTT DOCOMO, INC. announced today that it has agreed with OMRON Corporation and Nokia Solutions and Networks Oy to collaborate in trials of 5G mobile communication technology inside factories, with the aim of significantly enhancing future manufacturing productivity.

There is increasing demand for wireless communications inside manufacturing plants driven by the need for stable connectivity between IoT devices, including those embedded in machine controls. As machine background noise and the movement of people in manufacturing sites have the potential to interfere with wireless communications, thorough verification of the reliability and stability of any 5G technology deployed in such environments is required.

https://www.nttdocomo.co.jp/english/info/media_center/pr/2019/0910_00.html

https://www.nttdocomo.co.jp/info/news_release/2019/09/02_01.html

https://www.nttdocomo.co.jp/info/news_release/2019/09/10_00.html
5G Spectrum Allocation in Japan

- **3.7 GHz**: 100 MHz x 5 blocks
- **4.5 GHz**: 100 MHz x 1 block
- **28 GHz**: 400 MHz x 4 blocks

Myth and Reality of Initial 5G and Future of 5G

- **Coverage**
  - Myth: 5G will be available everywhere
  - Real: 5G will be deployed in limited area and expanded for several years. 4G network will be enhanced continuously and combined use of 4G and 5G is essential.
  - Future (My wish): (almost) 5G Everywhere

- **Performance**
  - Myth: 10 Gbps of data rate and 1 ms of latency everywhere
  - Real:
    - Several Gbps of peak data rate due to limitation of terminal performance. Typical data rate will be less than that depending on radio conditions, e.g. propagation loss, blockage, spectrum BW.
    - Latency will be several ms to several tens ms depending on NW configuration and distance between BS and server.
  - Future (My wish): Peak data rate > over 10Gbps, 1Gbps (almost) everywhere

- **Use cases**
  - Myth: 5G will be available for any use cases
  - Real: Need to develop nice application and business model beforehand
  - Future (My wish): cope with any use cases for eMBB, URLLC and mMTC
Thank you for your attention!