Orchestrating a brighter world

NEC

Network vision and activities towards 5G

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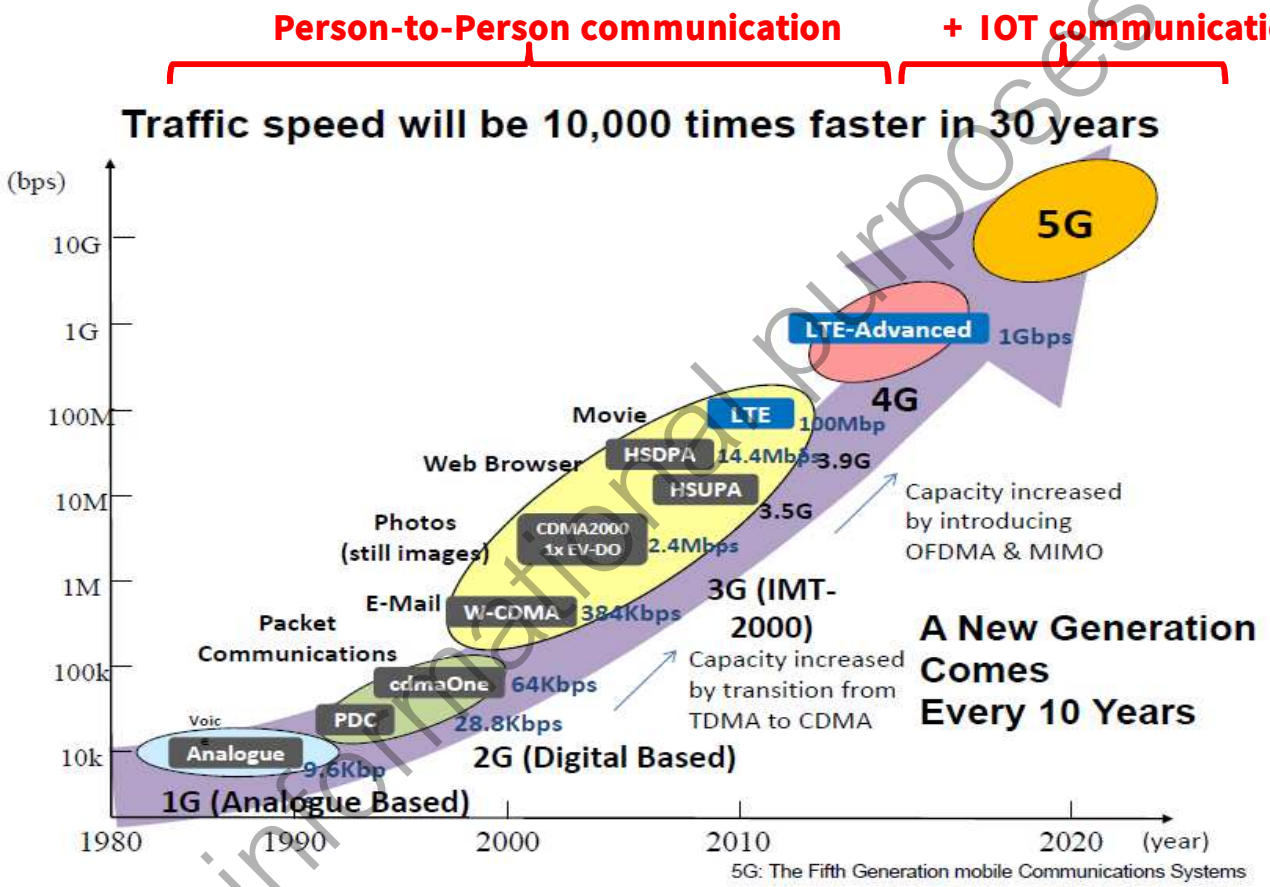
NEC Corporation

\Orchestrating a brighter world

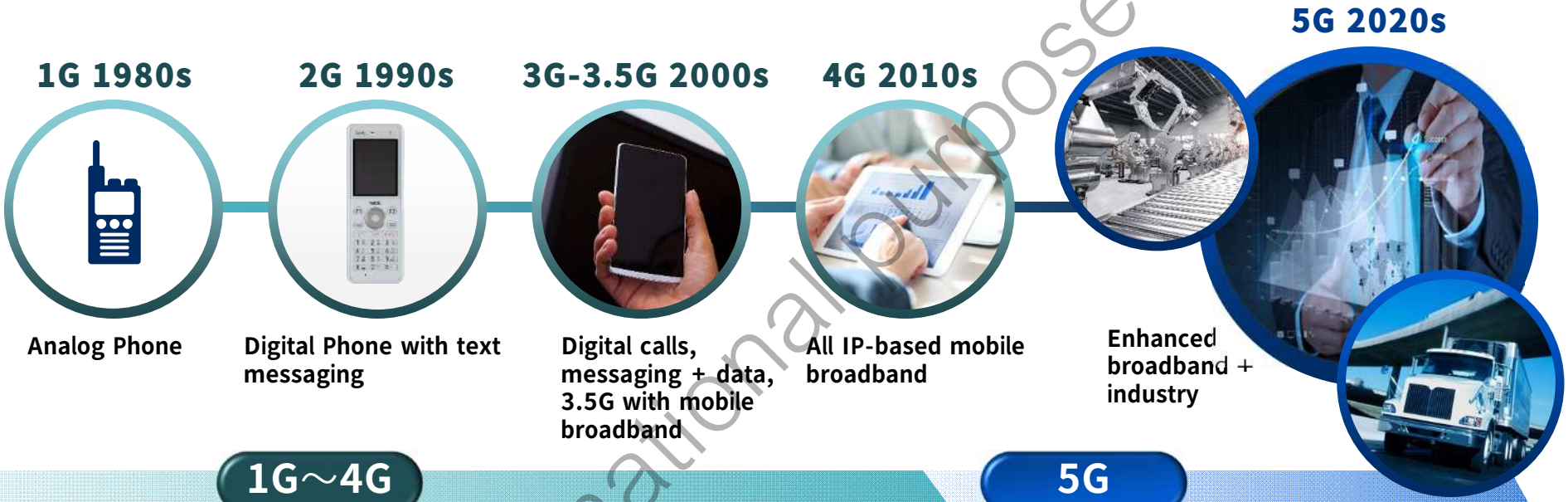
NEC brings together and integrates technology and expertise to create the ICT-enabled society of tomorrow.
We collaborate closely with partners and customers around the world, orchestrating each project to ensure all its parts are fine-tuned to local needs.

Every day, our innovative solutions for society contribute to greater safety, security, efficiency and equality, and enable people to live brighter lives.

Mobile Network Evolution Trend



5G, the Era of Revolution in Mobile History



1G～4G

- Better Connection
- Higher Throughput/Capacity
- **Evolution** from last generation

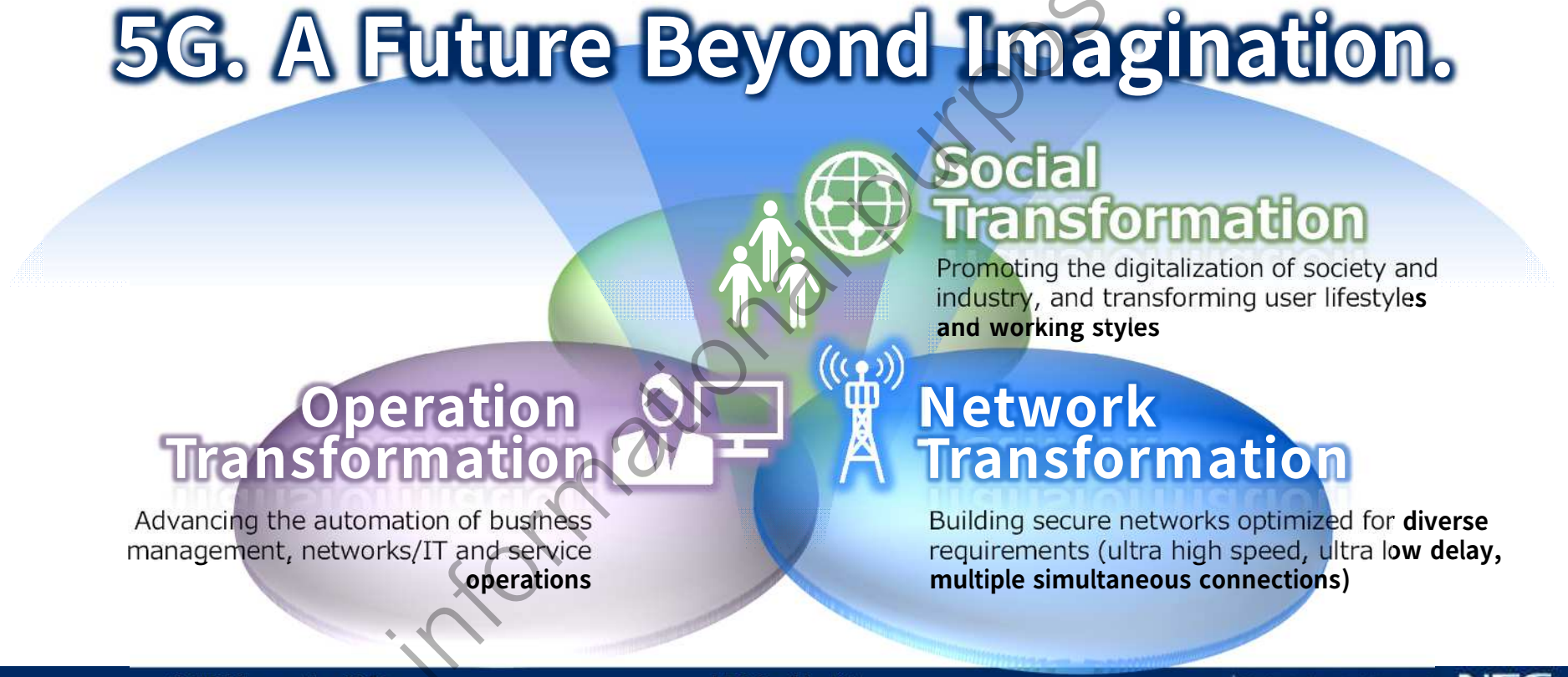
5G

- Not only for communication between humans but also for IoT new devices
- Age of **Revolution**

Source:IHS

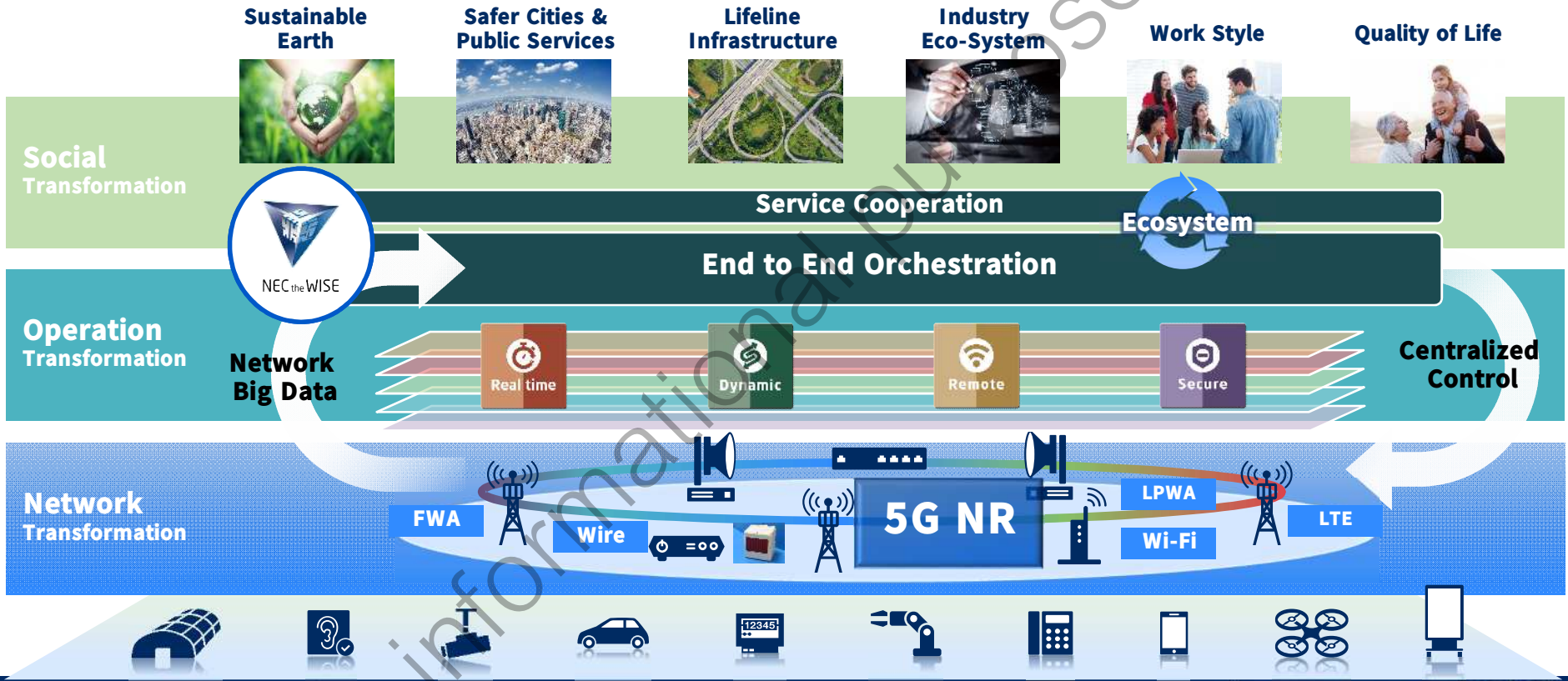
Three Transformations Achieved by “5G. A Future Beyond Imagination.”

Social, Network and Operation Transformation



Role of ICT in 5G Era

Next Generation ICT Infrastructure to support Diversified Services



Creating New Social Value with 5G

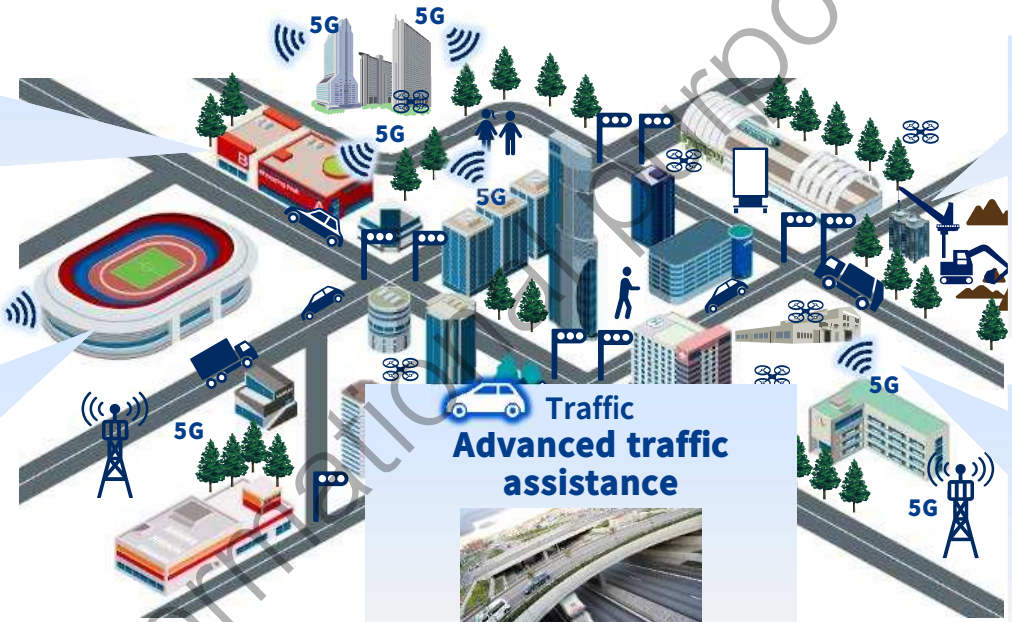
Smart house
Voice agent

Healthcare
Remote diagnosis

Entertainment
4K/8K video

Agriculture, forestry & fisheries
Automated farm management

Retail
Shopping mall hospitality SL



Work sites
Remote-controlled construction site work

Sports
E-stadium

Traffic
Advanced traffic assistance

Smart city
Advanced security

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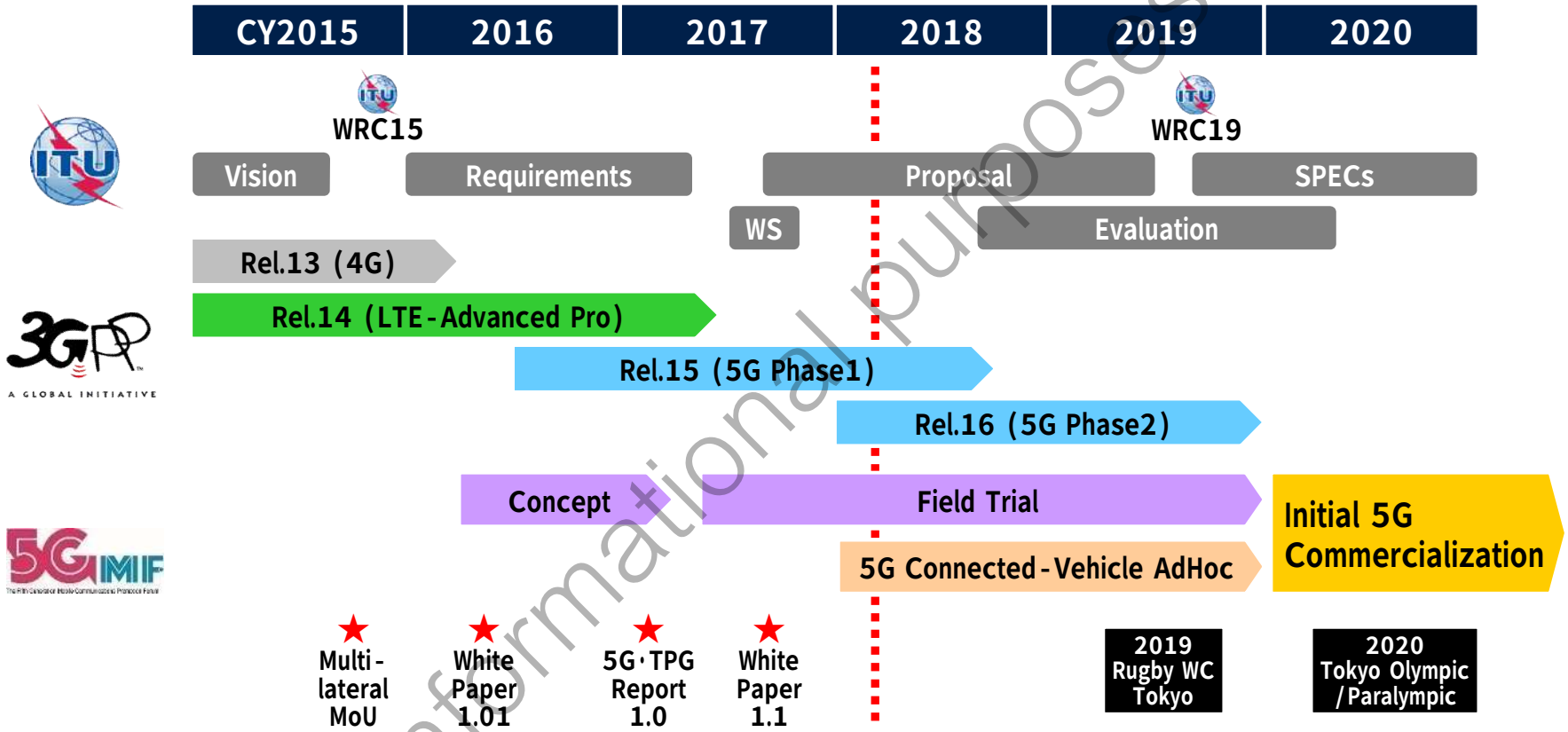
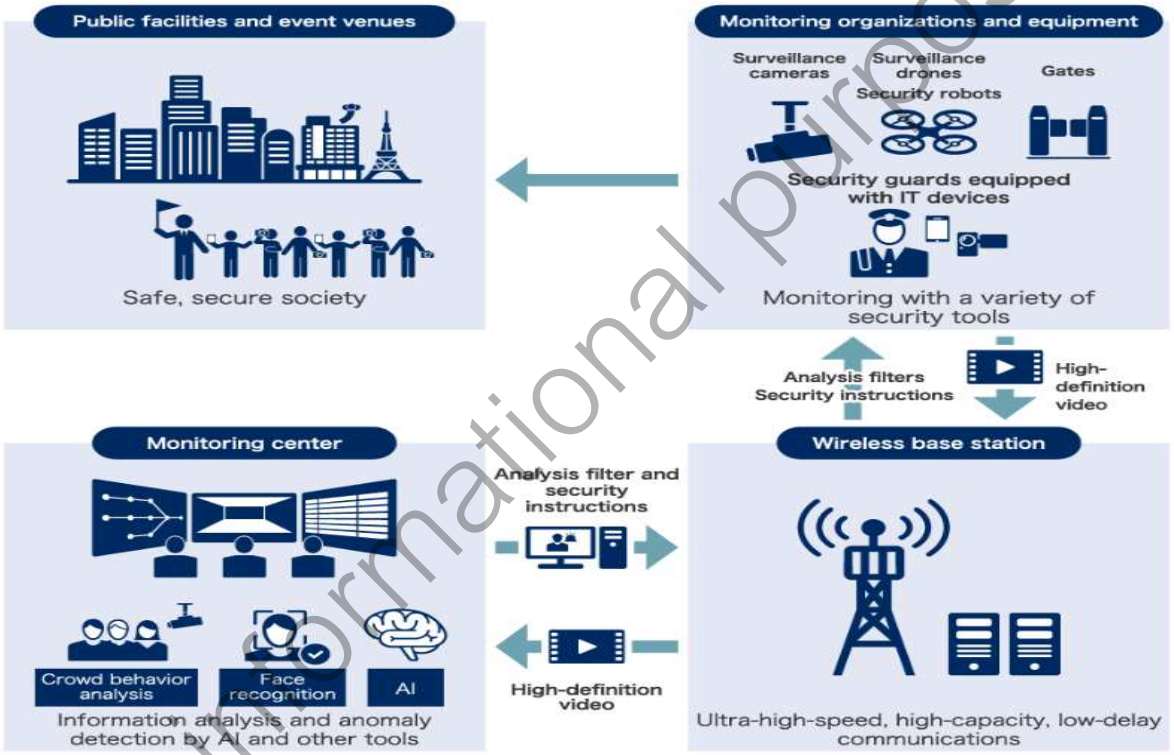
Activities towards 5G

5G Milestone (including activities in Japan)



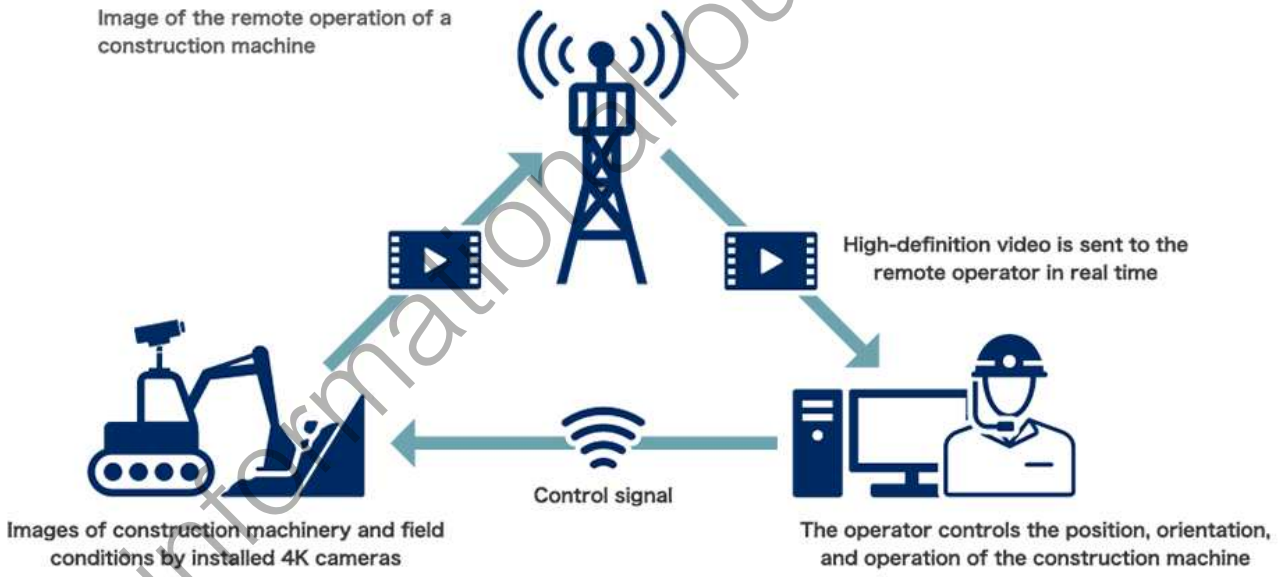
(Demo Testing) Advanced Security Services

With a growing need for the detection of warning signs and the advance prevention of crime and various other threats, it is necessary to provide advanced security services that enable such measures as the detection of abnormalities using image analysis.



(Demo Testing) Remote-Controlled Construction

- **Current issues with remote-controlled construction:** There are currently constraints in terms of increasing the definition of video streaming due to restrictions on communication speeds, as well as frequent transmission faults due to interference problems.
- **Solution to these issues:** By achieving transmission of high-definition video, which is difficult with existing mobile communications, through utilization of the distinctive features of 5G—high-capacity and low latency, NEC will seek to improve the workability of remote-controlled operation of construction machinery.



Remote operation using 5G network (Sample)

Difficult to operate due to NW latency and interference

Smooth operation with 5G's low latency & high capacity

Existing NW
(low throughput with latency)

- Overshoots due to latency/delay
- Halts due to interference/NW instability

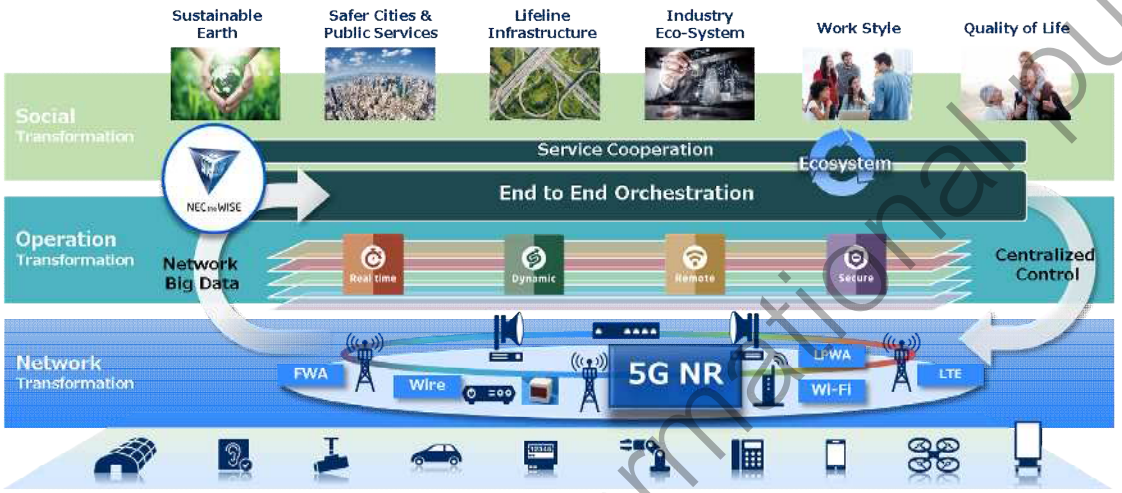
5G NW
(High throughput with low latency)

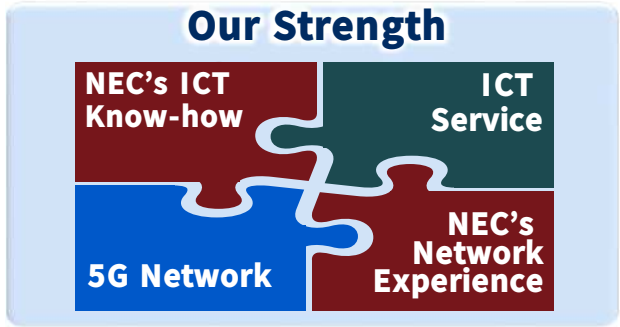
- No overshoot
- Stable operation

Note: This is a sample showing the influence of NW latency in remote operation. The video on the right demonstrates low latancy supposedly to be realized in 5G NW.

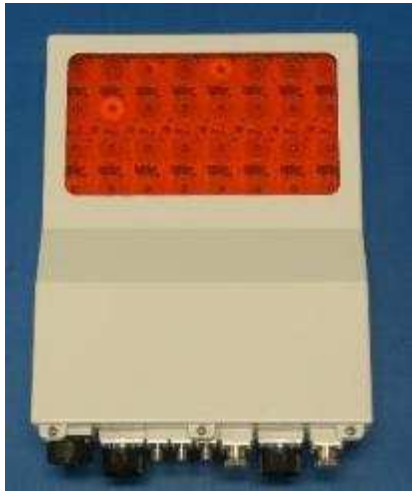
NEC's Strength: Expertise in both ICT and NW solution

- **NEC's rich ICT solution, Know-how and Experience help to realize Social Transformation.**
- **Creating optimized network with NEC 5G solution for each industry customer services.**





Massive MIMO AAS for Sub-6GHz



	Specification
Frequency, Bandwidth	4.6GHz Band, 100MHz
Duplexing	TDD
#Antenna elements	64 elements(=8x4x2polarities)
Beam control	Full-digital
EIRP	45.4dBm/single-beam
DU/CU interface	10GbE
Supply, Consumption	DC-48V
Dimension, Weight	287x350x52～83mm, 7kg

NEC's Massive MIMO Specialty:

- Highest level of frequency efficiency
- Reduction of equipment size & RF loss

ACKNOWLEDGEMENT
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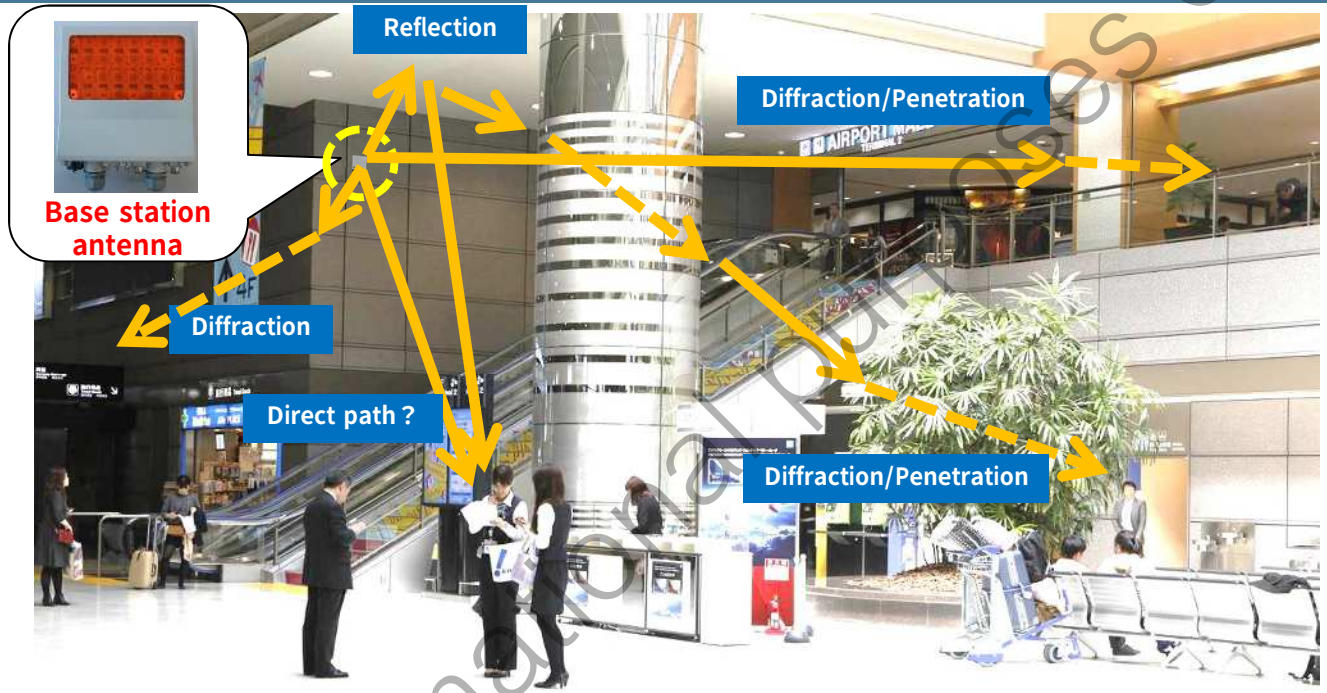
Massive MIMO for Sub-6GHz: Use case



Environments with many reflecting and diffracting radio wave (multi-path)

- business /entertainment/shopping area・train station ⟵ 5G target for capacity improvement (e.g. Hot spot/zone)

Environments that it is difficult to receive/transmit direct path

- shielding by body, building, tree, etc., ⟵ Difficult for higher frequency (e.g. mmWave)

Massive MIMO AAS for mmWave

	Specification
Frequency range	27.5~29.2GHz
Bandwidth	Up to 300MHz
Duplexing	TDD
# of Antenna elements	360 elements
Beam control	Full-digital in AZ, Consequent-squared fixed in EL.
EIRP	59dBm
Supply, Consumption	DC-48V、450W AC100V、710W
Dimension	AAS: 199(W) x 308(H) x 225(D) mm

NEC's Massive MIMO Specialty:

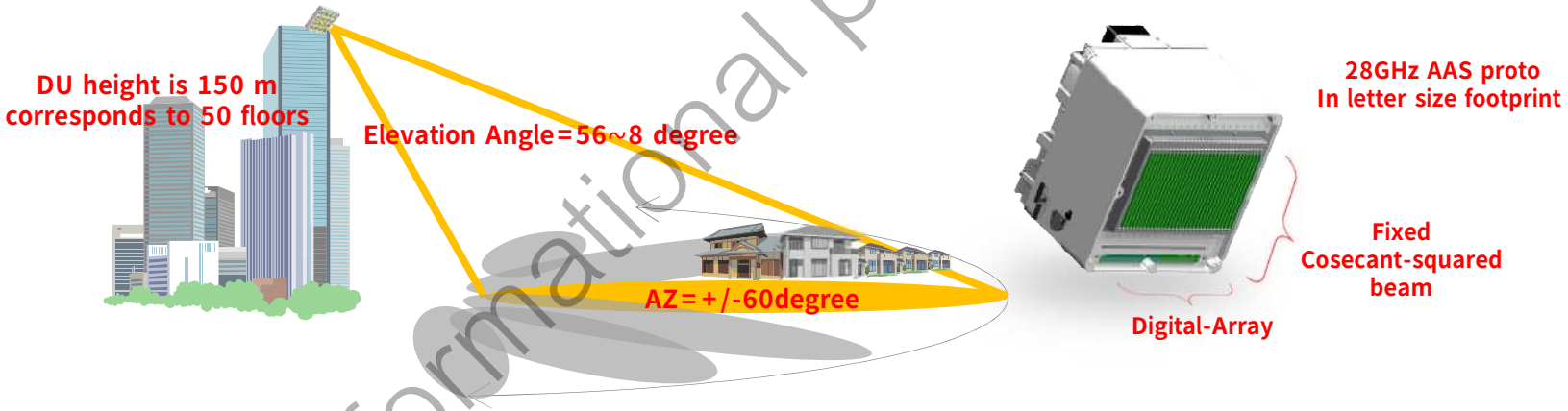
- Field proven reliable mmWave circuit and device technologies.
  experienced on the point to point radio communication products "iPASOLINK[1]" operating in more than 150 countries
- Reduction of Massive MIMO AAS size

[1] http://www.nec.com/en/global/prod/nw/pasolink/

Massive MIMO AAS for mmWave: Use case

Benefits/Features

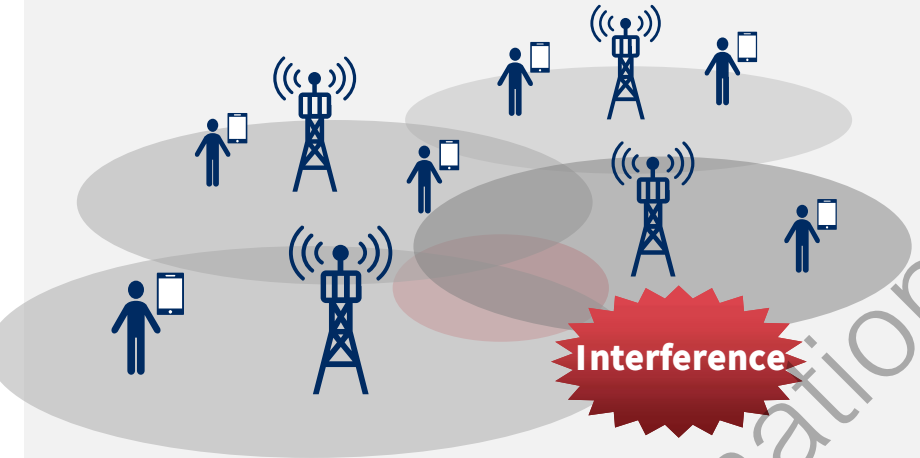
- The beam forming is efficient to maintain the mm-Wave propagation channel.
- Using already existing Macro-site or the long-range cell controlling save/minimize the additional investment for the fiber and sites.



Virtual Cells through Digital Beamforming

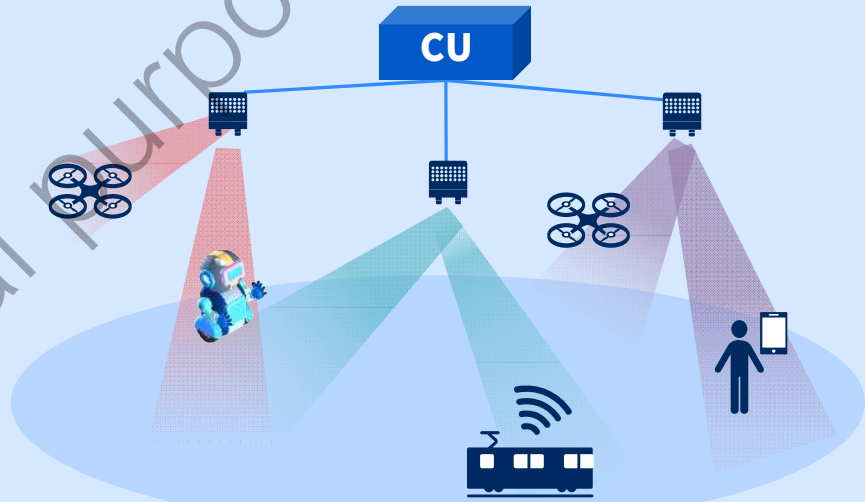
Flexible Coverage, Flexible Capacity

Traditional Deployment



- Fixed coverage
- Fixed capacity

Cell Virtualization

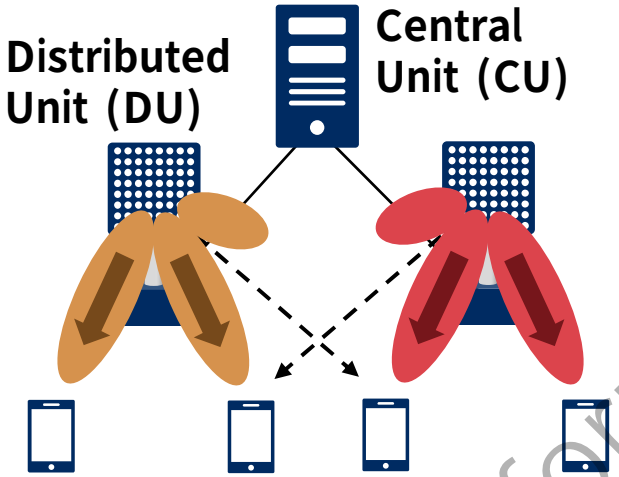


- Flexible coverage
- Flexible capacity

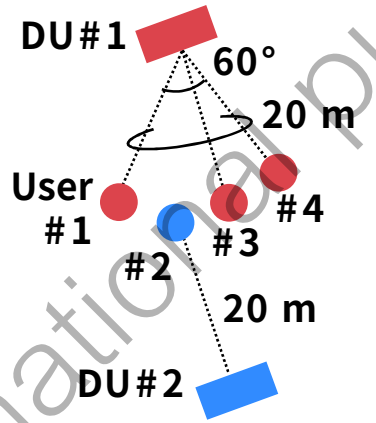
High quality communication can be achieved under virtual cell

NEC's Inter-Site Coordination Technology

Coordinated beamforming (CB) improves throughput performance, especially for users suffering from high inter-site interference, by suppressing the interference.



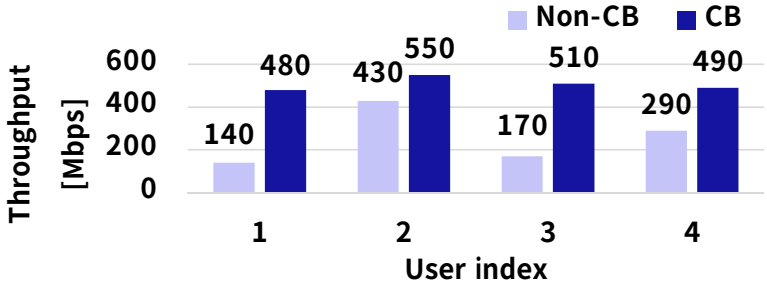
Coordinated beamforming



Deployment of DUs and users

Simulation conditions

Carrier frequency	4.6 GHz
System bandwidth	80 MHz
No. of DU antennas (row, col., pol.)	128 (8,8,2)



Performance evaluation by simulation

Conclusion

- 5G is NOT evolution from 4G. It's age of **Revolution**.
- **IT and Communication should be tightly combined** to realize social transformation.
- **Collaboration with various industry players** is essential to create social values with 5G.

5G. A Future Beyond Imagination.