

# **Wireless Broadband Access**

## **- Objective and Challenges -**



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**Corporate Chief Engineer**  
**Mobile Network Operations Unit**  
**NEC Corporation**

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# About NEC Corporation

# Profile of NEC Corporation

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**Established:** July 17, 1899

**President:** Kaoru Yano

**Capital:** 337.9 billion yen - As of Mar. 31, 2009 –

**Consolidated Net Sales:** 4,215.6 billion yen  
- Fiscal year ended Mar. 31, 2009 -  
1,653.7 billion yen  
- Six months ended Sep. 30, 2009 -

**Operations of NEC Group:** IT Service, IT Products, Network Systems,  
Social Infrastructure, Personal Solutions,  
Electron Devices

**Employees:** NEC Corporation  
23,446 - As of Mar. 31, 2009 -  
NEC Corporation and Consolidated Subsidiaries  
143,327 - As of Mar. 31, 2009 -

**Consolidated Subsidiaries:** 319 (Japan:119, Oversea:200) - As of Sep. 30,  
2009 -

Financial results are based on accounting principles generally accepted in Japan.

# NEC's Business Domains

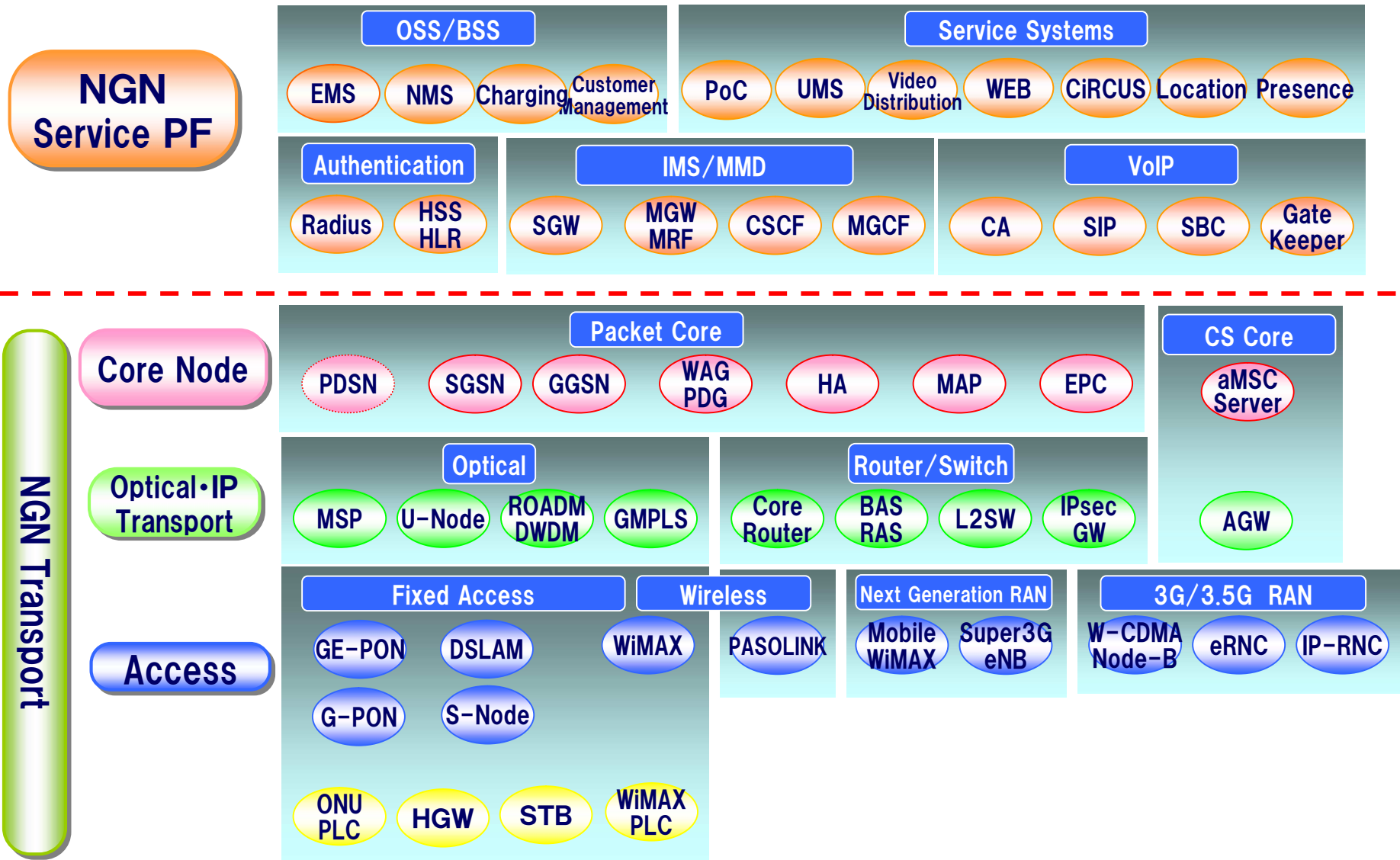
<b>IT Service Business</b>	<b>IT Products Business</b> 	<b>Personal Solutions Business</b> 
<b>Network Systems Business</b> 	<b>Social Infrastructure Business</b> 	

**Electron Devices Business**

				
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Products and services aimed at the Japanese domestic market are included.

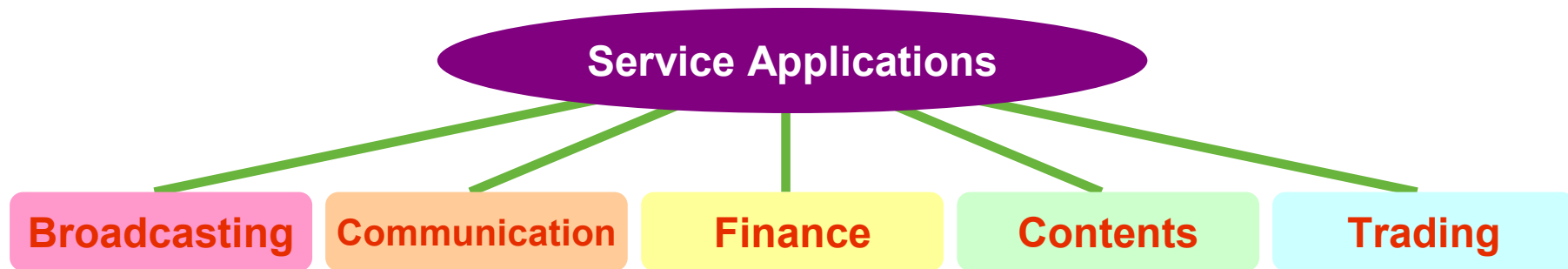
# NEC's Products for Carrier Networks



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# **Market Demands for Wireless Broadband**

# Service Applications in the Broadband Era



**Communication, Broadcasting  
= Triple Play =**

- TV
- Telephone
- Internet

**Broadband Communication  
= Mobility =**

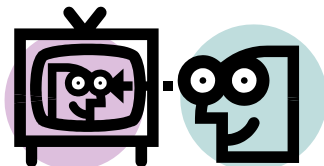
- TV/game
- data
- data

**Finance and Communication  
= m-Commerce =**

- eTicket
- shopping
- finance
- vending machine
- eWallet, credit card

## New Business Opportunities

- pay per view
- Video on demand
- game distribution
- video telephony



- home security
- medical home care
- internet shopping
- e-learning, net-schooling



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# **Network Evolution to support Mobile Broadband**

# Requirements on Network Evolution

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## Faster, Simpler, More Efficient, Cheaper

### Highly efficient radio technology

- ✓ Increased spectrum efficiency and therefore increase capacity
- ✓ Lower cost per bit and lower prices for the end user

### Simplified protocol stack & all IP network

- ✓ Reduced latency
- ✓ Easier network management
- ✓ CAPEX and OPEX savings

### Flexibility and scalability in deployment

- ✓ Operating in various frequencies and bandwidths
- ✓ Operators can start with smaller deployment and increase bandwidth as demand increase
- ✓ Supports resource aggregation of radio band resources



# Toward Wireless Broadband

## Two activities aiming for Wireless Broadband

### 3GPP/3GPP2 Standards

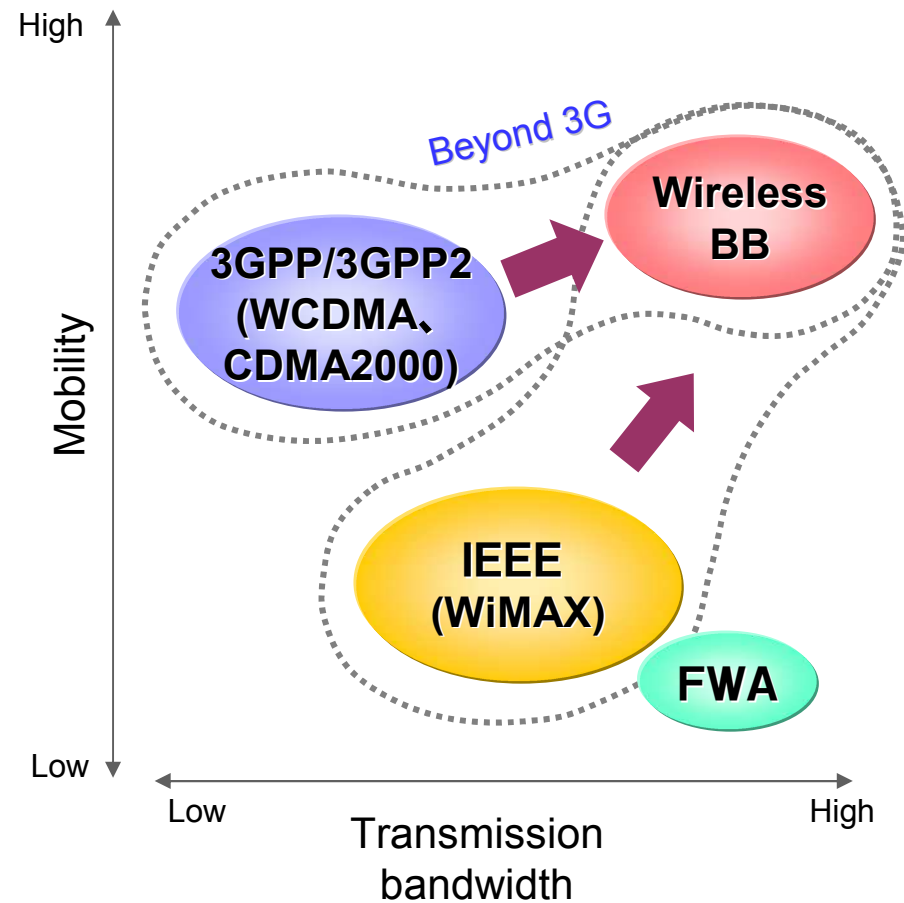
- ▶ WCDMA, CDMA2000
- ▶ Mobile Communication

### IEEE Standards

- ▶ WiMAX
- ▶ Fixed Wireless Access (Home Network)
- ▶ WiBro, etc.

## Realization of Wireless Broadband

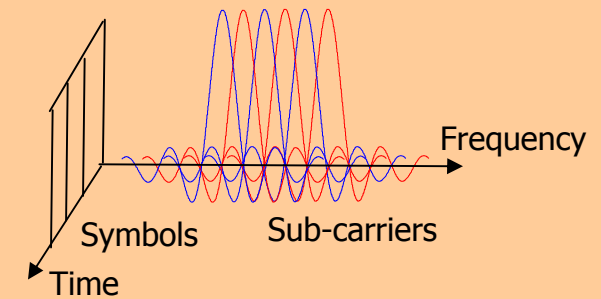
NEC is active in BOTH 3GPP and WiMAX evolution toward Wireless Broadband



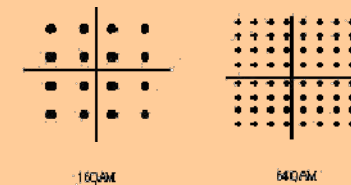
# Key Technologies

	LTE	WiMAX (802.16e)
Access Method	Downlink: OFDMA Uplink: SC-FDMA	OFDMA
Modulation	QPSK/16QAM/64QAM	QPSK/16QAM/64QAM
Delay	< 10 ms	< 50 ms (Total H/O latency)
Channel bandwidth	FDD 1.4, 3, 5, 10, 15, 20 MHz	TDD 3.5, 5, 7, 8.75, 10, (20) MHz
Throughput (DL)	172.8Mbps@20MHz MIMO:2x2	120Mbps@20MHz MIMO:2x2 DL/UL ratio 1:0
Antenna (MIMO)	2x2 to 4x4	1x2 to 4x4
Mobility	< 350km/h	< 120km/h

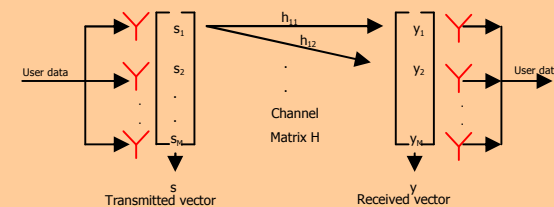
## OFDMA



## 16QAM / 64QAM

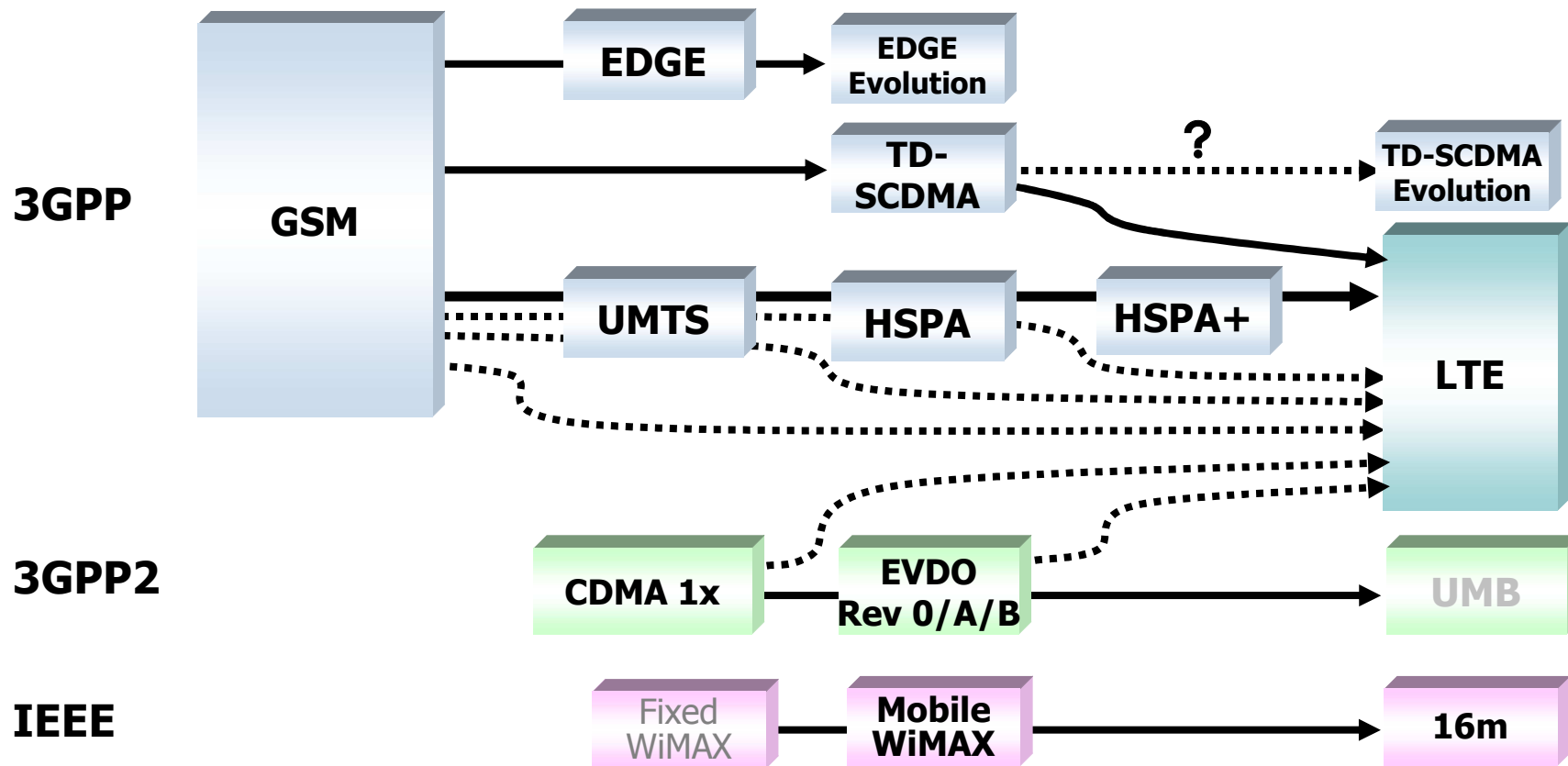


## MIMO



# Evolution/Migration Scenario for Mobile Technologies

Various Evolution/Migration scenarios and time line due to regional and operator circumstance



# WiMAX or LTE or BOTH???

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## Different User Segments

- ✓ Many WiMAX network is targeting FWA or limited mobility
- ✓ LTE will likely to target existing mobile users

## Spectrum Issue

- ✓ Available spectrum dictates which system can be operated (in most cases)
- ✓ WiMAX can be operated in most FWA spectrum

## Maturity of ecosystem

- ✓ Standards
- ✓ Conformance test
- ✓ Availability of terminal devices



***WiMAX will coexist with LTE for  
foreseeable future***

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# **Technology Evolution of LTE & WiMAX**

# Technologies for ECO<sup>2</sup>

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ECO<sup>2</sup>: Ecology and Economy

## SON

- Optimization of OPEX
- Improvement of Radio Coverage

## Power Efficiency

- Lower OPEX
- Smaller equipment size for easy installation

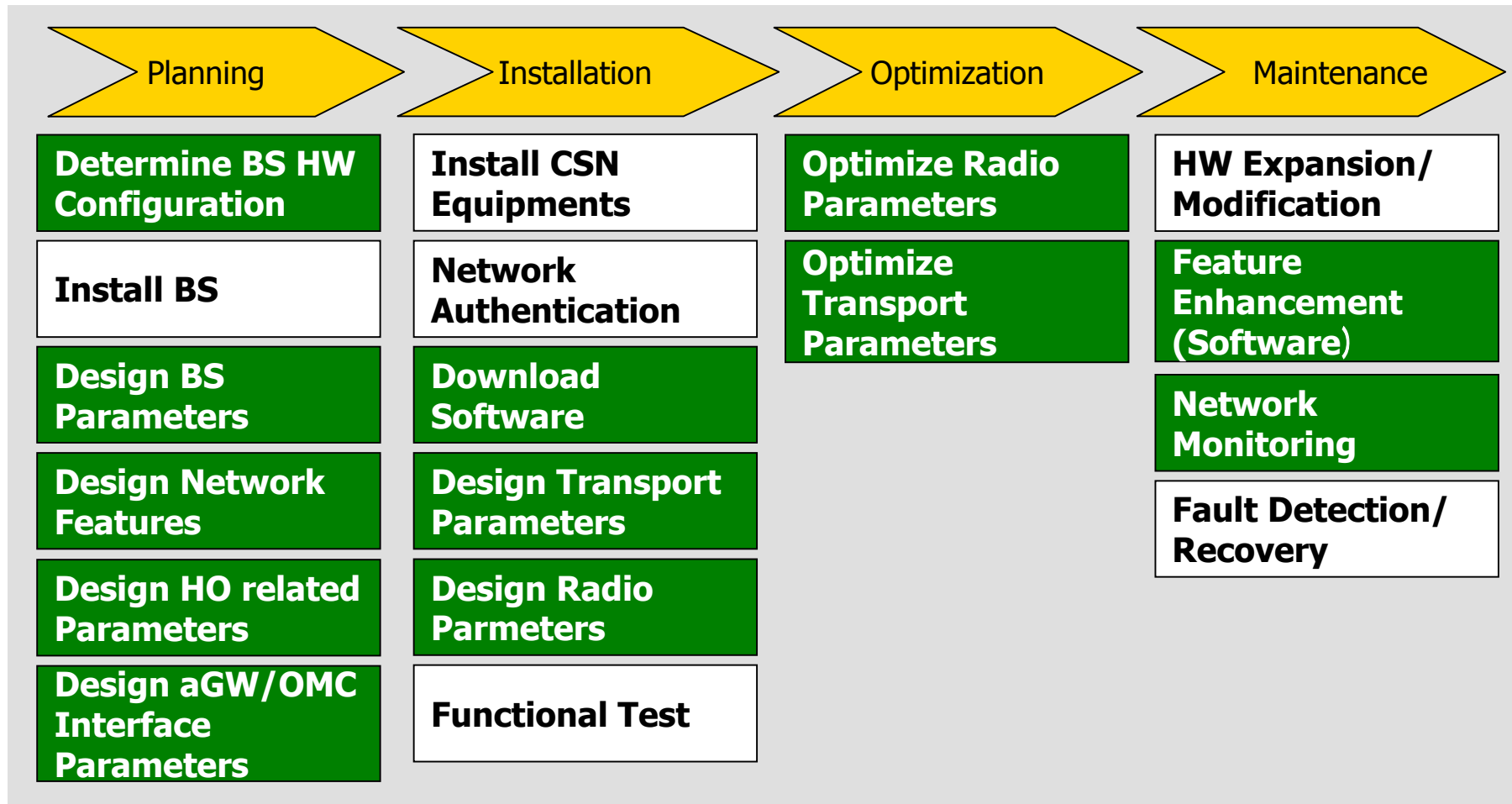
## Antenna Technology

- Improve cell coverage

SON : Self Organizing/Optimizing Network

# Application of SON Technology

## SON: Mechanism to automate Network Build-out and Operation



SON: Self Organizing/Optimizing Network

# Power efficient RF technology

## Lower Power Consumption of BS

- Traffic based Process Capacity Management
- High Energy Efficient Components
- Power Efficient Amplifier

Smaller Equipment  
 → Easy Installation  
 → Less Footprint

Higher Reliability

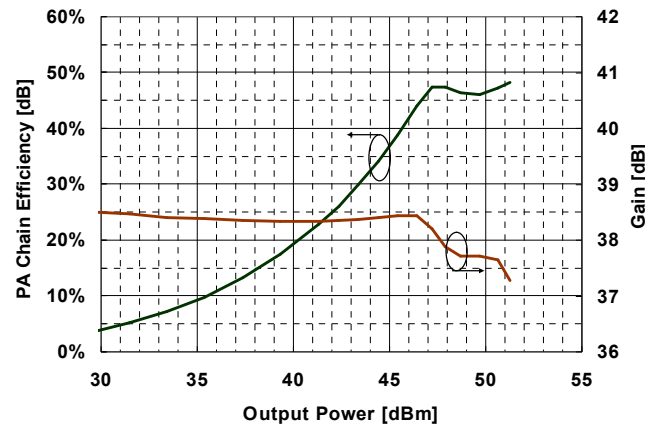
Lower OPEX

## Achievement by NEC

(World Top Class High Power Efficient Power Amplifier)

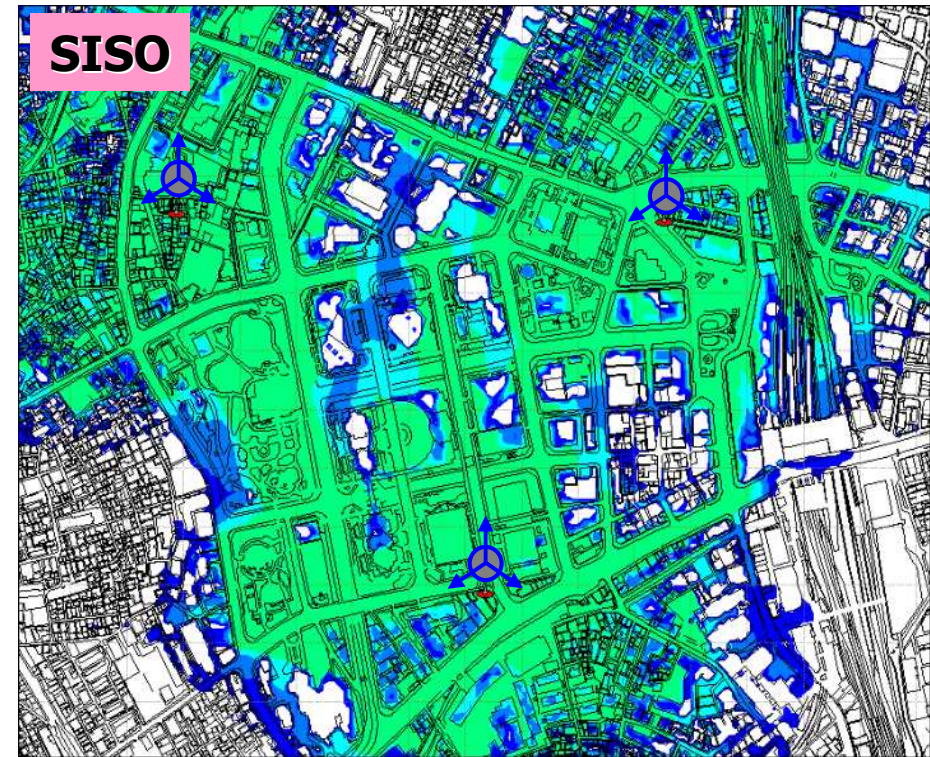
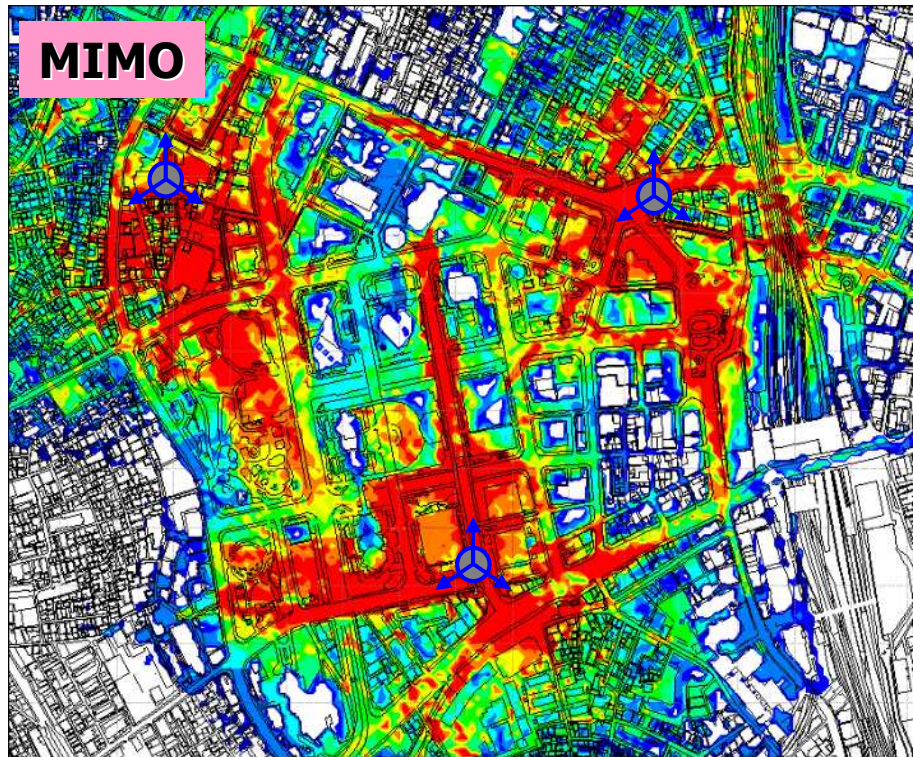
- Power Efficiency of Power Amplifier > 45%

Item	Specifications
Frequency	2.1GHz IMT Spectrum
Power Efficiency	45% typical ( WCDMA 45W TX Power )
Dimension	19cm x 14cm x 1.5cm
Application	WCDMA, LTE

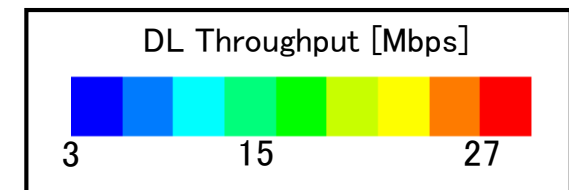


# Antenna Technology (1/3)

## Simulation of Effect of MIMO using null-fill Antenna

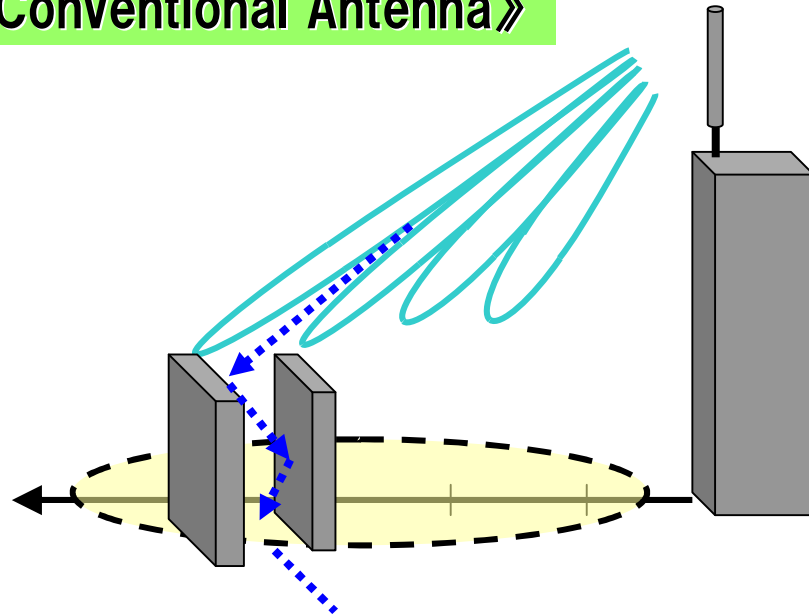


Signification improvement is seen in the multi-path rich environment such as between tall buildings



# Antenna Technology (2/3)

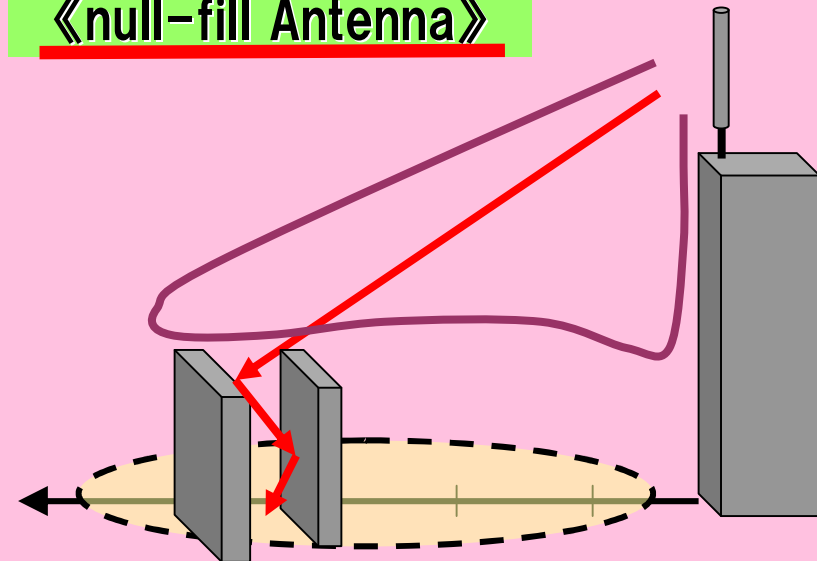
## 《Conventional Antenna》



Null of the radiation pattern may decrease radio signal between buildings  
→Decrease **MIMO** effectiveness

Creates multi-path environment to improve MIMO effectiveness

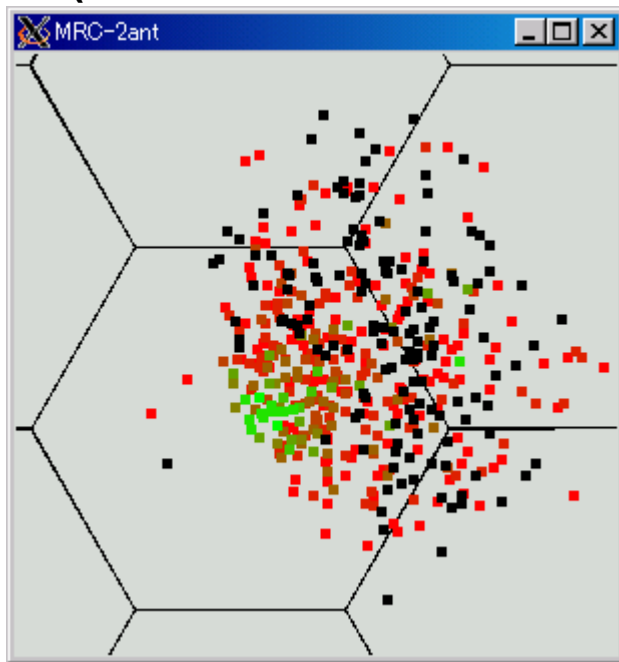
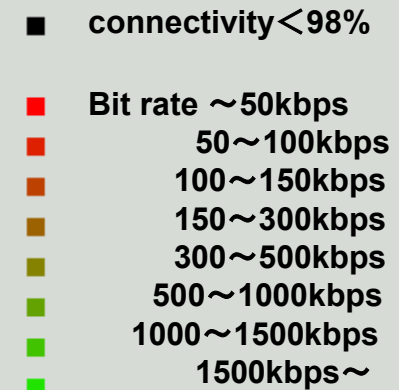
## 《null-fill Antenna》



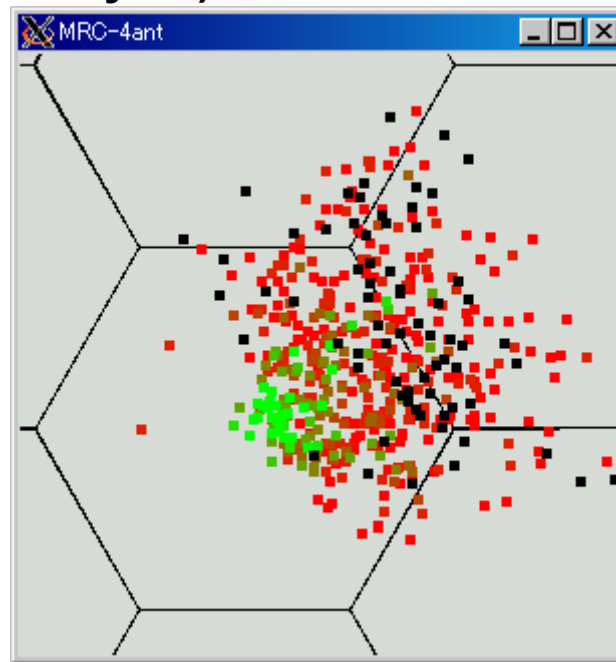
# Antenna Technology (3/3)

## Improvements of UL performance using Multi-Antenna Technology

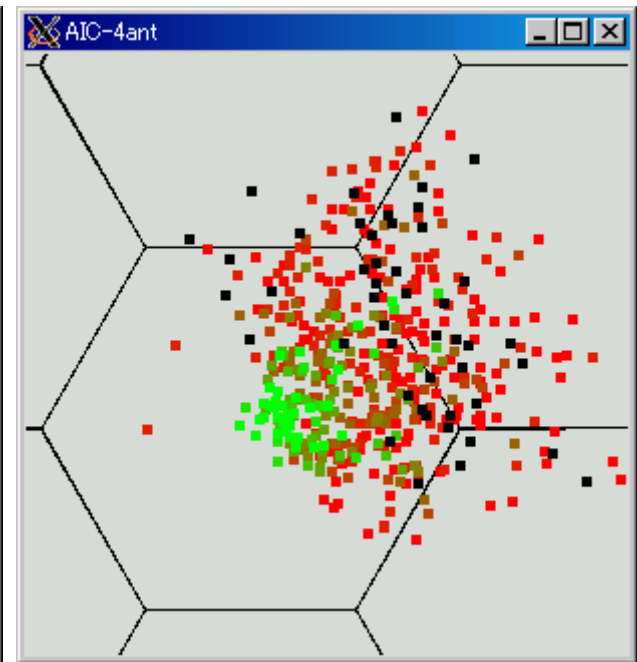
Distribution of Communication Quality  
(Result of UL Simulation analysis)



MRC 2 Antenna



MRC 4 Antenna



AIC 4 Antenna

MRC: Maximal-ratio combining

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# **Cost of Wireless Network Deployment**

# Items influencing cost of Wireless Broadband Network Deployment

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■ Frequency Spectrum

■ CAPEX

- Backhaul
- Radio Access Network
- Core Network
- Service Application Delivery Platform
- Terminals (end-user devices)

■ Site acquisition and build

■ OPEX

# Summary

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- **Broadband = high communication throughput**  
Synergy between the paradigm shift of Wireless and Broadband will bring fundamental changes which will create environment for new growth and introduction of new communication businesses.
- **Improved user experience (especially coverage) is a key factor for the success**
- **Technical Evolution to improve user experience, reduce OPEX, improve frequency spectrum efficiency is essential**

**NEC will continue development of key technologies to enable WiMAX and LTE thru our Mobile Broadband innovation.**

Empowered by Innovation

**NEC**