

# Development of Dependable Wireless System and Device

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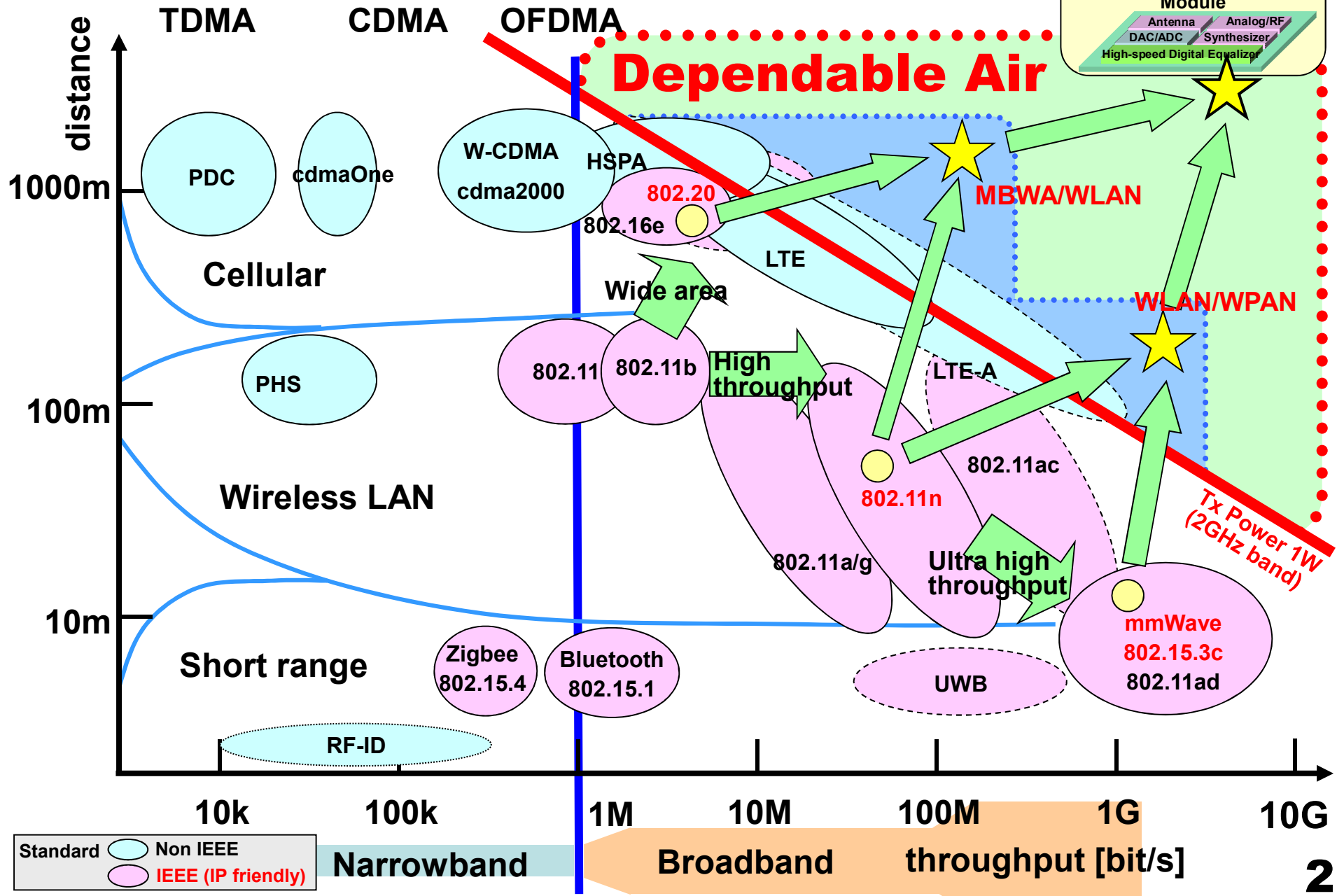
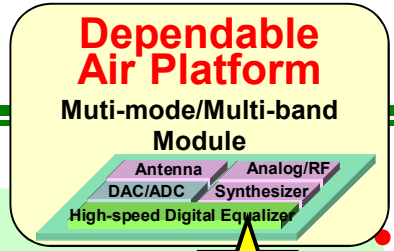
Research Director:

**Kazuo Tsubouchi**, Tohoku University

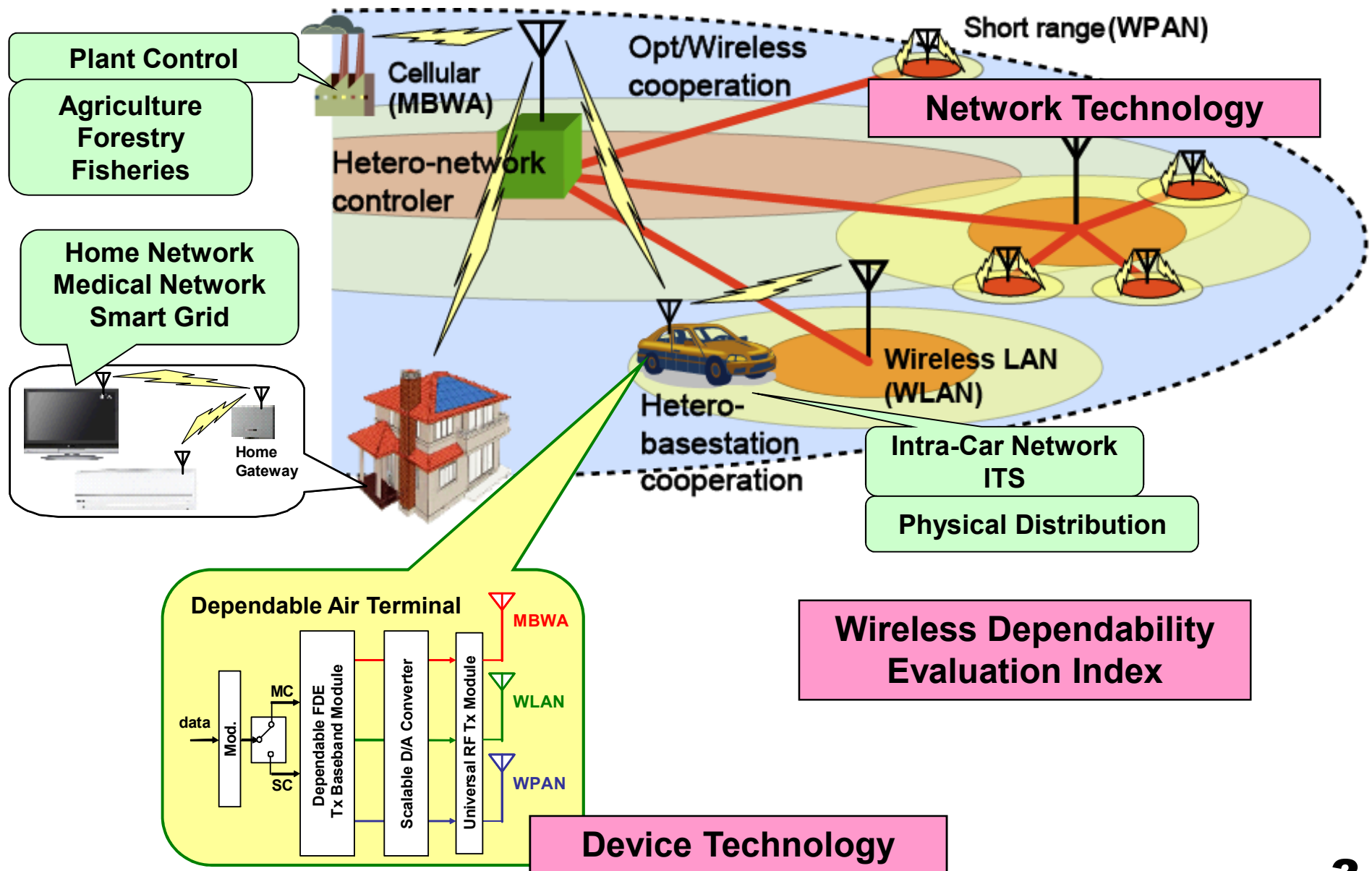
Members: **Akira Matsuzawa**, Tokyo Institute of Technology  
**Makoto Iwata**, Kochi University of Technology  
**Minoru Fujishima**, Hiroshima University  
**Hiroshi Oguma**, Toyama National College of Technology  
**Mitsubishi Electric Corporation**

Cooperators: **NEC Corporation**  
**SOFTBANK TELECOM Corp.** *etc.*

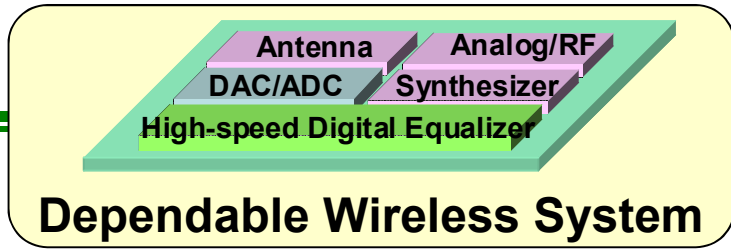
# Dependable Air: Heterogeneous and High-Reliable Wireless Network and Devices



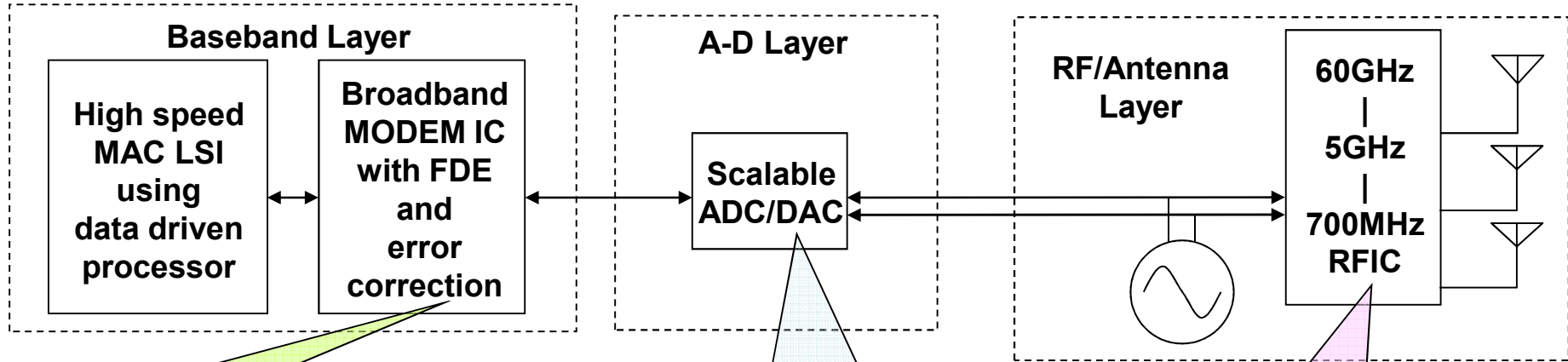
# Dependable Air: R&D



# Research Area: Devices



**All Si-CMOS** Broadband SC/MC FFT/IFFT



**2) Frequency Domain Equalization (FDE)**

Tohoku Univ., Kochi Univ. of Tech.,  
 Toyama National College of Tech.,  
 Softbank Telecom

**3) Scalable ADC/DAC**

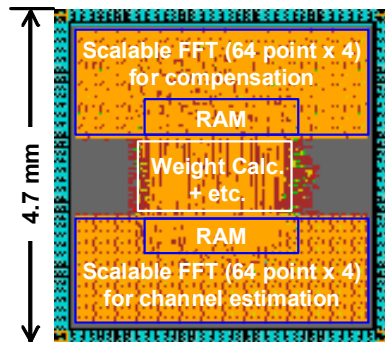
Tohoku Univ.,  
 Tokyo Institute of Tech.

**1) All Si CMOS RFIC (500MHz~70GHz)**

Tohoku Univ., Hiroshima Univ.,  
 Mitsubishi Electric Corp., NEC

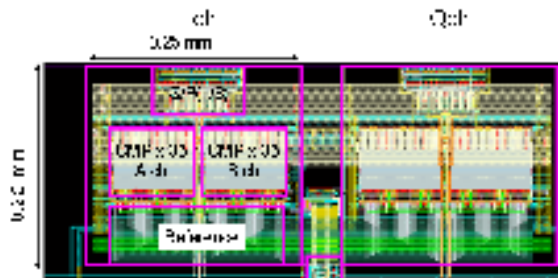
■ ASIC Implementation of Scalable FDE

180nm CMOS  
 Core size 17.6 mm<sup>2</sup>



■ Flash ADC for 60GHz-Band Communication System

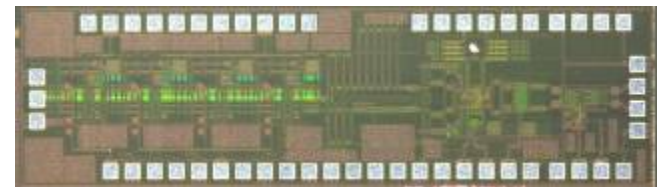
5bit, 2.3GSps, 12mW



40nm CMOS

■ 60GHz-Band Receiver Front-End CMOS IC

Chip size: 2.85mm x 0.82mm



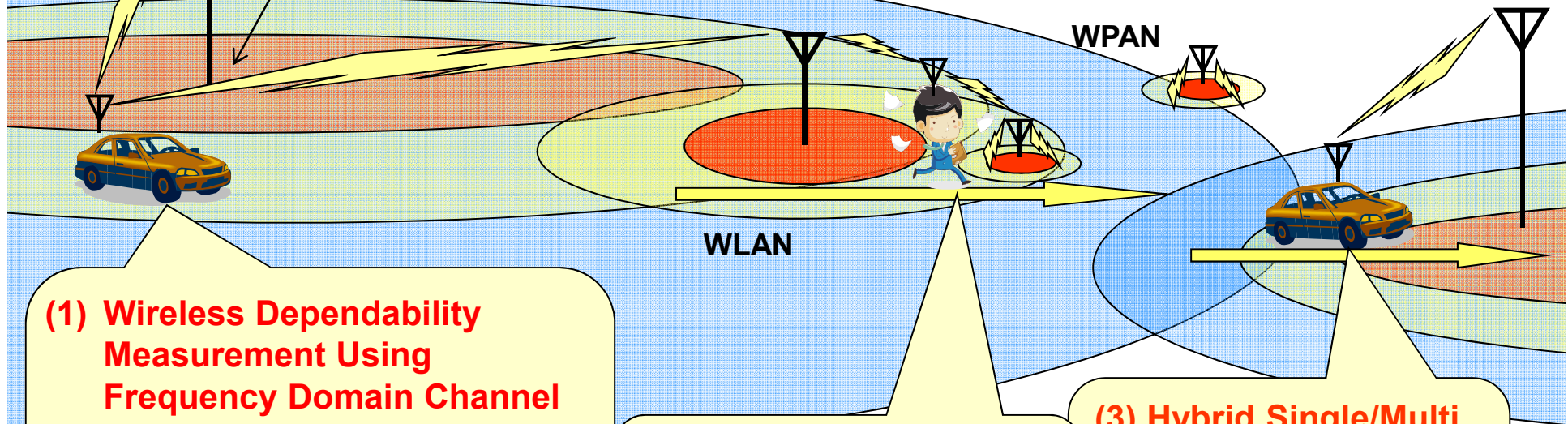
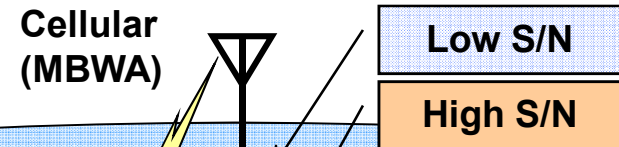
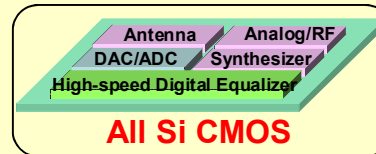
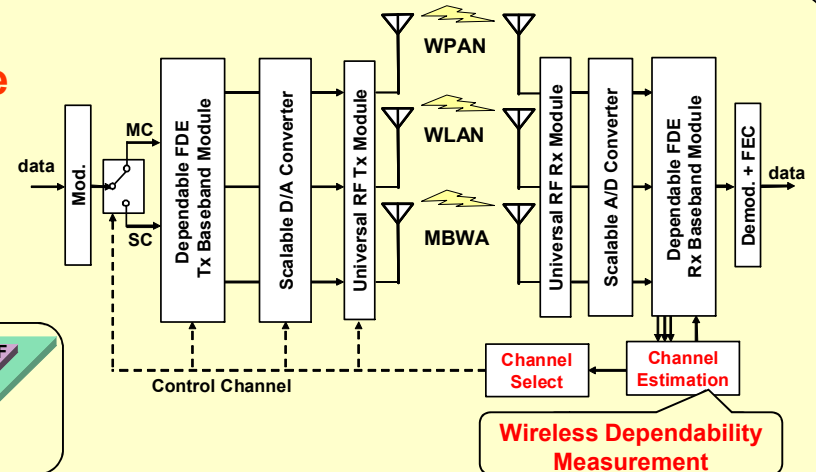
90nm CMOS

# Research Area: Network

**Hetero-Network Joint**  
H2H, H2M, M2M  
Information network &  
Control network

## Dependable Air Interface

- (1) Universal RF
- (2) FDE
- (3) Scalable A/D & D/A



### (1) Wireless Dependability Measurement Using Frequency Domain Channel Estimation Method

- + Measuring multi channel functions simultaneously: distance, S/N, BER
- + Selection of optimum channels after channel compensation

### (2) Hetero-Network System Handover

- + High mobility
- + Optimum channel selection

### (3) Hybrid Single/Multi Carrier Modulation

- + Optimum modulation for distance, S/N, BER
- + Improving connectivity

# Members

## Devices and Circuits for Dependable Air

(1) All Si CMOS  
RFIC  
(500MHz ~ 70GHz)

**Tohoku Univ.**

**Hiroshima Univ.  
(Prof. Fujishima)**

(2) Broadband  
FDE

**Tohoku Univ.**

**Kochi Univ. of Tech.  
(Prof. Iwata)**

(3) Scalable  
ADC/DAC

**Tohoku Univ.**

**Tokyo Institute of Tech.  
(Prof. Matsuzawa)**

**Tx LSI : Tohoku Univ. (with NEC)**

**Rx LSI : Tohoku Univ. Mitsubishi Electric Corp.**

**(Extended 1) Beam Forming Antenna: Tohoku Univ.**

## Network for Dependable Air

(Extended 2)  
Dependable Network  
Processor

**Tohoku Univ.  
Kochi Univ. of Tech.  
(Prof. Iwata)**

(Extended 3)  
Dependable  
Heterogeneous Network  
for Big Disaster

**Mitsubishi Electric Corp.  
Toyama National College of Tech.  
(Assoc. Prof. Oguma)  
(with Softbank Telecom)**

**Discussion**

**Agreement  
(NDA and patent)**

**Tohoku Univ.  
Mitsubishi Electric Corp.  
NEC  
Softbank Telecom**

# Extended Dependable Air: Joint Terrestrial & Satellite Communication

