

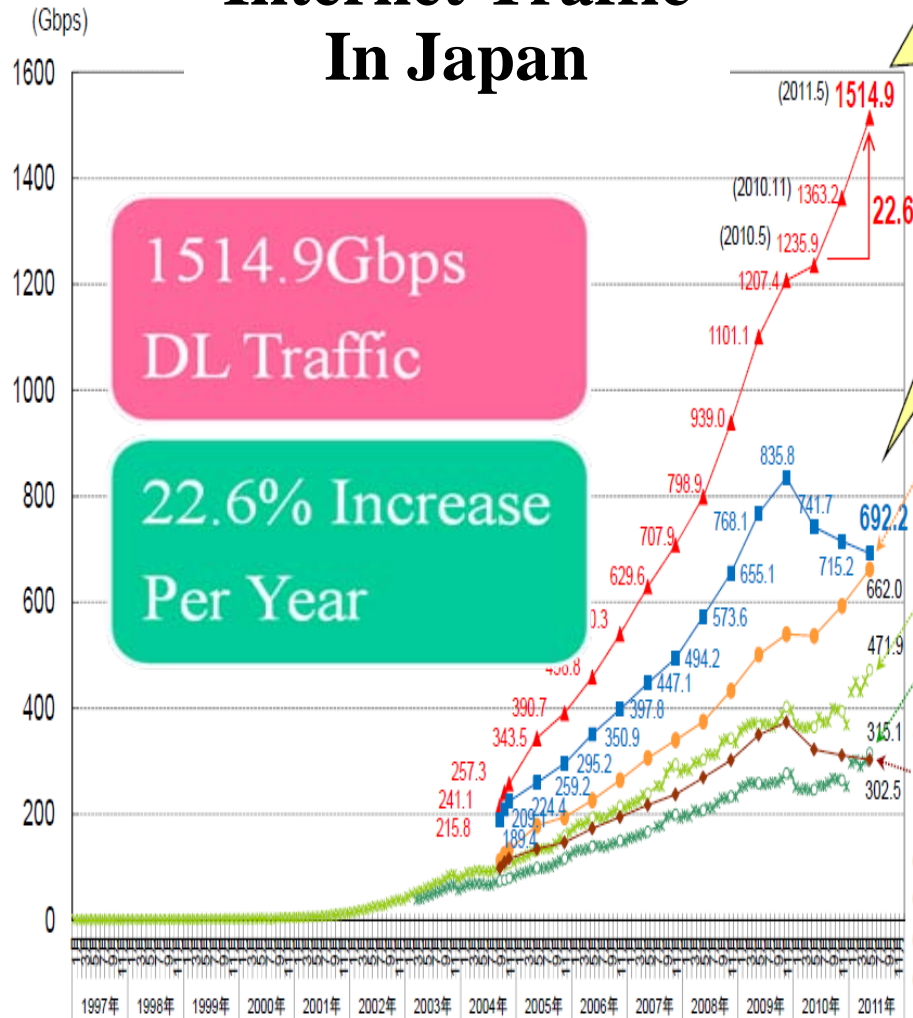
「4<sup>th</sup> Japan-EU Symposium」

# Research Activities with Establishing Characterization-Methodology for Millimeter Wave System and Beyond

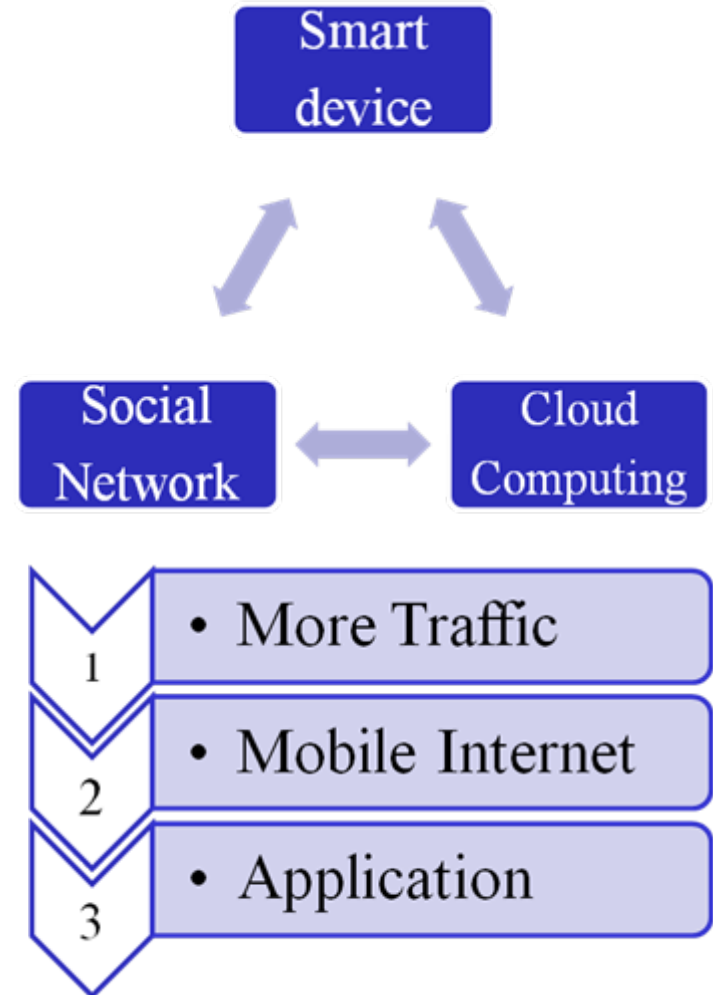
Hiroshi Hanyu and Masaki Noda, PhD

January 19, 2012

## Internet Traffic In Japan

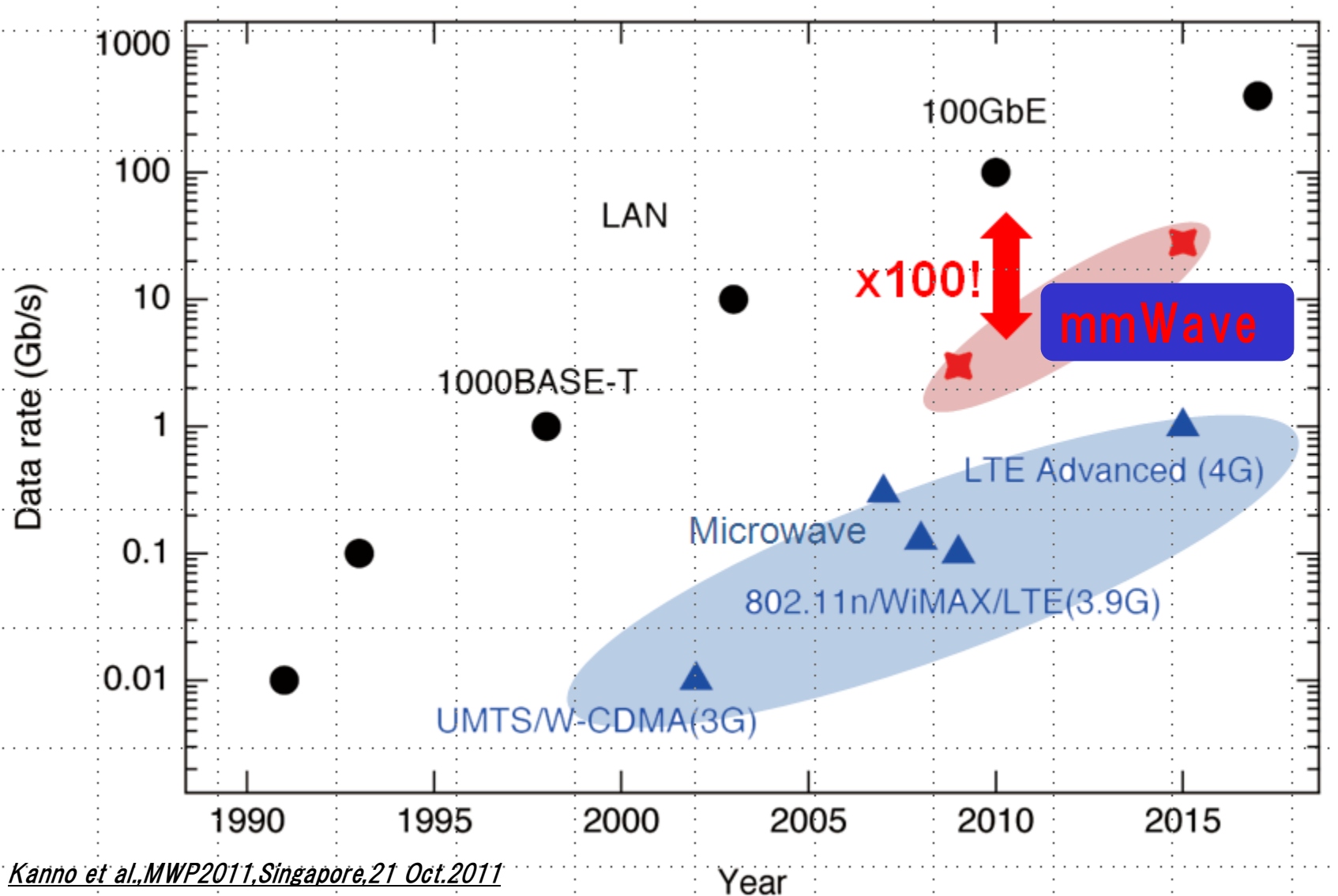


## Key Driving Factors



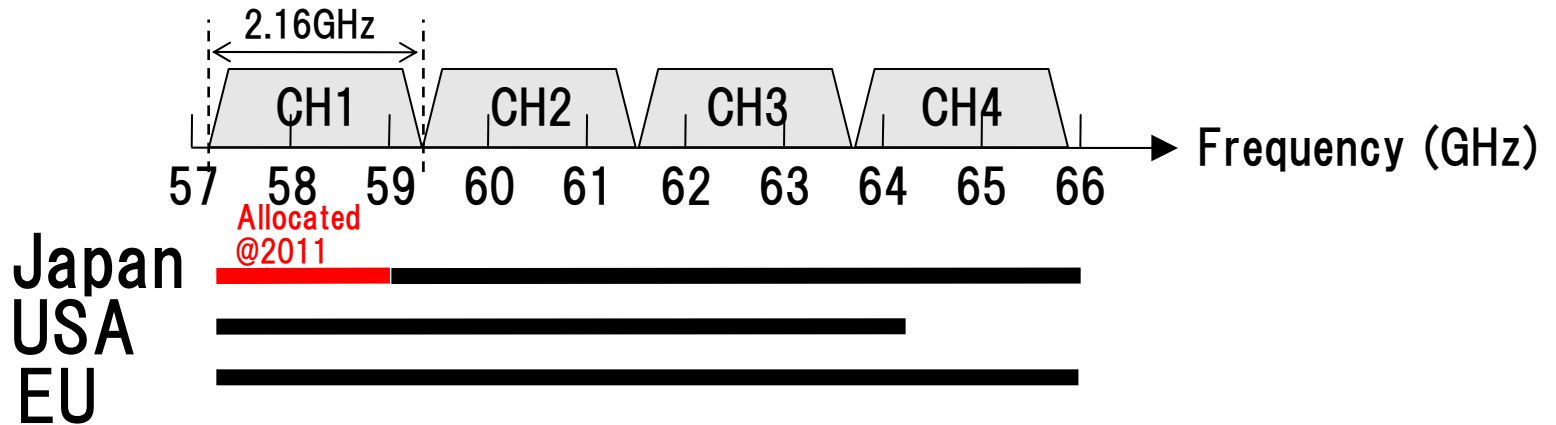
[http://www.soumu.go.jp/main\\_content/000130485.pdf](http://www.soumu.go.jp/main_content/000130485.pdf)

## Microwave → mmWave → Higher Frequency



*Kanno et al., MWP2011, Singapore, 21 Oct. 2011*

## Interoperability & Coexistence in Global Level is the Key.



MCS class	MCS ID	Data rate* (Mb/s)	Modulation	FEC type
Single Carrier Class 1	0	25.8	$\pi/2$ BPSK/(G)MSK	RS(255,239)
	1	412		
	2	825		
	3	<b>1650</b>	$\pi/2$ BPSK/(G)MSK	LDPC(672,504)
	4	1320		
	5	440	$\pi/2$ BPSK/(G)MSK	LDPC(672,336)
	6	880		

## **To drive mmWave technologies into markets, we are trying...**

### [Research Activities]

- To investigate propagation of ultra wide band mmWave
- To investigate device behavior on ultra wide band signal
- To establish wide band antenna measurement/characterization
- To provide prototype of commercial mmWave radio test system

### [Conformance Test Environment]

- To establish RF device characterization method
- To build the prototype of RF/PHY test system

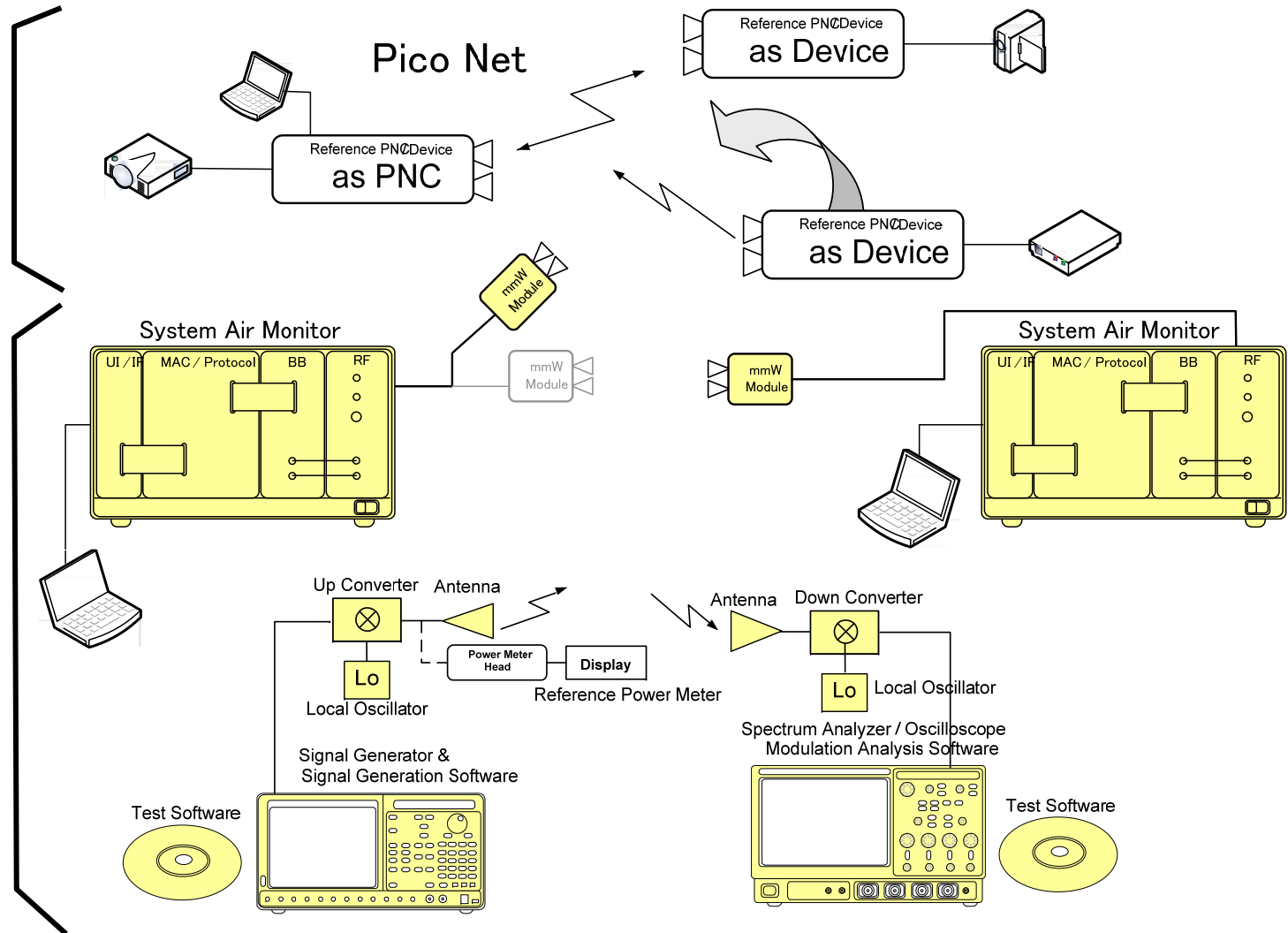
### [Application / Business]

- To deploy mmWave applied system
- To enhance Hitachi business group / product lines

## mmWave Conformance Test Environment

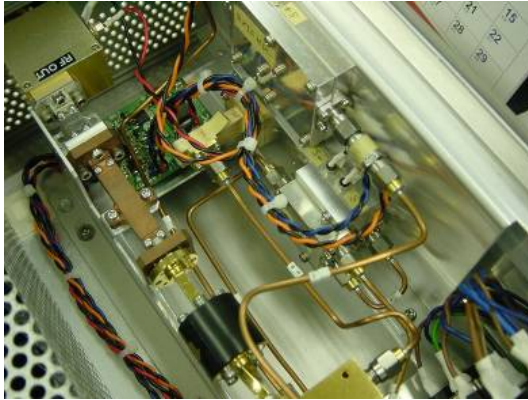
RF/PHY test system (incl. MAC)

RF device Characterization

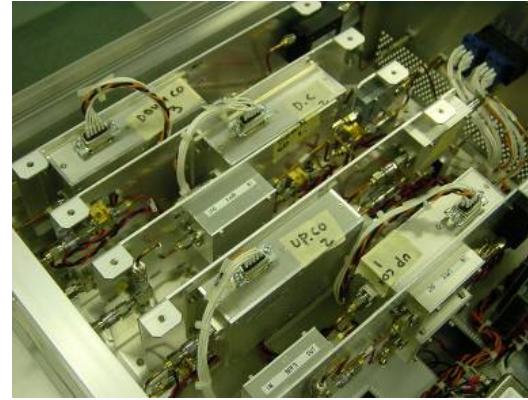


## Example of Prototype Hardware

[UpConverter]

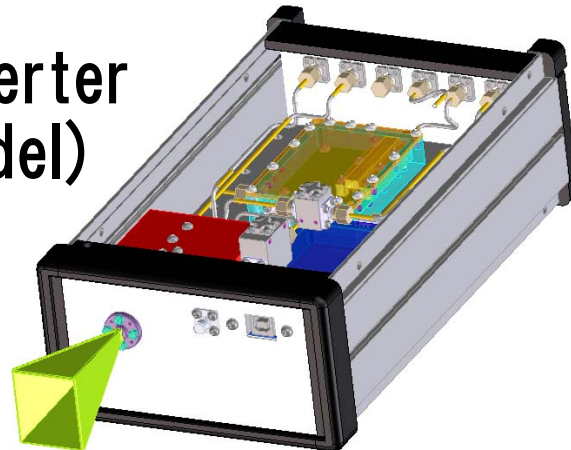


[IF&PLL]

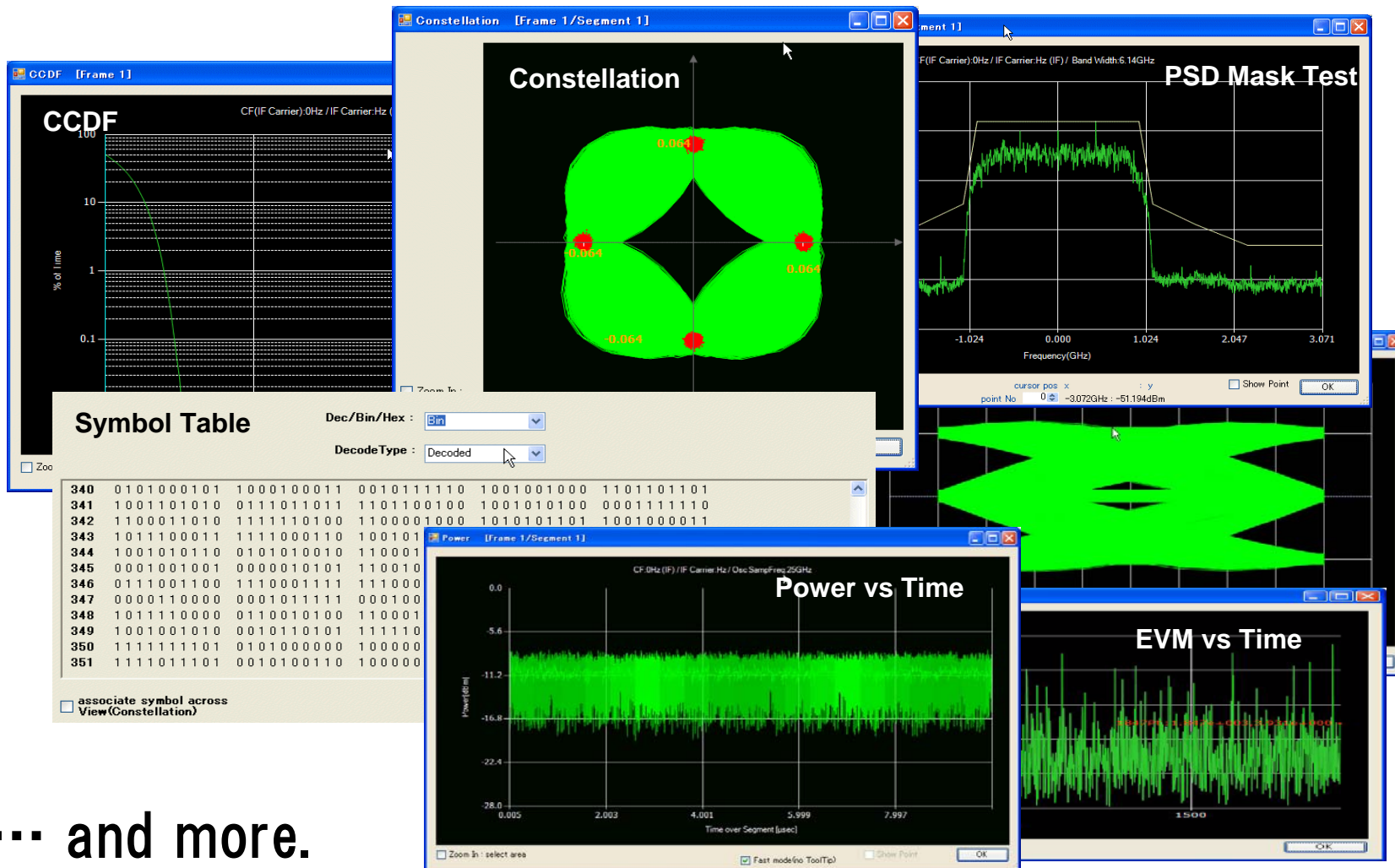


mmWave converter for device evaluation

mmWave converter  
(3D Design Model)



## Example of Date Analysis



... and more.

## **Still, There are Upcoming Technologies, such as...**

- Beyond 60GHz communication  
76/79GHz, 80GHz, 90GHz, 120GHz, 300GHz and more
- Radio on Fiber technology (RoF)  
Combination benefit of RF signal and optical fiber
- Beyond lithography limit  
Fine CMOS technology realize System on chip dream
- Beyond the power limitation  
GaN, SiC, InP etc. High power efficiency device
- Imaging & Sensing  
THz Imaging for security  
Wide area sensing system for social infrastructure

**Collaborations should work in these areas.**

## **We are going to explore new markets, such as...**

- **High-Speed Wireless Beyond 10Gbps communication**  
60GHz, 76/79GHz, 80GHz, 90GHz, 120GHz, 300GHz  
and more
  
- **High-Speed Wireless for Social infrastructures**  
Such as  
High speed transportation system, Power plant etc.
  
- **Medical Imaging system**  
Heart rate monitoring, passive & active imaging
  
- **Wide area sensing with mmWave & RoF**  
Rail way, highway and power plant etc.

[Gratitude]

This work has been supported by Ministry of Internal Affairs  
and Communications of the Japan.

**END**

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for  
millimeter wave system and beyond

2012/1/19

Hitachi Ltd.

Hiroshi Hanyu and Masaki Noda, PhD