2010年 10月 19日

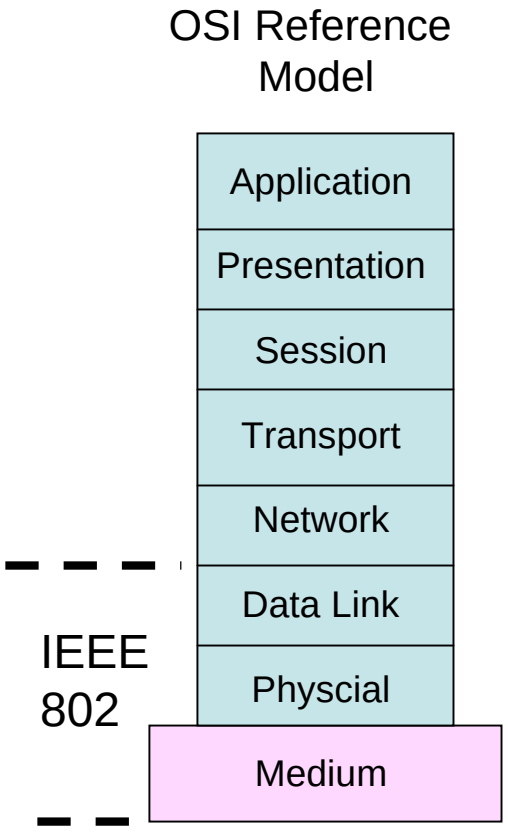
IEEE802.15 Terahertz Interest Group (IG thz) に関する動向

NTTマイクロシステムインテグレーション研究所

味戸克裕、ソンホジン

IEEE Project 802 LAN/MAN Standards Committeeについて

- IEEE 802 or LMSC
  - Formed **at 1980** by **Computer Society**
  - Develop LAN and MAN standards
  - Mainly for link and physical layers of the network stack



*OSI: Open Systems Interconnection model

IEEE 802 Organization

EXECUTIVE COMMITTEE (EC)

CHAIR
Paul Nikolich

WORKING GROUP/TAG CHAIRS

802.1 **BRIDGING/ARCH** **Tony Jeffree**	**802.3** **CSMA/CD** **David Law**	**802.11** **WLAN** **Bruce Kraemer**
802.15 **WPAN** **Bob Heile**	**802.16** **BWA** **Roger Marks**	**802.17** **ResPackRing** **John Lemon**
802.20 **MBWA** **Mark Klerer**	**802.21** **Handoff** **Vivek Gupta**	**802.22** **WRAN** **Carl Stevenson**

802.18 TAG **Radio Regulatory** **Mike Lynch**
802.19 TAG **Coexistance** **Steve Shellhammer**

APPOINTED OFFICERS

1st VICE CHAIR **Mat Sherman**	**2nd VICE CHAIR** **Pat Thaler**
EXECUTIVE SECY **Buzz Rigsbee**	**RECORDING SECY** **James Gilb**
TREASURER **John** **Hawkins**	**MEMBER** **EMERITUS** **Geoff** **Thompson**

HIBERNATION

802.2 LLC (Dave Carlson)
802.5 Token Ring (Bob Love)

DISBANDED

802.4 Token Bus
802.6 DQDB
802.7 Broadband TAG
802.8 Fiber Optic TAG
802.9 ISLAN
802.10 Security
802.12 Demand Priority
802.14 CATV

802 Working Groupsについて

802.1 Bridging and Architecture – generally the top of the link layer

802.3 CSMA/CD – Carrier sense multiple access/collision detect – wired **Ethernet**

802.11 WLAN – wireless LAN

802.15 WPAN – wireless personal area network

802.16 BWA – broadband wireless access

802.17 ResPackRing – resilient packet ring

802.18 Radio Regulatory TAG

802.19 Coexistance TAG

802.20 MBWA – mobile broadband wireless access

802.21 Media Independent Handoff

802.22 WRAN - wireless regional area networks

802 meeting includes 11-independent conferences

Working Groupについて

- WG - Working group – responsible for developing standards in an area (eg. 802.11, 802.15)
  - Task group or task force (TG): a part of a working group which focuses on a particular project.
  - Study Group (SG): a group formed to investigate a project and produce **PAR**
  - Call for interest/Interest group (IG): a brief meeting to outline a topic and determine if there is interest in investigating possible project

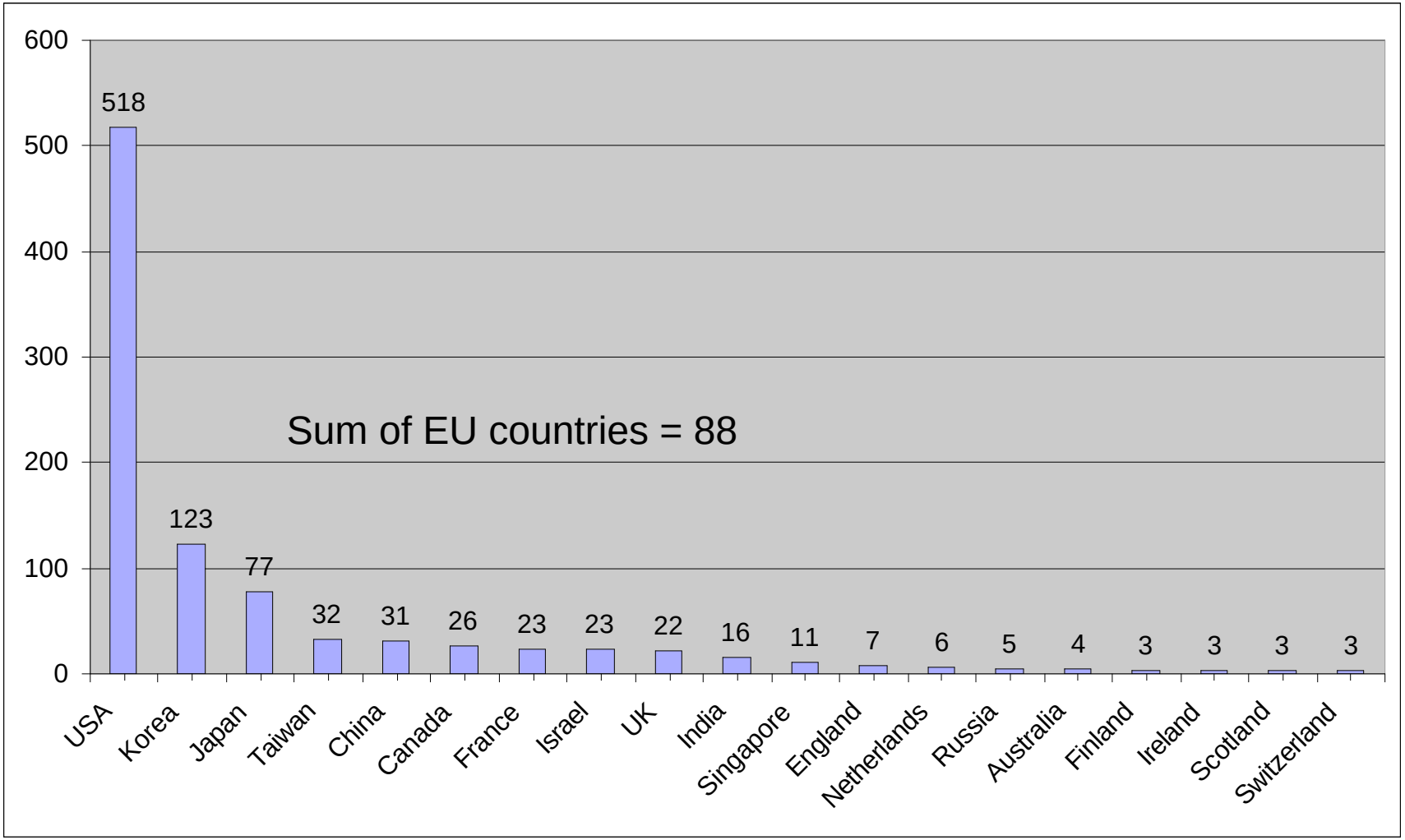
- PAR – project authorization request – the document that authorizes work on a project.
- Five Criteria – In IEEE 802 the basis for determining whether to forward a PAR.

IEEE 802 Five Criteria

- Broad Market Potential
  - Target applications?
- Compatibility
  - With current standard/market
- Distinct Identity
  - Is that new? What is merits?
- Technical Feasibility
  - All issues on implementation: device, fabrication, computation power, etc…
- Economic Feasibility
  - Cheap enough to make a big market?

参加国

802.15　Plenary meeting (March 2010)



IEEE 802.15 WPAN™ Terahertz Interest Group (IG thz) について

- Chairman: Thomas Kürner
  (Technische Universitat Braunschweig, Germany)
  Vice Chairman: David Britz
  (AT&T, USA)
- 最新の情報は以下のホームページから入手可能
  IEEE 802.15 Working Group for WPAN
  http://ieee802.org/15/index.html
  Terahertz Interest Group (IGthz)
  http://www.ieee802.org/15/pub/IGthz.html

IG thzの目的

- In 2008 the IEEE 802.15 Terahertz Interest Group has been chartered to explore the feasibility of Terahertz for wireless communications.
- The Terahertz frequency band runs roughly from 300 GHz to 3 THz, a staggering 2700 GHz of bandwidth.
- An impressive 300 GHz of bandwidth provides a vision of wireless data rates of 100 Gbit/s and beyond.
- Apart the implementation aspects of THz Communications there are important regulatory aspects to be considered. For example the allocation THz spectrum for passive services is on the agenda of the next WRC 2012.

前回(第67回)802.15 Plenary meetingについて

- 日程：2010年7月11-16日
- 場所：Manchester Grand Hyatt Hotel
  San Diego, CA, USA
- IG THz スロット数：2
- 参加者： 14 （2 committee + 3 speaker + 7 others）

Thomas Kürner (TU Braunschweig), David Britz (AT&T), Sebastian Priebe (TU Braunschweig) Ho-Jin Song (NTT) Shoichi Kitazawa (ATR Wave Engineering Labs), Jim Tomcik (Qualcomm), Katsuhiro Ajito (NTT), Gilbert Ching, (Kozo Keikaku Engineering), Yukiko Kishiki (Kozo Keikaku Engineering), André Bourdoux (IMEC), Domenico Giustiniano (Disney Research), Young-Chai Ko (Korea University)

前回のPlenary meeting (2010年7月11-16日)の802.15 Time Table

67th IEEE 802.15 WPAN MEETING
Manchester Grand Hyatt, One Market Place, San Diego, CA 92101
July 11-16, 2010
The graphic below describes the weekly session of the IEEE P802.15 WG in graphic format.

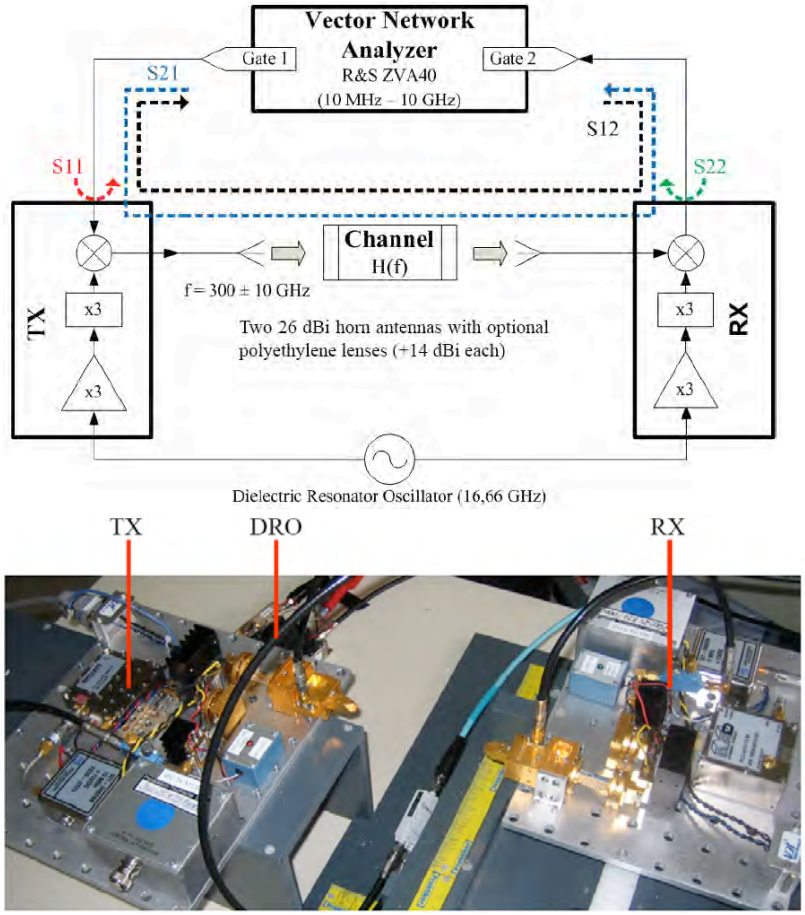
SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
			802.15 AC MEETING		
	802 EC MEETING; TG4e; TG4g SUN	TG4e; TG4f RFID; IG LECIM; TG6; SG MBAN	TG4h COR1; TG4f RFID; IG LECIM; TG6; TG7 VLC	TG4h COR1; TG4f RFID; TG4g SUN; TG7 VLC; TG6	
	Break	Break	Break	Break	
	802.15 WG Opening	TG4e; TG4f RFID; TG4g SUN; TG6; SG MBAN	802.15 WG Midweek; WNG; Tech Editors Meeting?	TG4e; TG4f RFID; TG4g SUN; TG7 VLC; TG6	
	Lunch on Your Own	Lunch on Your Own	Lunch on Your Own	Lunch on Your Own	Lunch on Your Own
	TG4e; TG4f RFID; TG4g SUN; TG7 VLC; SG MBAN	TG4e; TG7 VLC; TG4g SUN; TG6; SG PSC	TG4e; IG THZ; TG4g SUN; TG6; TG7 VLC	TG4e; SG PSC; TG4g SUN; TG7 VLC; TG6	802 EC MEETING
Break	Break	Break	Break	Break	
VIRELESS LEADERSHIP MEETING	TG4e; TG4f RFID; TG4g SUN; TG7 VLC; TG6	TG4e; TG7 VLC; TG4g SUN; TG6; SG PSC	TG4e; IG THZ; TG4g SUN; TG6; TG7 VLC	TG4e; SG PSC; TG4g SUN; TG7 VLC; TG6	
Break	Tutorial 1; Dinner on you own	Dinner on you own	Break	Break	
802.15 AC MEETING			Social	802.15 WG CLOSING	
Optional Meeting Time	Tutorial 2	RULES; 15.4i		Dinner on your own	
	Tutorial 3				

講演の概要

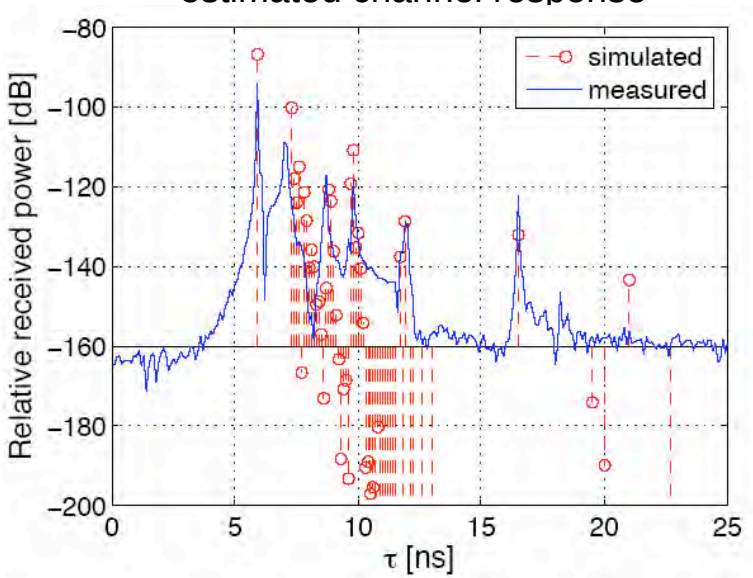
(1) ‘Towards a 300 GHz Channel Model’, S. Priebe (Germany)
(2) ‘Digital Data Transmission at 300 GHz’, S. Priebe (Germany)
(3) ‘Recent development of THz Amplifier and Low Complexity Beamforming Schemes’, Y.C. Ko, (Korea)
(4) ‘Status of Preparation Activities for WRC 2012’, T. Kurner (Germany)

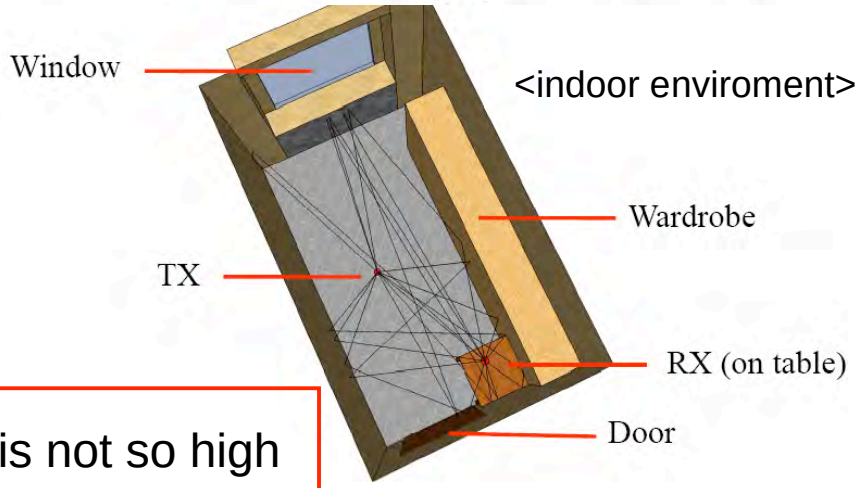
(1) Towards a 300 GHz Channel Model

<channel measurement setup>



<estimated channel response>





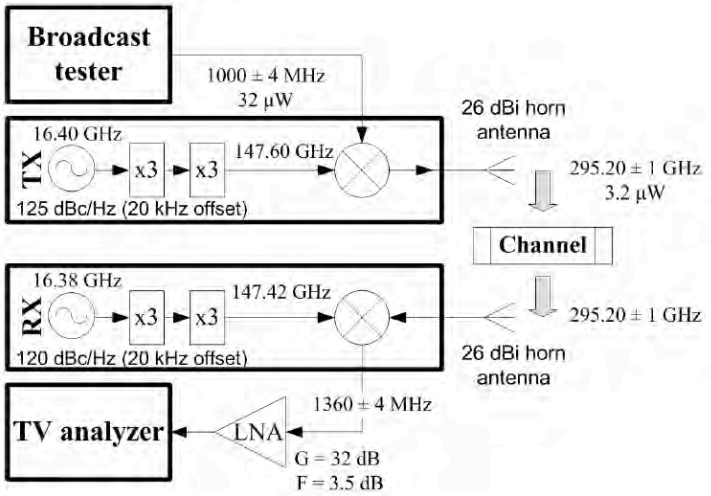
<indoor enviroment>

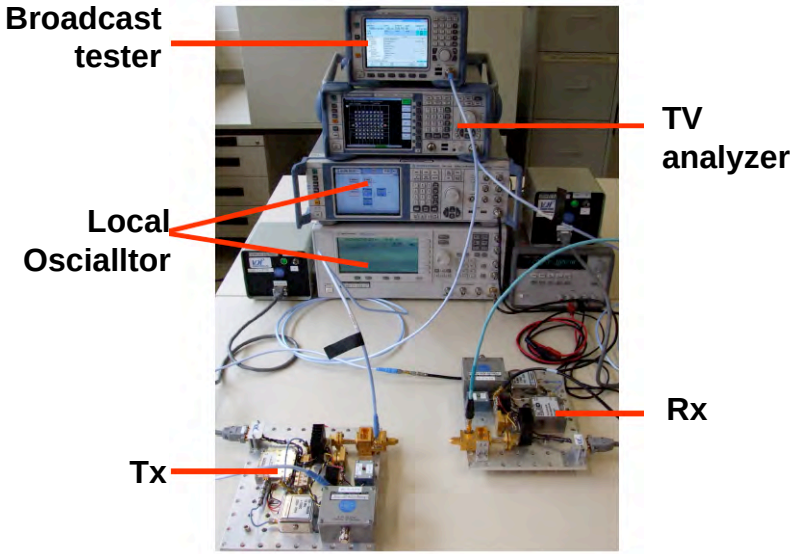
- Multipath effects occur, if antenna directive is not so high

→ Impulse response measurement

→ AoA/AoD measurement

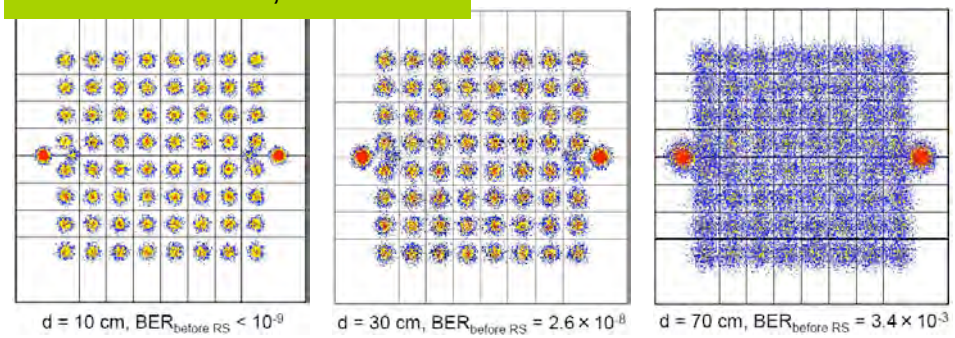
(2) Digital Data Transmission at 300 GHz



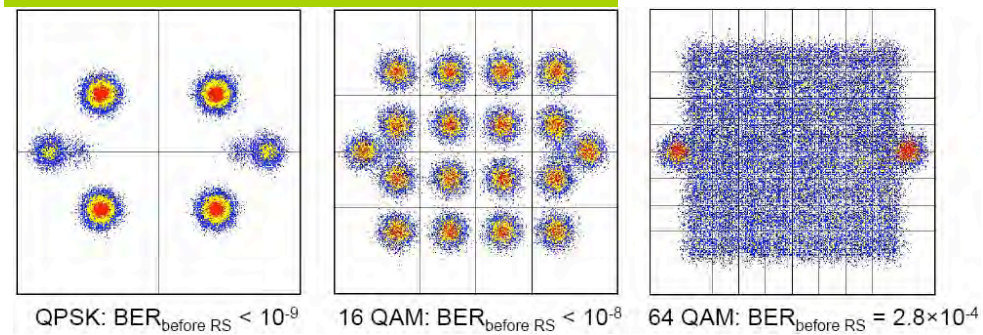


- upconverting digital QAM signal to 300 GHz
- 3.2-uW output power
- 64QAM (BW: 8MHz), 31.677 Mbps

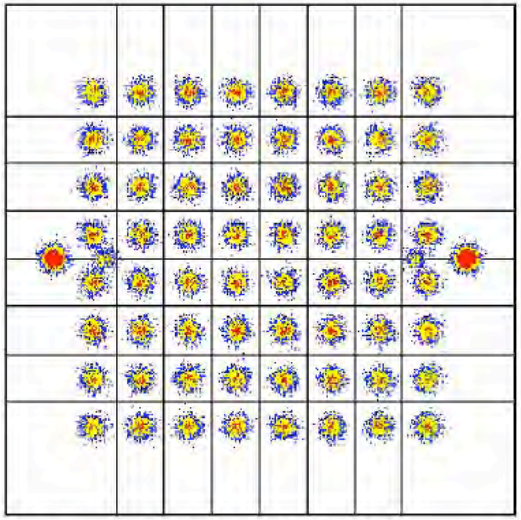
<Horn antenna, w/o lens>



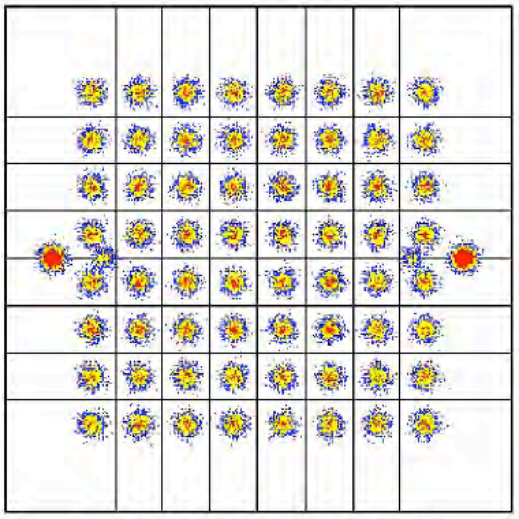
<Horn antenna, w/ lens, 52 meter>



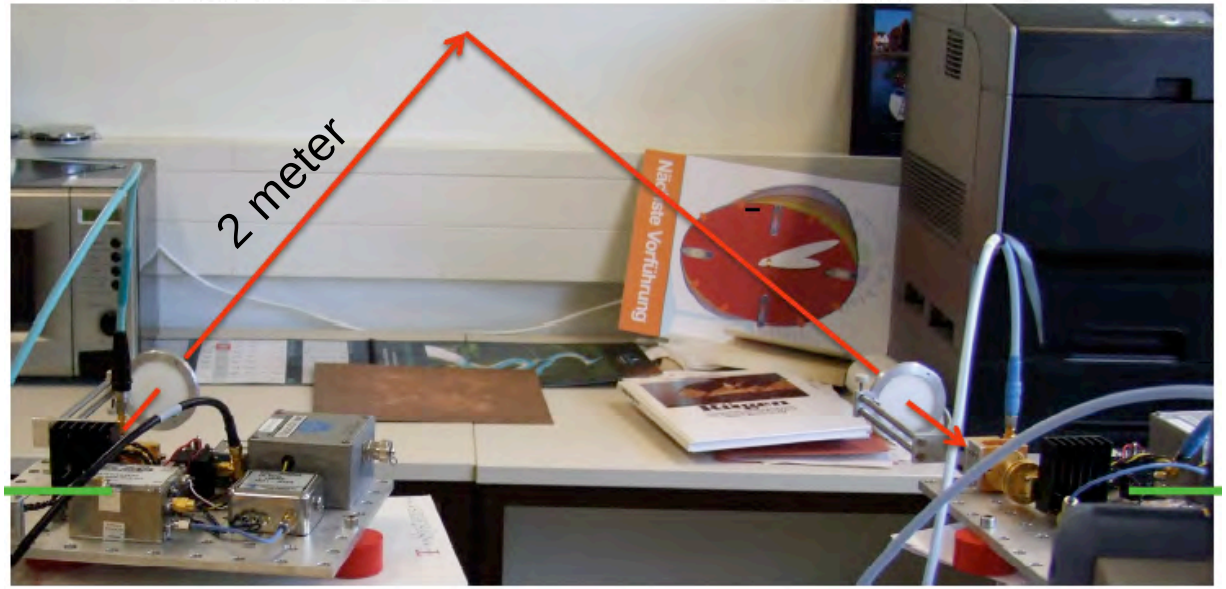
(2) Digital Data Transmission at 300 GHz



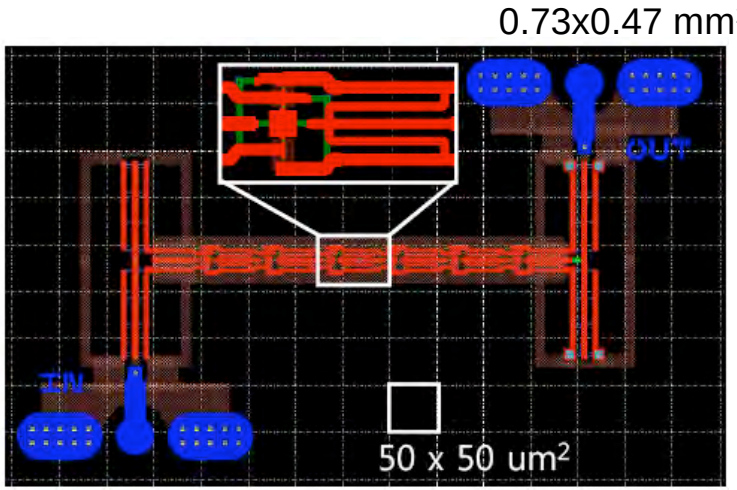
φ_{in} = 8°, C/N = 37.6 dB,
$BER_{before\ RS} < 10^{-8}$

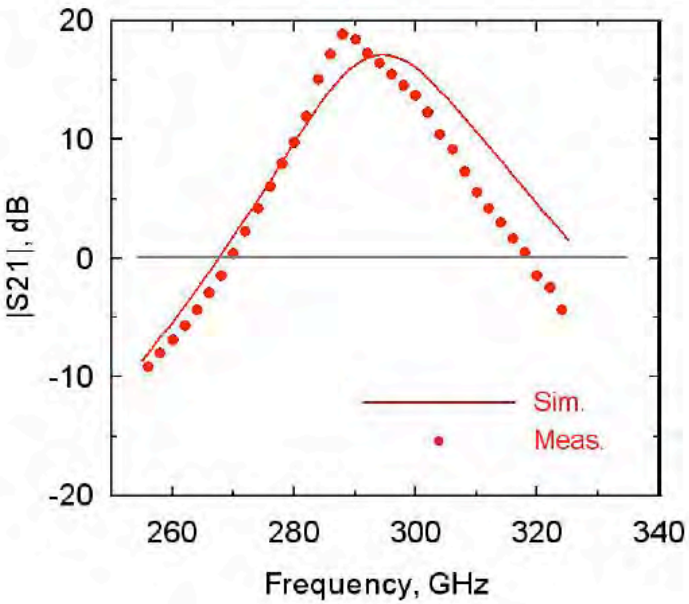


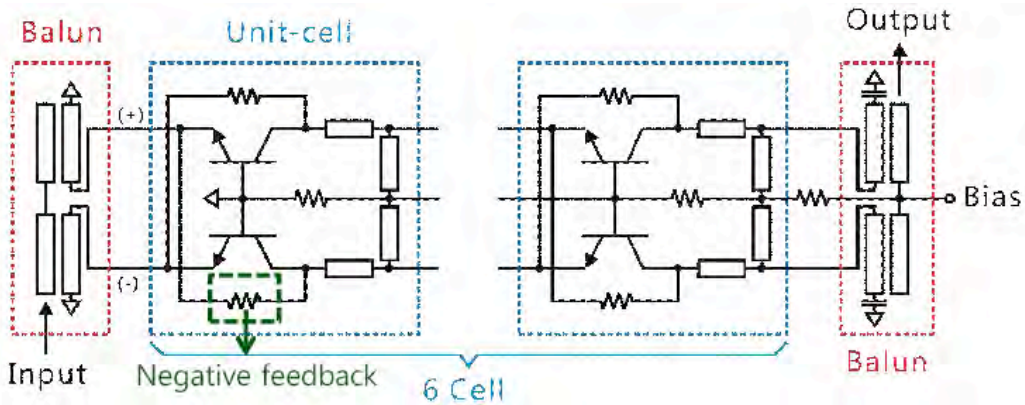
φ_{in} = 18.5°, C/N = 34.2 dB,
$BER_{before\ RS} < 10^{-8}$

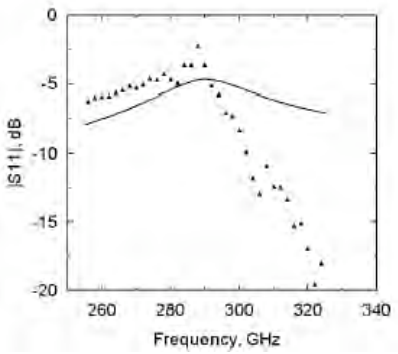


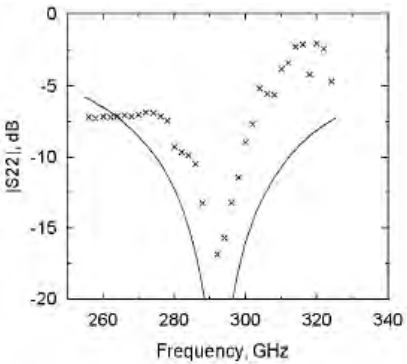
(3) Recent development of THz Amplifier











- Teledyne HBT (f_t / f_{max} = 400 / 800 GHz) ← former engineer of Teledyne
- 6-stage differential CB amplifier with a negative feedback
- 18.5 dB peak gain @ 289 GHz, 14 dB gain @ 300 GHz

(4) Status of Preparation Activities for WRC 2012

Agenda item 1.6 of WRC2012

- 1.6: *to review No. 5.565 of the Radio Regulations in order to update the spectrum use by the passive services between 275 GHz and 3 000 GHz, in accordance with Resolution 950 (Rev.WRC-07), and to consider possible procedures for free-space optical-links, taking into account the results of ITU-R studies, in accordance with Resolution 955 (WRC-07);*

Footnote 5.565 *The frequency band 275-1 000 GHz may be used by administrations for experimentation with, and development of, various active and passive services. In this band a need has been identified for the following spectral line measurements for passive services:*

- *radio astronomy service: 275-323 GHz, 327-371 GHz, 388-424 GHz, 426-442 GHz, 453-510 GHz, 623-711 GHz, 795-909 GHz and 926-945 GHz;*

- *Earth exploration-satellite service (passive) and space research service (passive): 275-277 GHz, 294-306 GHz, 316-334 GHz, 342-349 GHz, 363-365 GHz, 371-389 GHz, 416-434 GHz, 442-444 GHz, 496-506 GHz, 546-568 GHz, 624-629 GHz, 634-654 GHz, 659-661 GHz, 684-692 GHz, 730-732 GHz, 851-853 GHz and 951-956 GHz.*

(4) Status of Preparation Activities for WRC 2012

- CEPT (EU) recognizes that the identification of possible use of certain bands in the range 275-3000 GHz by the passive services shall not automatically preclude future consideration of these bands for active services.
- CITEL (Brazil, Canada, USA) supports the modification of No. 5.565 to include all appropriate bands interest to RAS EES, and SRS in the range 275-3000 GHz based upon studies being conducted in Study Group 7. The identification of bands for use by the passive services above 275 GHz should not preclude the use of these bands by the active services in the future.
- Arab group supports the modification of the No. 5.565 to determine specific allocations of the passive services, in the band 275-3000 GHz by either: (1) referring in this footnote to the Relevant Resolution(s), or (2) mentioning specifically these frequency bands in this footnote.
- One member of APT (Asia) supports that the results of studies should not lead to monopolizing spectrum for passive services; recognizing an identification of possible use of certain bands for passive services should not preclude future consideration of these bands for active services.

今後の802.15 IG thzの方向性

- The committee members (Prof. Kurner and Dr. Britz) think that
  - 2012 is good timing to move to Study group.
  - By the time, we have to prepare for WRC2015 to win a practical spectral allocation for communications above 275 GHz or, at least, to make the ITU-R start to discuss this issue.
  - To do so, now we need to first gain the number of this 802.15.IG THz community.
  - And technical progress which enable the terahertz communications is essential as well.

次回のPlenary meeting (2010年11月7-12日)の802.15 Time Table

R1
draft

69th IEEE 802.15 WPAN MEETING
HYATT REGENCY DALLAS, 300 Reunion Boulevard, Dallas, Texas, USA 75207
November 7-12, 2010

The graphic below describes the weekly session of the IEEE P802.15 WG in graphic format.

	SUNDAY	MONDAY	TUESDAY	WEDNESDAY	THURSDAY	FRIDAY
07:00-07:30				802.15 AC MEETING		
07:30-08:00						
08:00-08:30		802 EC MEETING	TG6 / IG HIP / TG4h Cor1 / TG4g SUN / TG4i Rollup	SG LECIM / SG MBAN / SG PSC / TG4i Rollup / TG4f RFID	SG MBAN / TG7 VLC / TG4e / TG4g SUN / SG PSC	
08:30-09:00						
09:00-09:30						
09:30-10:00						
10:00-10:30		Break	Break	Break	Break	
10:30-11:00				802.15 WG Midweek		
11:00-11:30		802.15 WG Opening	TG6 / TG7 VLC / TG4e / TG4g SUN / TG4i Rollup	WNG/HIP / Tech Editors Meeting?	SG LECIM / TG7 VLC / TG4e / TG4g SUN / TG4i Rollup	
11:30-12:00						
12:00-12:30						Lunch on Your Own
12:30-13:00		Lunch	Lunch	Lunch	Lunch	
13:00-13:30						
13:30-14:00		TG6 / TG7 VLC / TG4e / TG4g SUN / IG THZ	TG6 / TG7 VLC / TG4e / TG4g SUN / IG SRU	TG6 / TG7 VLC / TG4e / TG4g SUN / TG4f RFID	TG6 / TG7 VLC / TG4e / TG4g SUN / TG4f RFID	
14:00-14:30						
14:30-15:00						
15:00-15:30						
15:30-16:00	Break	Break	Break	Break	Break	802 EC MEETING
16:00-16:30	WIRELESS LEADERSHIP MEETING	TG6 / TG7 VLC / TG4e / TG4g SUN / IG THZ	TG6 / TG7 VLC / TG4e / TG4g SUN	TG6 / TG7 VLC / TG4e / TG4g SUN / TG4f RFID	TG6 / TG7 VLC / TG4e / TG4g SUN / TG4f RFID	
16:30-17:00						
17:00-17:30						
17:30-18:00	802.15 AC MEETING					
18:00-18:30		Tutorial 1 THz / Dinner on you own	Dinner on you own	Break	Break	
18:30-19:00						
19:00-19:30		Tutorial 2 HIP	RULES / SG LECIM / SG MBAN / SG PSC	Social	802.15 WG CLOSING	
19:30-20:00						
20:00-20:30						
20:30-21:00		Tutorial 3			Dinner on your own	
21:00-21:30						
21:30-22:00						
22:00-22:30						

802.15 IG thzの開催予定

November 7-12, 2010

Hyatt Regency Dallas, TX, USA,

March 13-18, 2011

Marina Bay Sands, Singapore

July 17-22, 2011

Hyatt Regency San Francisco at Embarcadero Center,

San Francisco, CA, USA