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“Millimeter wave ITS Radio Communications”

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NiCT National Institute of Information and Communications Technology

Study on MM-ITS Wireless Communications

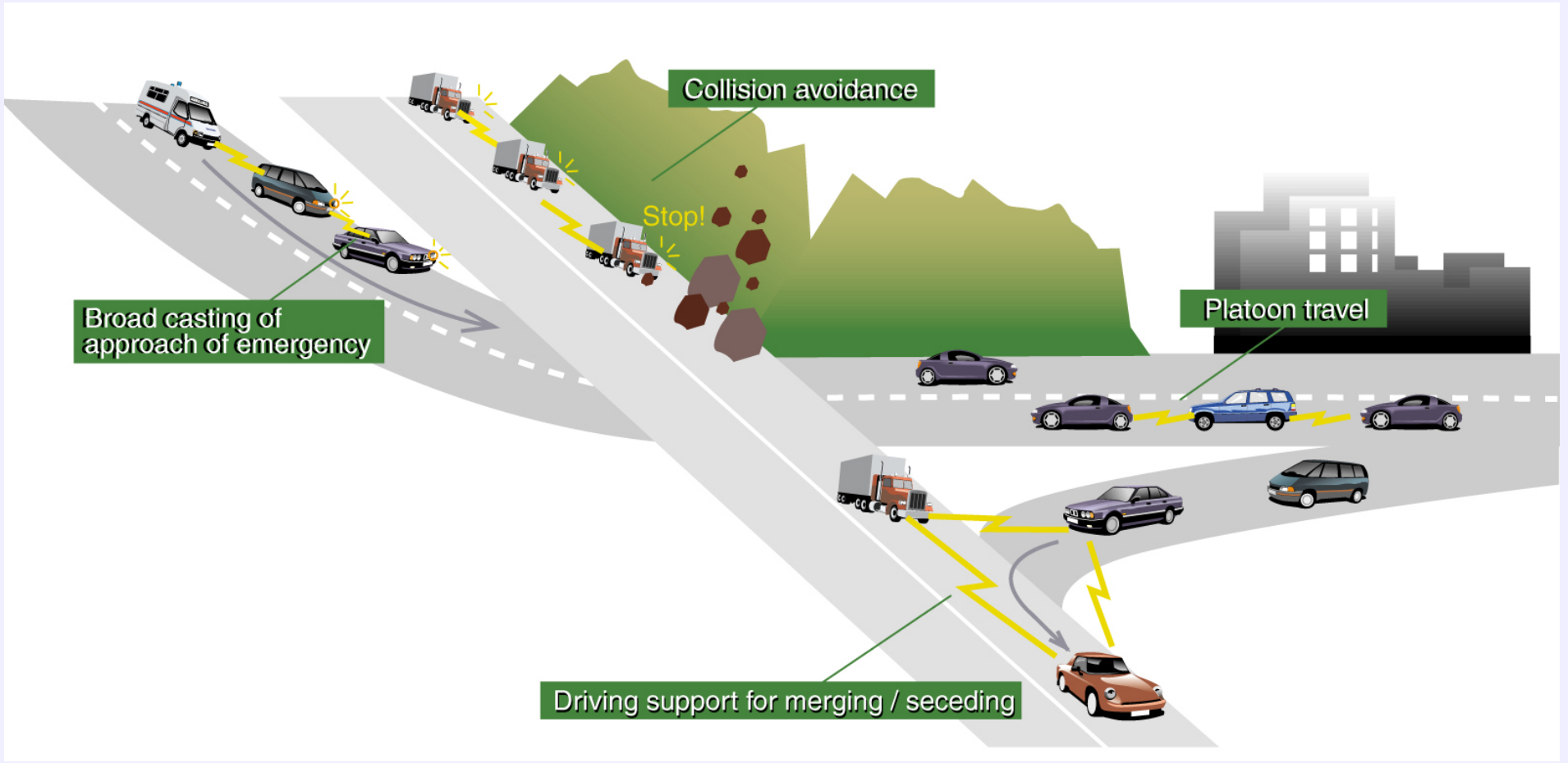
Millimeter wave ROF road-vehicle communication system

- Multi-service
- high speed data transmission

Millimeter wave inter vehicle communication system

- integrated radar communication system
- safety operation support

Driving Support using Inter-Vehicle Communication



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Why millimeter wave (MM wave) ?

- High-efficiency of frequency reuse due to high attenuation compared with microwave
- Low attenuation caused by rain, fog, and snow compared with light-wave
- Potential of wide-band transmission
- Small size of of RF unit

Research on IVC in NICT

- Measurement of propagation characteristics of 60 GHz millimeter wave on the road, expressway, e.t.c.
  - Propagation model between vehicles on the road
- Estimation of inter-vehicle transmission between running vehicles.
  - Characteristics of received power vs. bit error rate,
  - Effect of space diversity
- System design for IVC system
  - Feasibility study of IVC system in millimeter wave,
  - Radar with communications function

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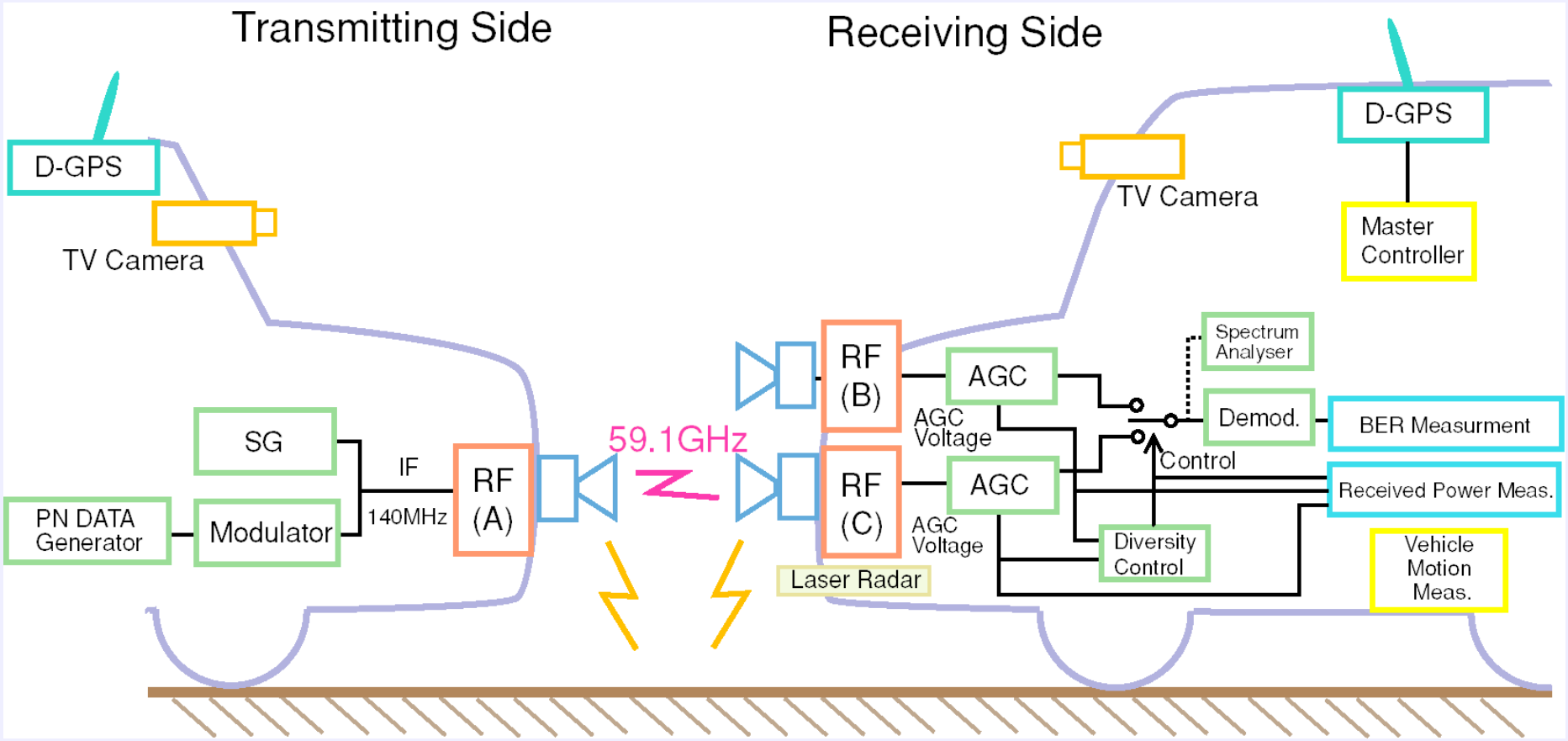
Experimental facility



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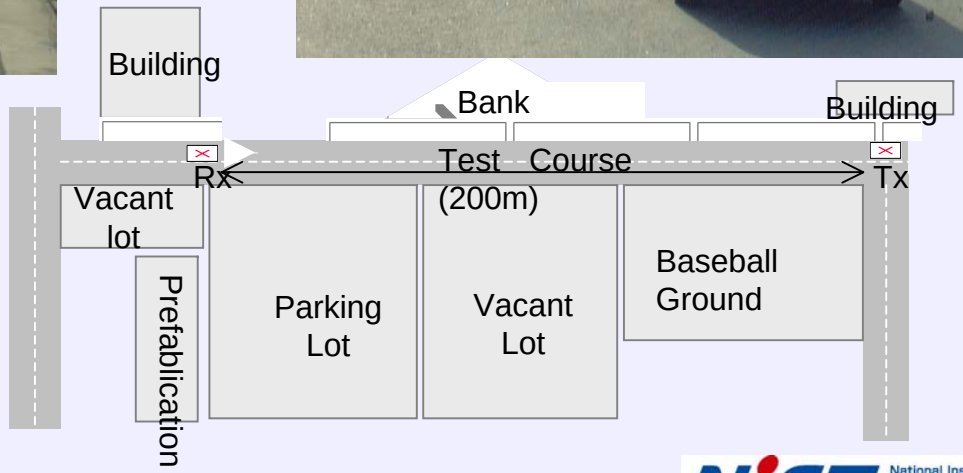
Test course



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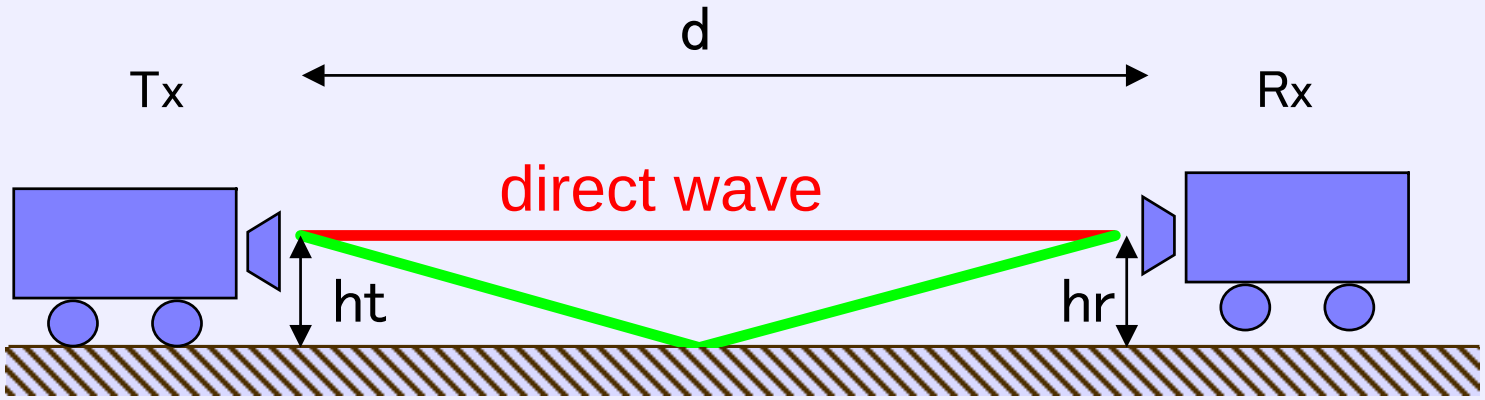
Experimental condition

Center frequency	59.1 GHz
Transmitted power	+9 dBm
Data rate	10 Mbps
Modulation	DFSK
Detection	Differential
Antenna	Standard Horn
Antenna gain	24 dBi

Two ray model

Received power

$$P_r = \frac{P_t G_t G_r}{L(d)} \left(\frac{\lambda}{2\pi d} \right)^2 \sin^2 \left(\frac{2\pi h_t h_r}{\lambda d} \right)$$



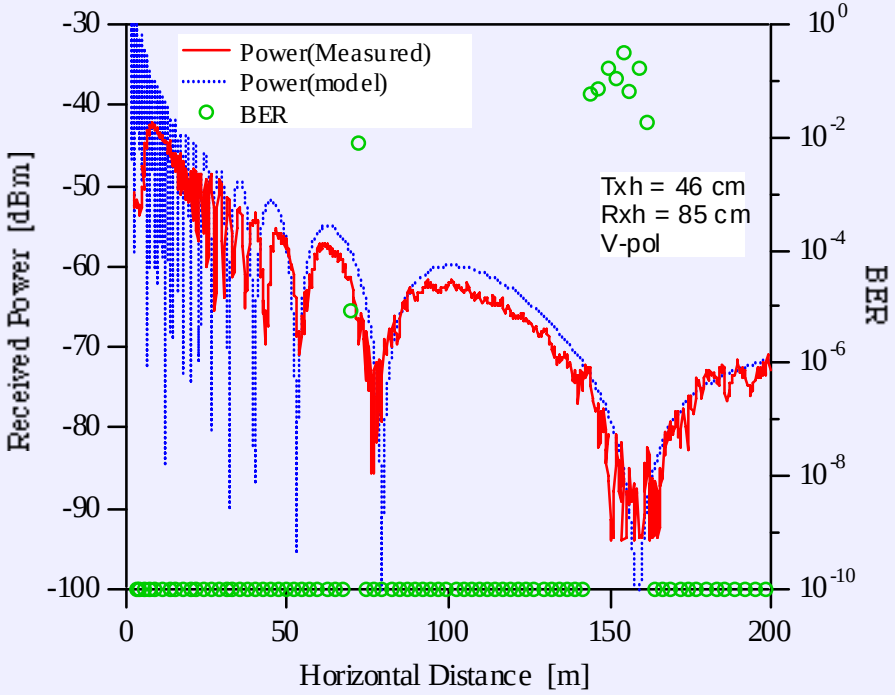
reflected wave

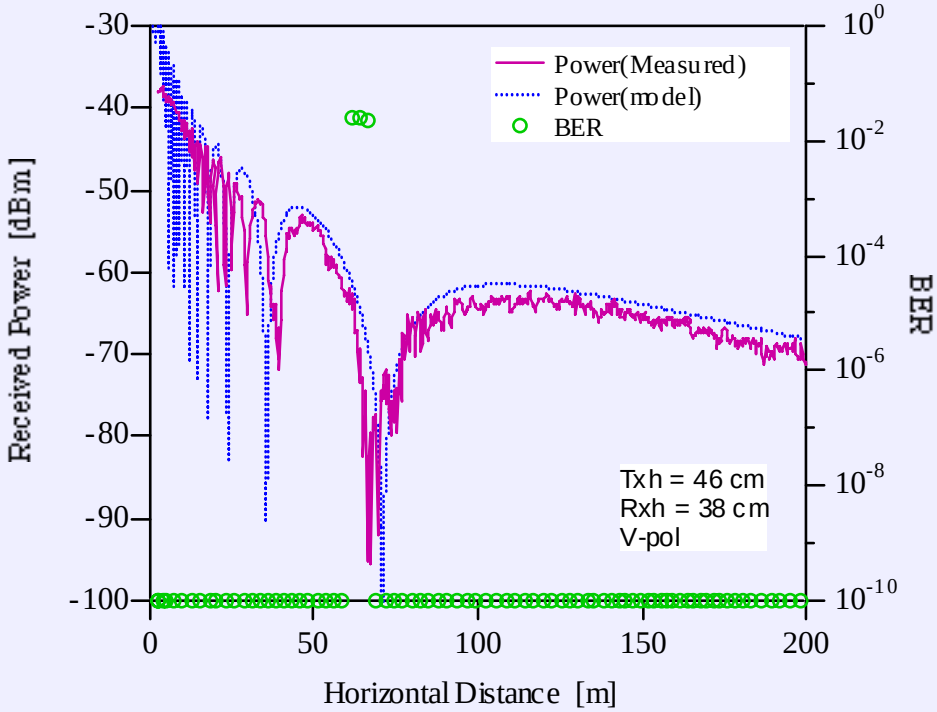
（ reflection coefficient = -1 ）

Two ray model（assumption ）

- Reflection coefficient of pavement = -1
- Roughness of pavement was ignored
- Directivity of antennas was ignored
- Absorption of Oxygen @60 GHz = 16 dB/km

Resuls （V-pol）





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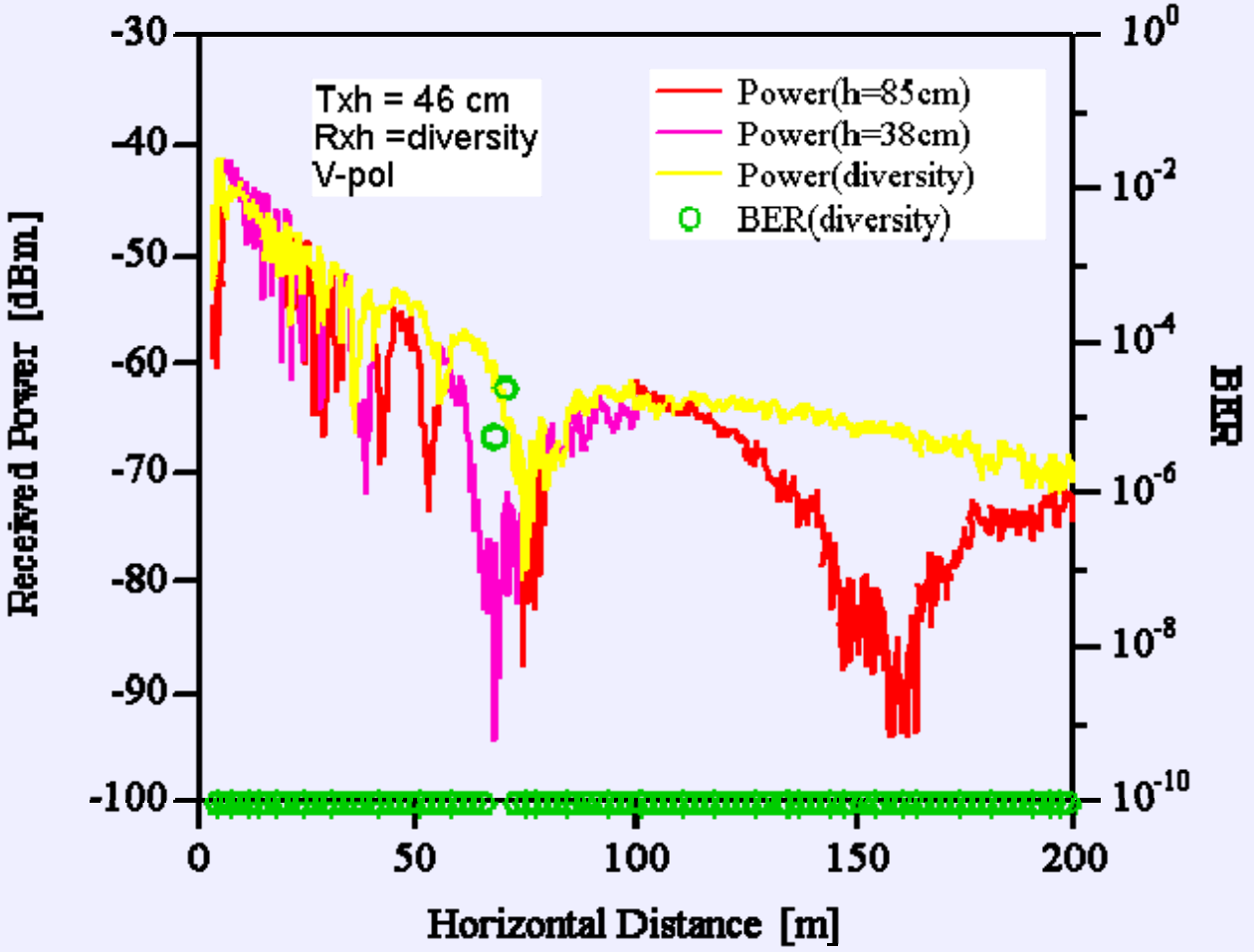
Results （Rxh = diversity, V-pol ）



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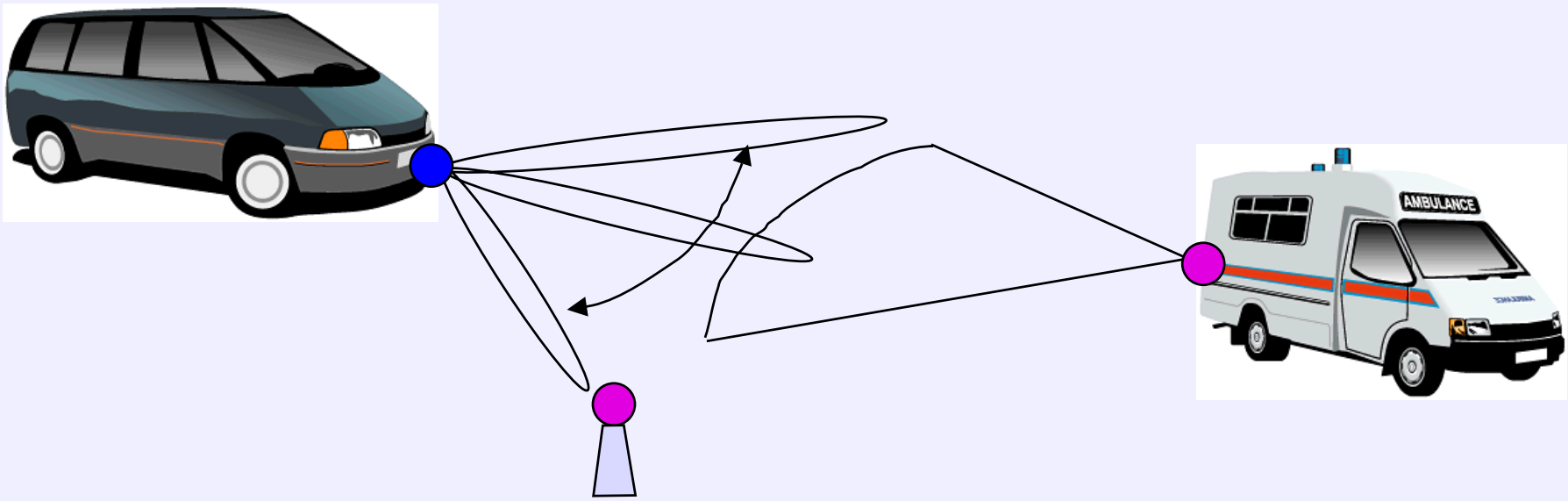
Radar with Communications Function and Transponder system (Vehicle Safety System)

- Radar unit with Communications Function (Scanning Antenna)
- Transponder unit



Sign post

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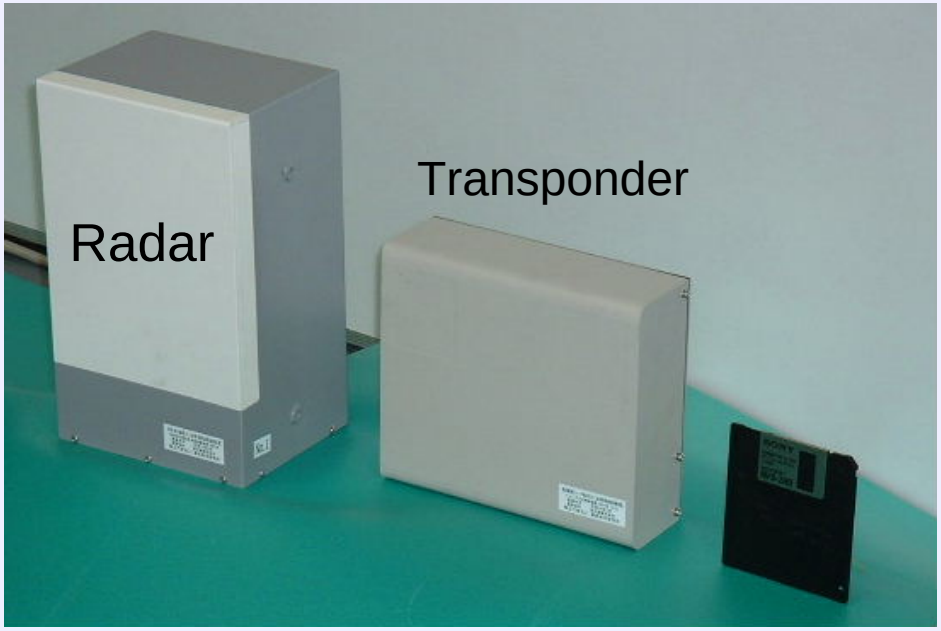
Radar and Transponder trial system

- Transmission rate: 100kbps
- BER : less than 10^{-4}
- Comm. range: 100m
- Frequency: 60GHz
- Antenna beam width:

  3deg.(Radar)

  30deg.(Transponder)
- Rader type: FM-CW
- FM sweep range: 100MHz



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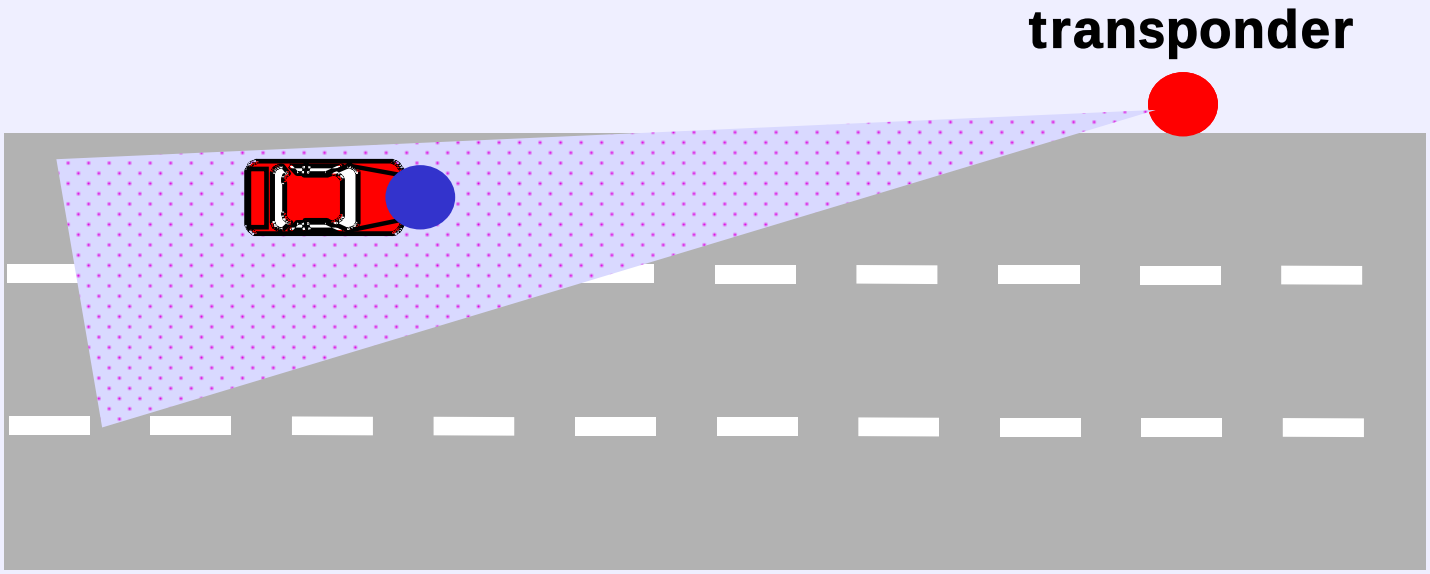
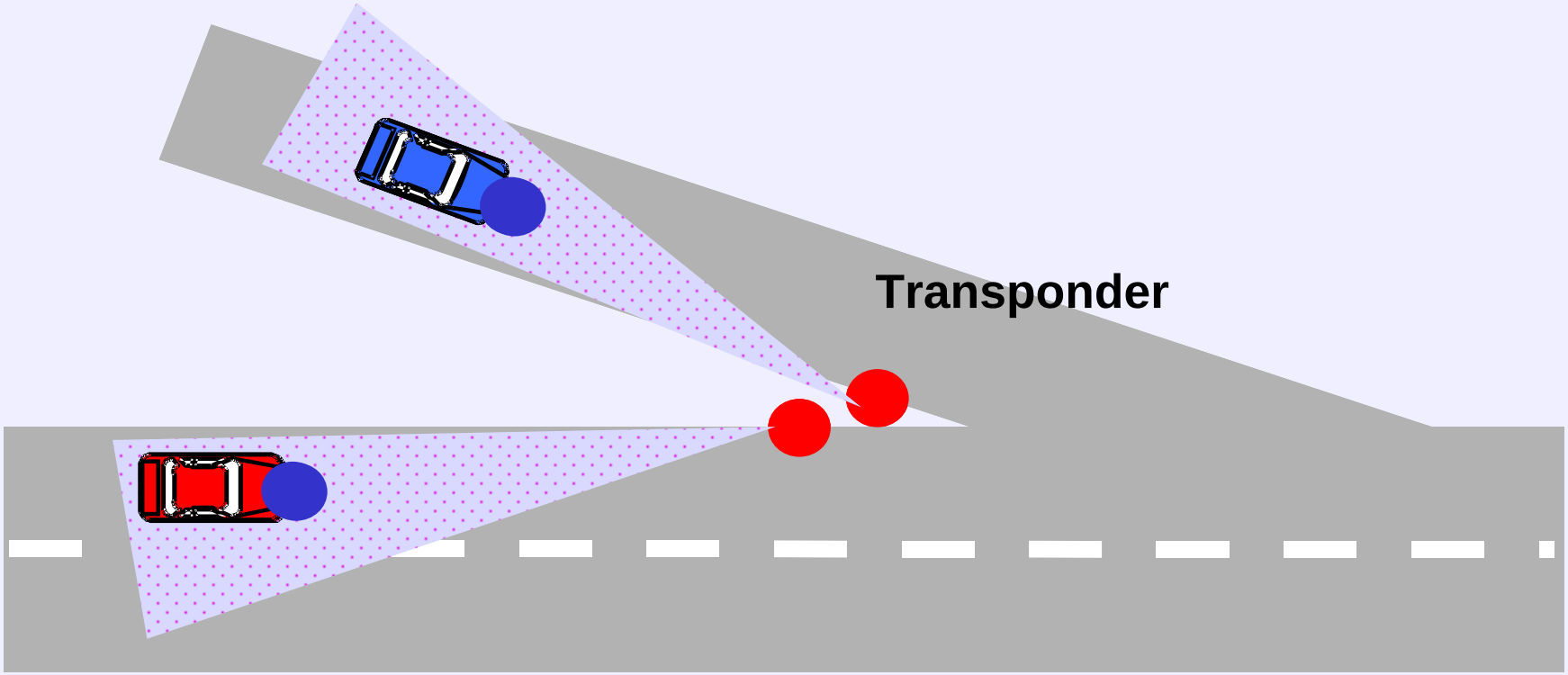
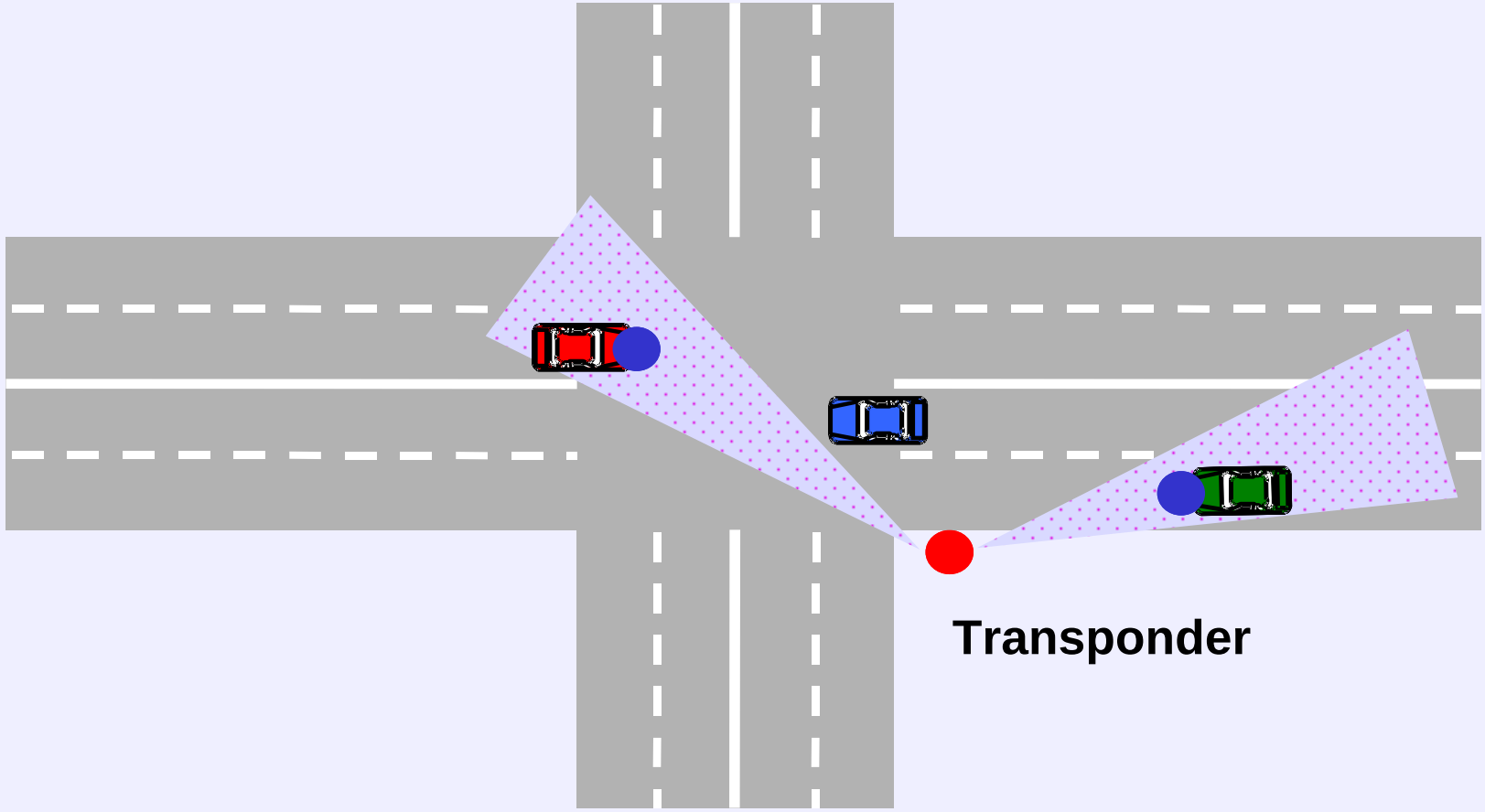
radio wave markers (sign post)



support for safe driving in converging traffic



intersection safety system



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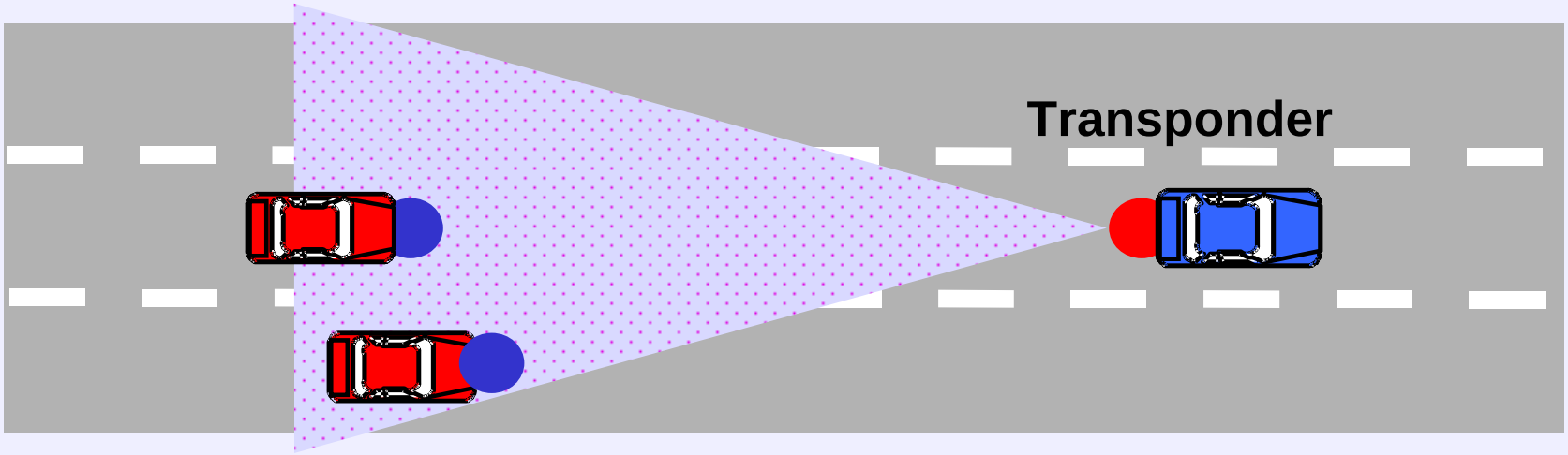
rear-end collision avoidance alarm



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Road-Vehicle communications

Features:

- Millimeter-wave hot-spot access system
- Broad band wireless transmission
- Multi-service
- Radio over Fiber transmission

Specification of RoF hot-spot access trial system

- down link: 59.0-60.0 GHz
- up link: 61.0-62.0 GHz
- RF power: 10 dBm
- antenna gain: 14dBi(BS), 11dBi(MS)
- modulation: D-BPSK
- band width: 270MHz
- data rate: 155.52Mbps

Configuration of access network

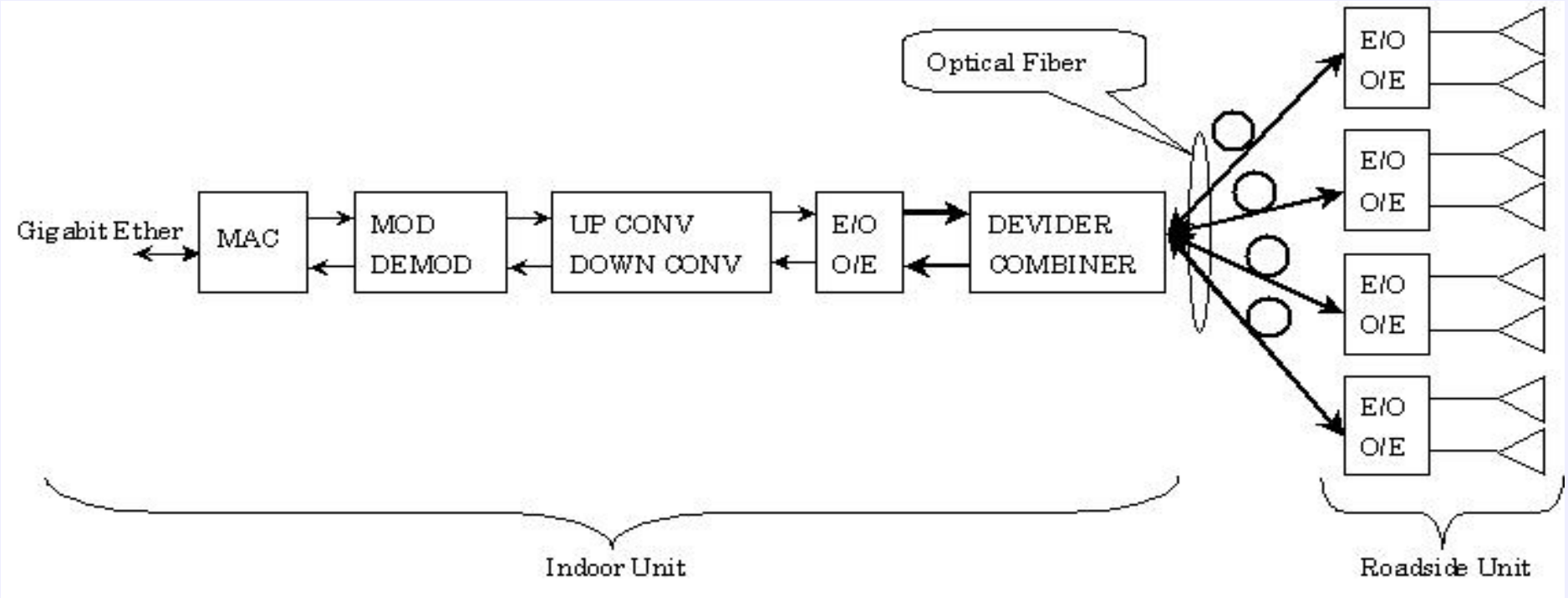
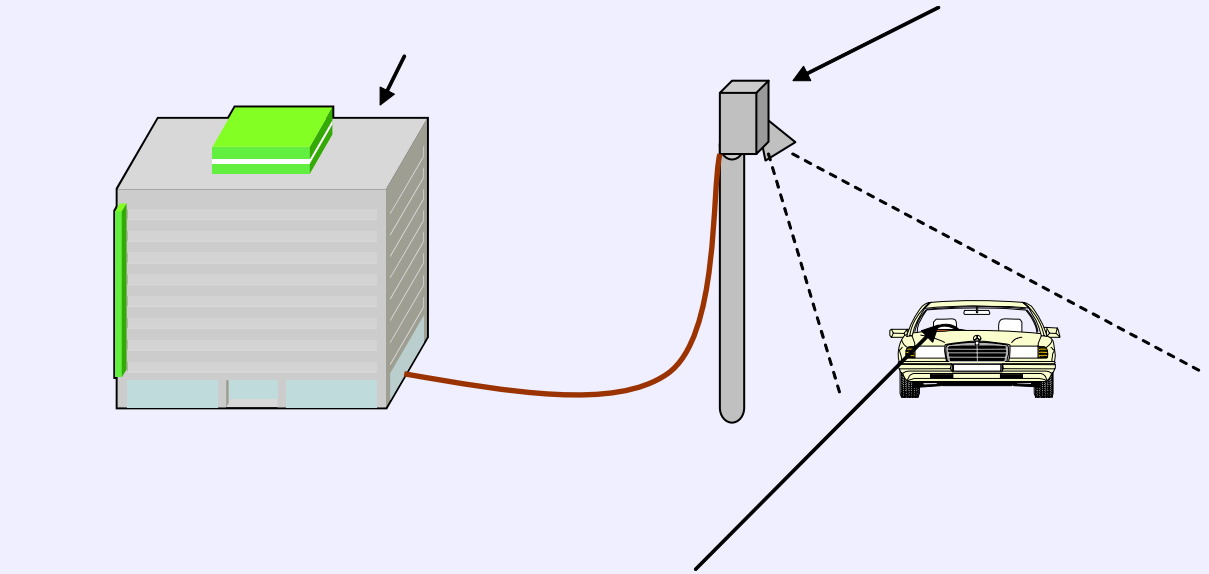


Image of a service scene and the configuration of mobile terminal unit



Mobile Unit

ROF spot communication system

Control station

Base station

Mobile station

12cmx18cmx6cm

Antenna

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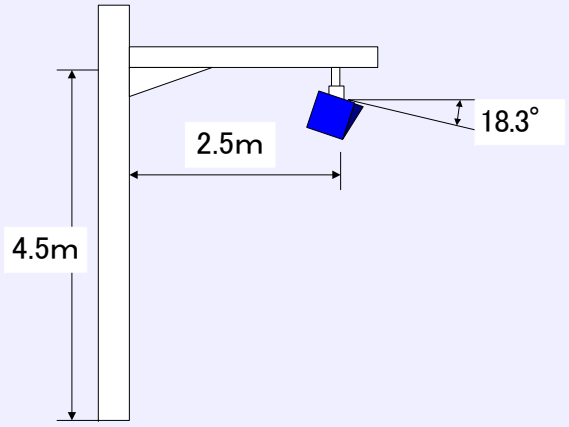
Experiment



Base station

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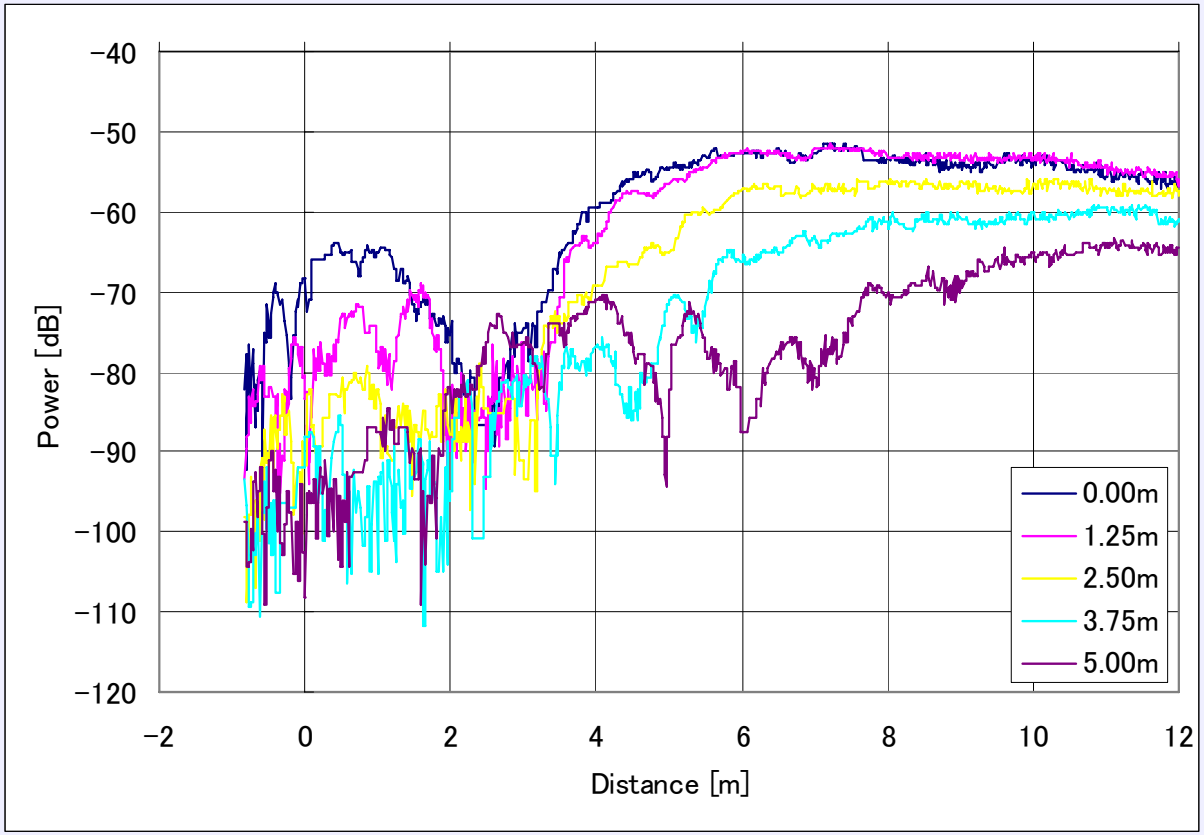
Received power



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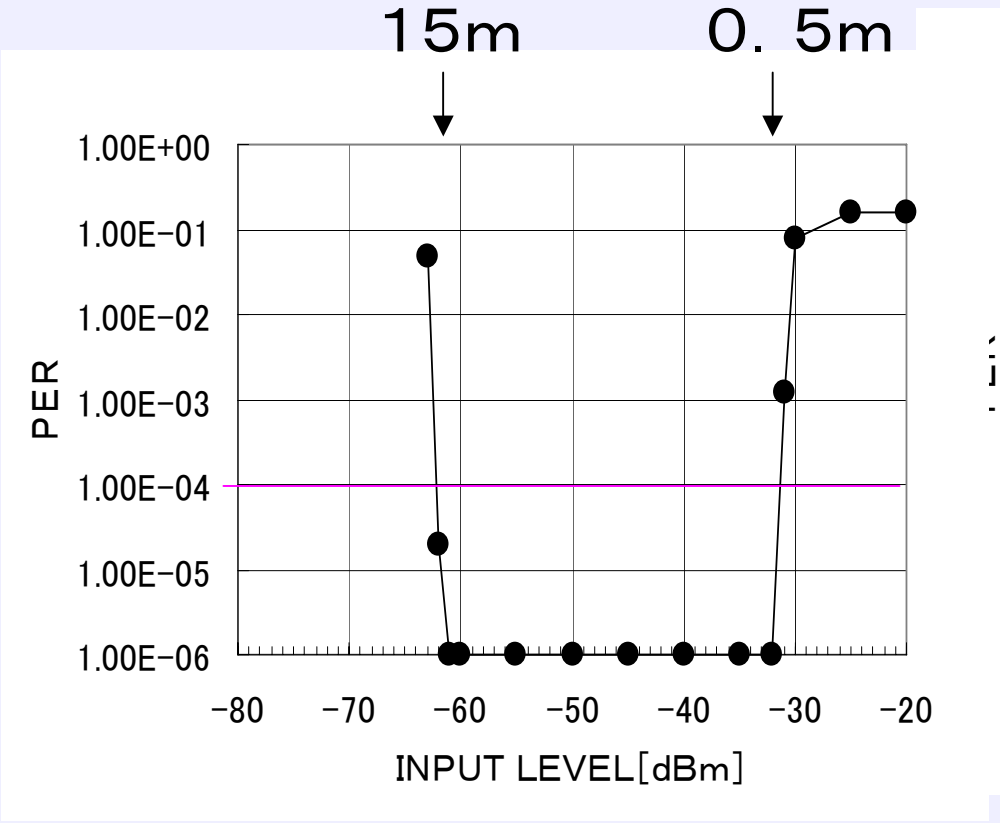
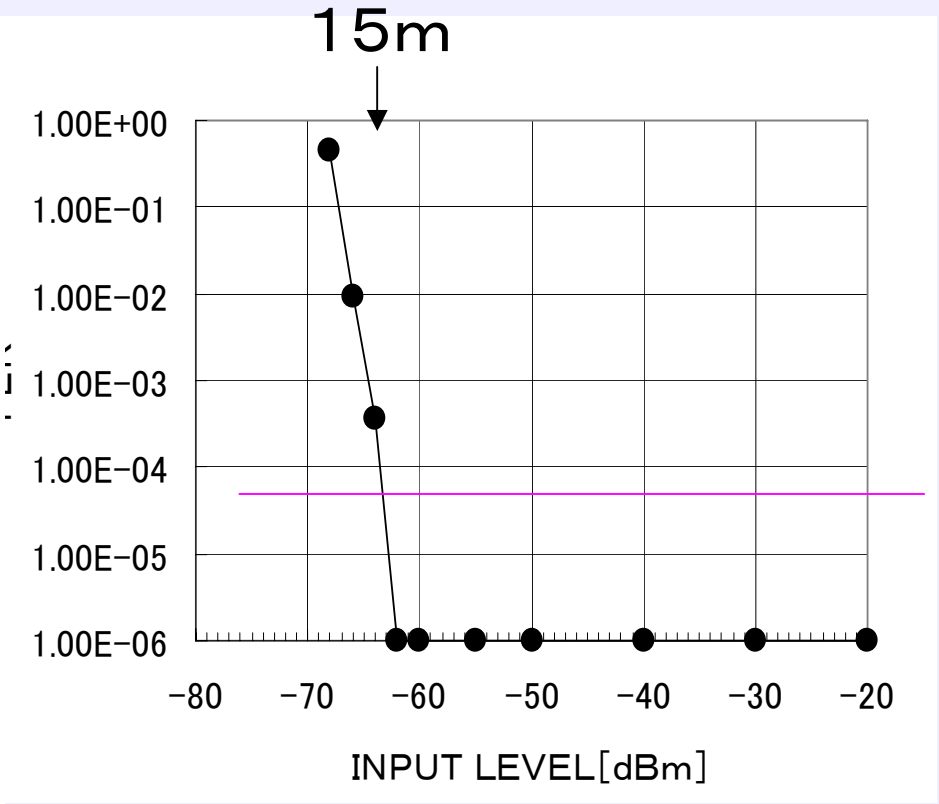
Packet Error Rate



down link



up link

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International Standardizations

- ITU-R SG8 WP8A WG2(ITS)

  MM ITS for inter-vehicle communications and road to vehicle communications

- ISO-TC204 WG16.1 CALM-MM

  Protocol for interface between MM-communications and ITS network architecture

International conference on IT telecommunications

ITST2006

June 21-23, 2006

Chengdu, China

- http://www.itst2006.uestc.edu.cn

ITST 2006 The 6th International Conference on ITS Telecommunications

21-22-23 June, 2006 Chengdu, China

FIRST CALL FOR PAPERS

The 6th International Conference on **ITS Telecommunications (ITST2006)** will be held in **Chengdu** on **21 – 22 – 23 June, 2006.**

After five previous editions, the conference is taking place for the first time in China. It will bring together engineers and scientists in the emerging field of Intelligent Transportation Systems (ITS), and topics not only in ITS but also in the wider field of wireless communications will be presented, given the close link between the two.

The conference will provide a forum within the international scientific and engineering community for the exchange of ideas, information and latest results on telecommunications and ITS applications.

There will be both oral and poster sessions, with contributed and invited papers. They will include the topics of transportation policy, economics and standards, as well as infrastructures, research results, technologies and applications. Technical exhibitions and demonstrations will be held at the conference center and technical visits will also be proposed.

AREAS OF INTEREST INCLUDE, BUT ARE NOT LIMITED TO:

Policy, Social and Institutional Issues
Bringing Applications and Services to Vehicles
Broadcasting
Software Design Technologies
Architecture, Interoperability and Standards
Transmission Technologies
Access Control Schemes
Mobile IP and Network Mobility in IPv6
Multiple Interface Management
Ad-hoc Networks
Sensor Networks
In-Vehicle Communications
Inter-Vehicle Communications
Infrastructure to Vehicle Communications
Antennas and Propagation, Smart Antennas
Sensing Technologies: Radars, Lidars
On Board Equipment, Embedded Electronics
Device and Circuit Technologies
RF Identification Technology

GUIDELINES FOR SUBMISSION

Prospective authors are invited to submit electronically via the conference web site(http://www.itst2006.uestc.edu.cn) a full-length paper (4 pages normally and 6 pages maximum) of their work in .pdf format, including figures in black and white. The cover page must include: the title of the paper, authors' names and affiliations, contact author's name and address (both postal and electronic), keywords and submission area (from the list of relevant areas of interest). Paper submission template can be downloaded from the webpage of ITST2006. The submission of a paper implies that the paper is original and has not been submitted under review or copyright protected elsewhere.

A reprint of the accepted papers (for which at least one author is registered for ITST 2006 by 30 April, 2006) will be handed out to participants on the opening day. The conference proceedings will also be distributed on CD-ROM. Detailed please notice that there will be three best paper awards with a certificate and a prize each.

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IMPORTANT DATES		
	Paper Submission :	28 February,2006
	Notification of Acceptance:	31 March,2006
	Camera Ready Paper:	30 April,2006

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