

[Intra-cluster response model and parameter for channel modeling at 60GHz]

Date: 2009-08-20

Authors:

Name	Affiliations	Address	Phone	email
Hirokazu Sawada	Tohoku University	2-1-1 Katahira, Aoba-ku, Sendai 980-8577, JAPAN	+81-22-217-6112	sawahiro@iec.tohoku.ac.jp
Shuzo Kato	NICT/ Tohoku University	3-4, Hikarino-Oka, Yokosuka, Kanagawa 239-0847 Japan		shu.kato@nict.go.jp
Katsuyoshi Sato	NICT	3-4, Hikarino-Oka, Yokosuka, Kanagawa 239-0847 Japan		satox@nict.go.jp

Abstract

[This document describes intra-cluster model and antenna beam width effect for TGad channel modeling.]

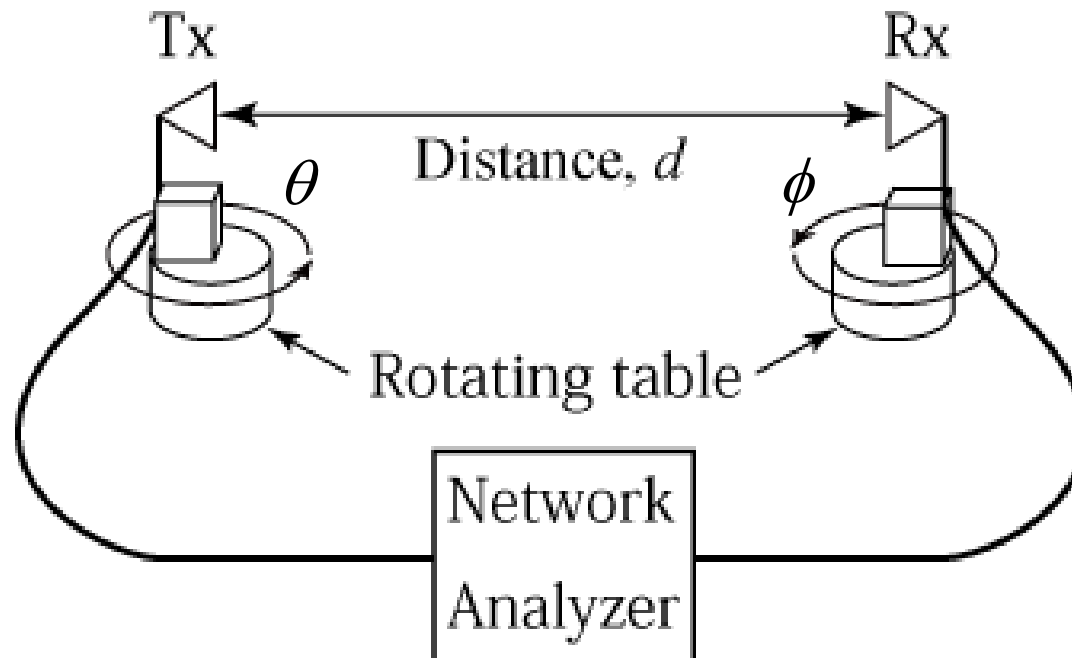
- 1. Proposal of intra-cluster response model**
- 2. Introduction of effect of antenna beam width for the intra cluster parameter**

Current status of channel models and this contribution

Environments		Inter cluster by simulation	Intra cluster by measurement	Dual polarization feasibility
Conference	Previous work	Done	Done	Done Conclusion?
	Team of NICT and Tohoku Univ.		Measurement: Done Modeling:	Done Linier pol.: STA-STA OK AP-STA ? Circular pol.: STA-STA OK AP-STA OK
Living	Previous work	Not yet	Not yet	Not yet
	Team of NICT and Tohoku Univ.		Measurement: Done Modeling:	Done Linier pol.: OK Circular pol.: OK
Cubicle	Previous work	Not yet	Not yet	Not yet
	Team of NICT and Tohoku Univ.		Measurement: Done Modeling:	Done Linier pol.: STA-STA OK AP-STA ? Circular pol.: STA-STA OK AP-STA OK

Measurement procedure and results in living room

Measurement system



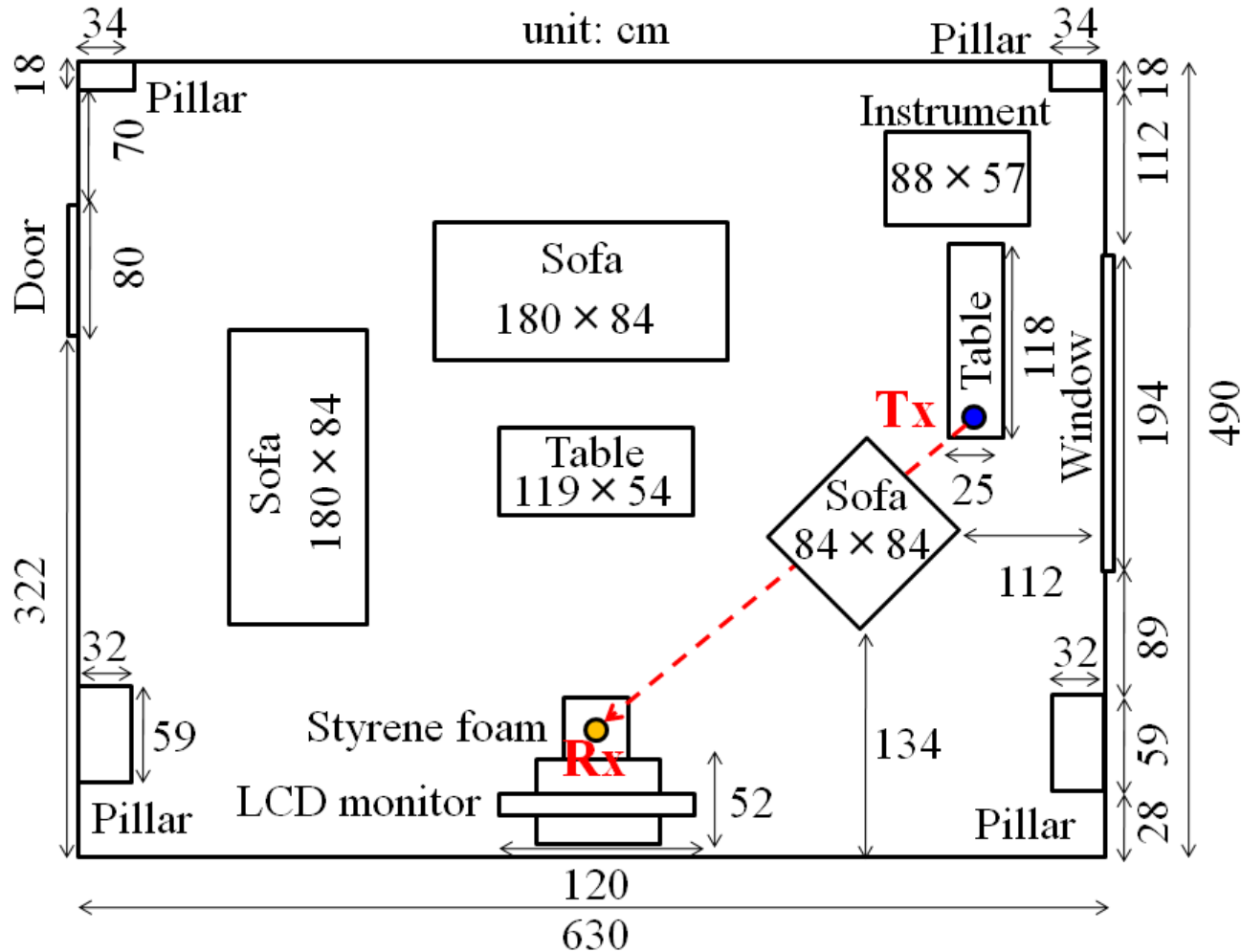
- Instrument: Vector network analyzer
- Antenna: Conical horn antenna

Measurement set up in living room

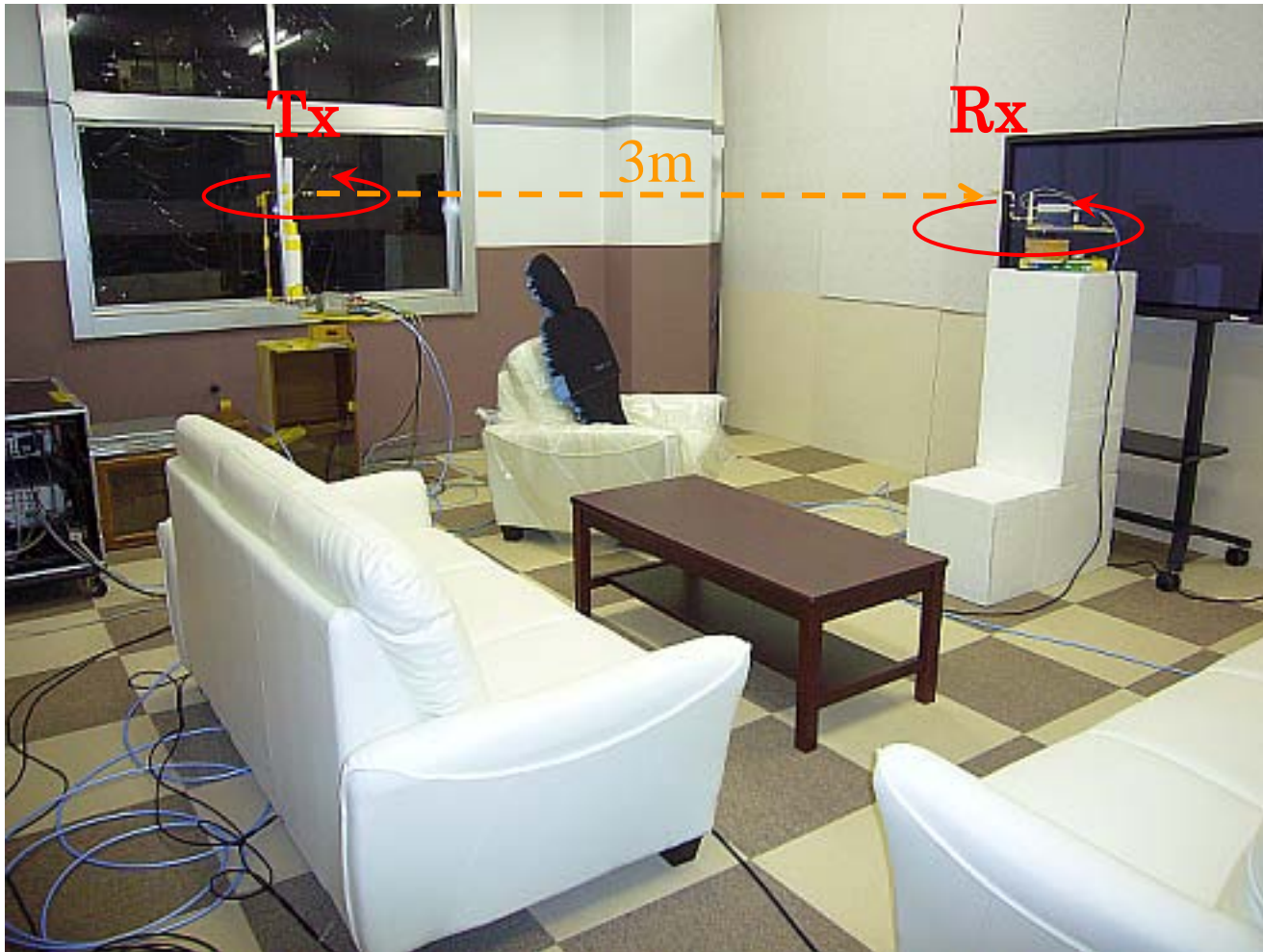
Parameter	Value
Center frequency	62.5 GHz
Band width	3 GHz
Number of frequency points	801
Frequency step	3.75 MHz
HPBW of antenna (Gain)	5, 15, 30, 90 degree
Polarization	Vertical
Calibration	Direct port connection without antennas

Floor plan of living room defined by TGad

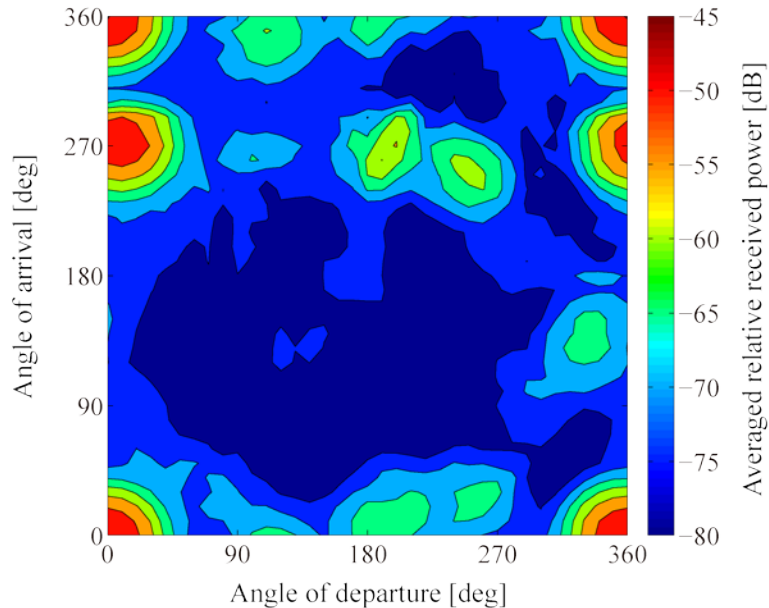
Antenna height:
 1.5m (LoS scenario)
 1.0 m (NLoS scenario)



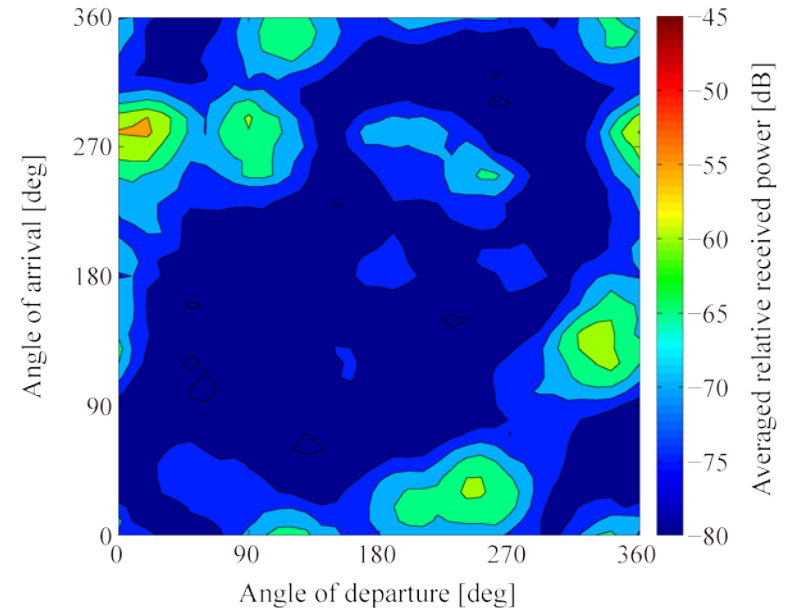
Communication link



Received power in LOS/NLoS scenario for co-pol. signal waves



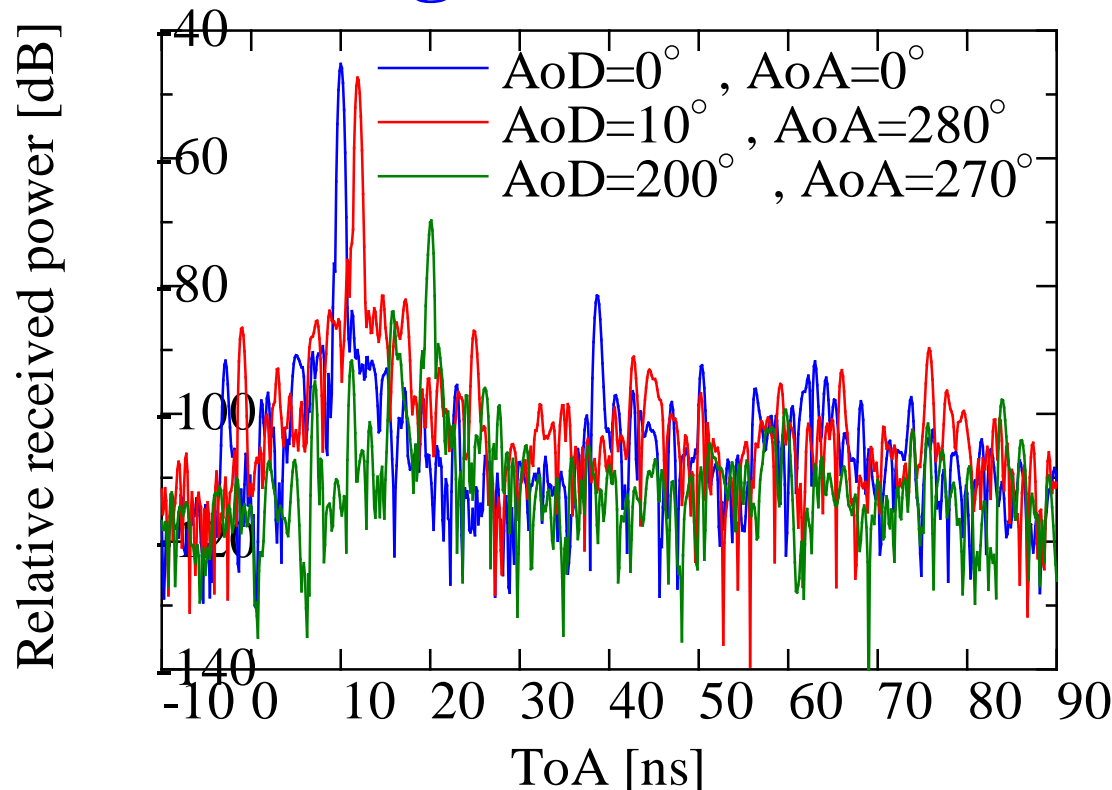
LOS scenario



NLOS scenario

- NLOS scenario: Attenuated LOS component by human absorber
- Strong reflection waves came from (AoD, AoA)=(10°, 280°), (200°, 270°)

Impulse response example of LOS scenario (V-V) in living room environment

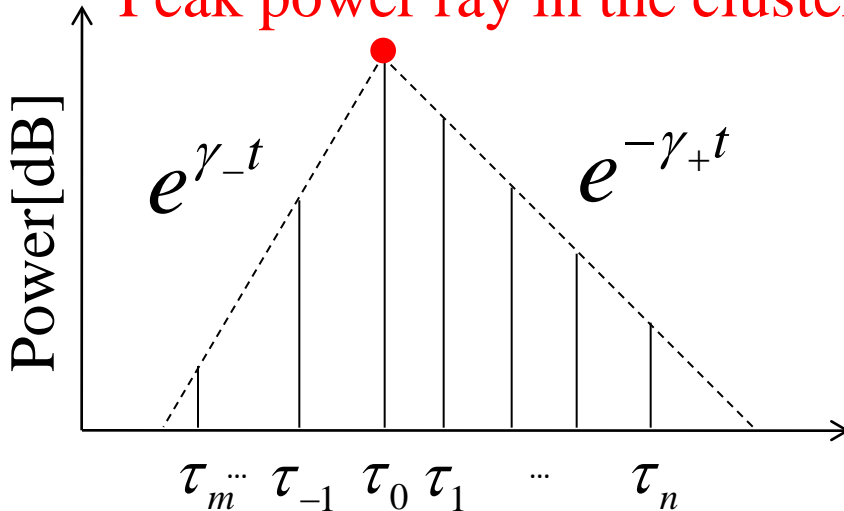


- Intra cluster parameters in each cluster can be extracted from measurement results

Proposed intra-cluster response model

- Two-side exponential decay model
- Decay parameter, γ_-, γ_+
- Arrival rate, λ is assumed as Poisson process
- Angle spread of ray, σ is Laplace distribution

Peak power ray in the cluster



Relative time of arrival [ns]

$$h(t) = \sum_m^n \beta_i(\tau_i)$$

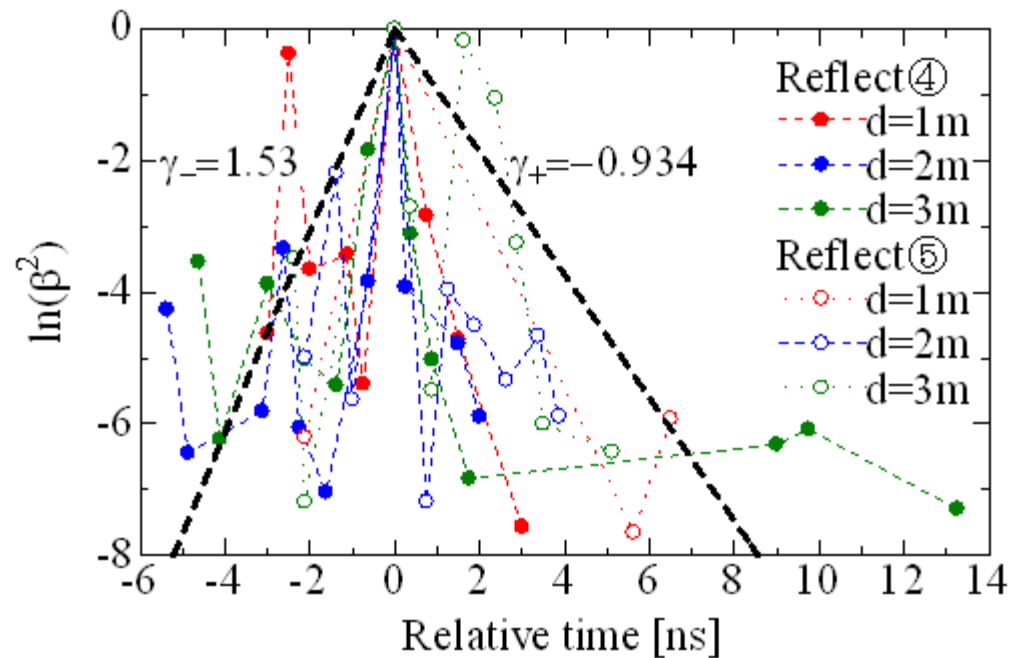
$$|\beta_i^2(\tau_i)| = \begin{cases} e^{\gamma_- t} & t < 0 \\ e^{-\gamma_+ t} & t \geq 0 \end{cases}$$

$$P(\tau_{k-1} | \tau_k) = \lambda e^{-\lambda(\tau_k - \tau_{k-1})}, k < 0$$

$$P(\tau_k | \tau_{k-1}) = \lambda e^{-\lambda(\tau_k - \tau_{k-1})}, k > 0$$

where k denotes the number of rays

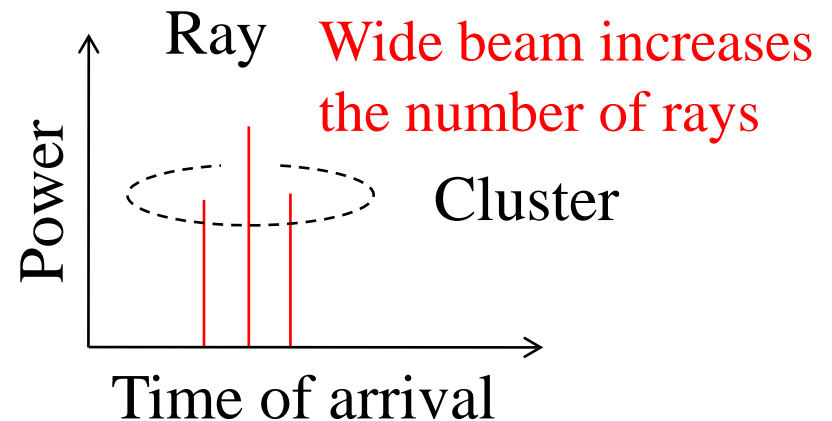
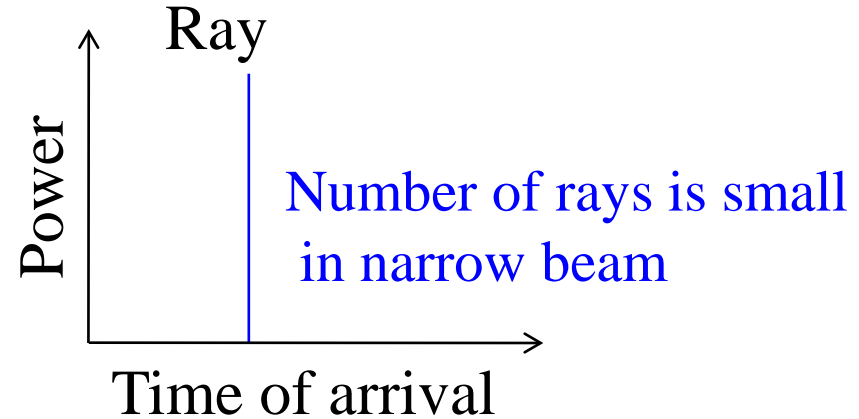
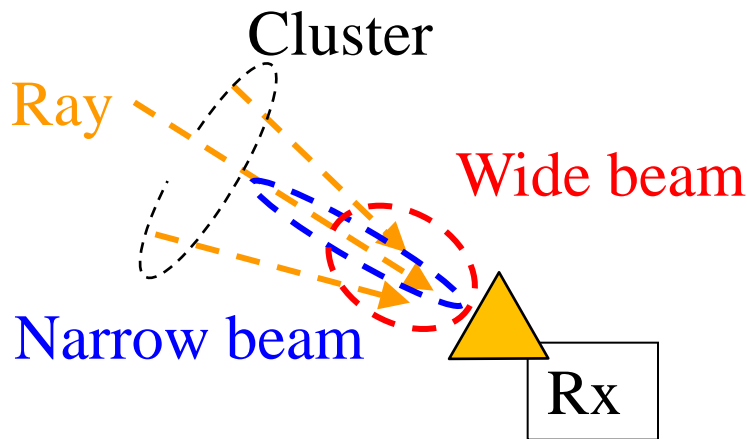
Example of decay parameter extraction



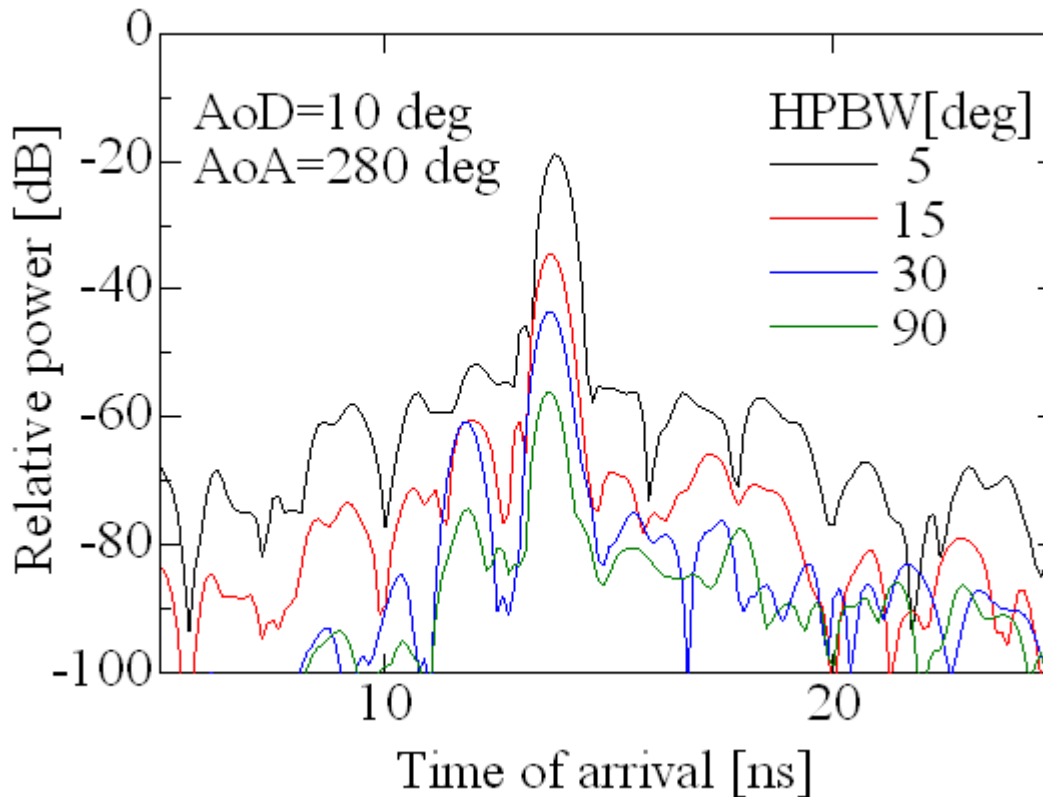
- Decay parameter was extracted by linear fitting

Effect of antenna beam width to intra-cluster parameter

- Number of ray in the cluster depends on antenna beam width



Example of cluster impulse response



In the figure, the antenna direction was fine tuned to peak power angle for narrow beam.

- Intra cluster response was changed by HPBW of the antenna
- Convolution with antenna pattern should be considered in a manner similar to TG3c channel model

Summary

- Measurement result for living room was shown using various beam width antenna
- Intra cluster model was proposed, and the parameter for all environments will be shown in Hawaii meeting
- Antenna beam width effect for the intra cluster parameter was explained. This effect will be included in channel model by convolution with antenna pattern