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**Source:** [H.Sawada<sup>1</sup>, Y.Shoji<sup>1</sup>, C.S.Choi<sup>1</sup>, K.Sato<sup>1</sup>, R.Funada<sup>1</sup>, H.Harada<sup>1</sup>, S.Kato<sup>1</sup>, M.Umehira<sup>1</sup>, I.Toyoda<sup>2</sup>, K.Kawasaki<sup>3</sup>, Y.Oishi<sup>4</sup>, K.Takahashi<sup>5</sup>]

Company [NICT<sup>1</sup>, NTT<sup>2</sup>, SONY<sup>3</sup>, FUJITSU<sup>4</sup>, Panasonic(Matsushita)<sup>5</sup>]

Address <sup>1</sup>[3-4 Hikari-no-oka, Yokosuka-shi, Kanagawa 239-0847, Japan] <sup>2</sup>[1-1 Hikari-no-oka, Yokosuka-shi, Kanagawa 239-0847, Japan] <sup>3</sup>[6-7-35 Kitashinagawa, Shinagawa-ku, Tokyo 141-0001, Japan] <sup>4</sup>[5-5 Hikari-no-Oka, Yokosuka-shi, Kanagawa 239-0847, Japan] <sup>5</sup>[4-12-4, Higashi-Shinagawa, Shinagawa-ku, Tokyo 140-8587, Japan]

Voice:[+81-46-847-5096<sup>1</sup>, +81-46-859-2366<sup>2</sup>, +81-3-5795-7879<sup>3</sup>, +81-46-839-5373<sup>4</sup>, +81-3-6710-2029<sup>5</sup>]

FAX: [+81-46-847-5440<sup>1</sup>, +81-46-855-1497<sup>2</sup>, +81-3-5795-7385<sup>3</sup>, +81-46-839-5560<sup>4</sup>, +81-3-6710-3915<sup>5</sup>]

E-Mail:[sawahiro@nict.go.jp<sup>1</sup>, toyoda.ichihiko@lab.ntt.co.jp<sup>2</sup>, Kenichi.Kawasaki@jp.sony.com<sup>3</sup>, yasu@labs.fujitsu.com<sup>4</sup>, takahashi.kazu@jp.panasonic.com<sup>5</sup>]

**Abstract:** [This contribution describes reference antenna models for each Usage Model Definition]

**Purpose:** [Contribution to mmW TG3c meeting.]

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# Reference antenna models proposal for each Usage Model Definition

H.Sawada, Y.Shoji, C.S.Choi, K.Sato,  
R.Funada, H.Harada, S.Kato, M.Umehira (NICT)  
I.Toyoda (NTT)  
K.Kawasaki (SONY)  
Y.Oishi (FUJITSU)  
K.Takahashi (Panasonic (Matsushita))

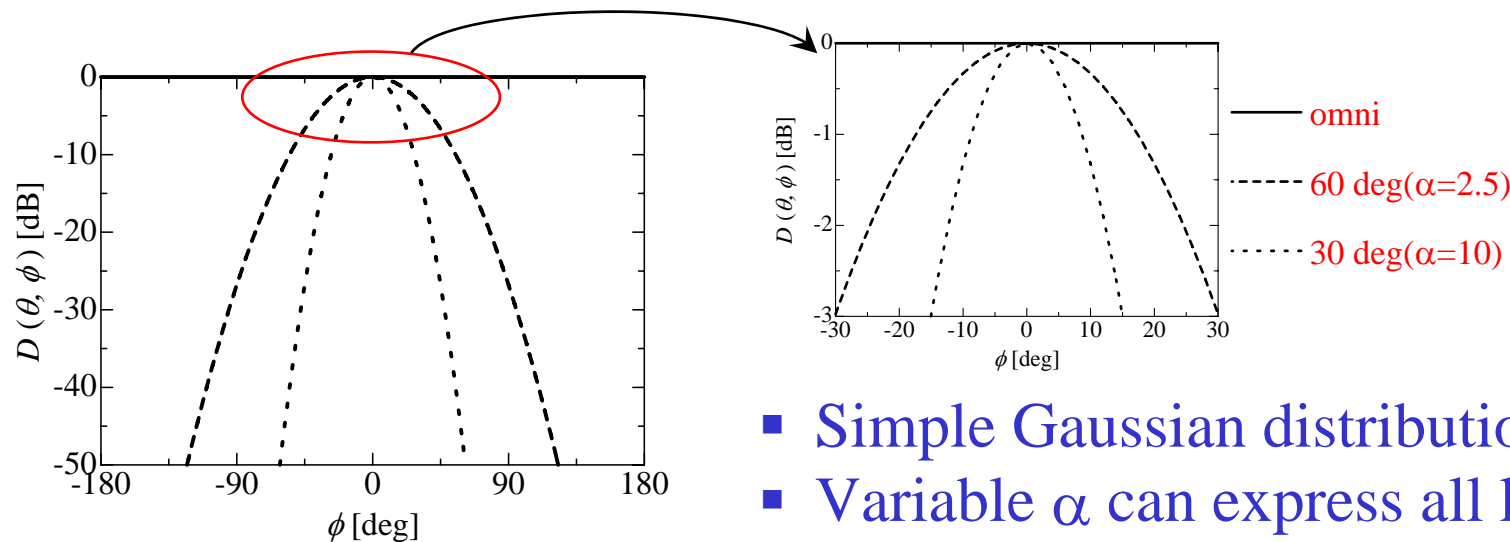
## Background

- TG3c called for reference antenna model to perform PHY/MAC simulation
- Reference antenna models are required for each usage model definition

## Basic reference antenna model

Antenna gain:  $G_r(\theta, \phi) = G D(\theta, \phi)$   $\theta$ : vertical angle [rad]  
 $\phi$ : horizontal angle [rad]

- Omni directional antenna:  $D(0, \phi) = 1$
- Directional antenna:  $D(0, \phi) = \exp(-\alpha \phi^2)$



- Simple Gaussian distribution
- Variable  $\alpha$  can express all kinds of beam-width

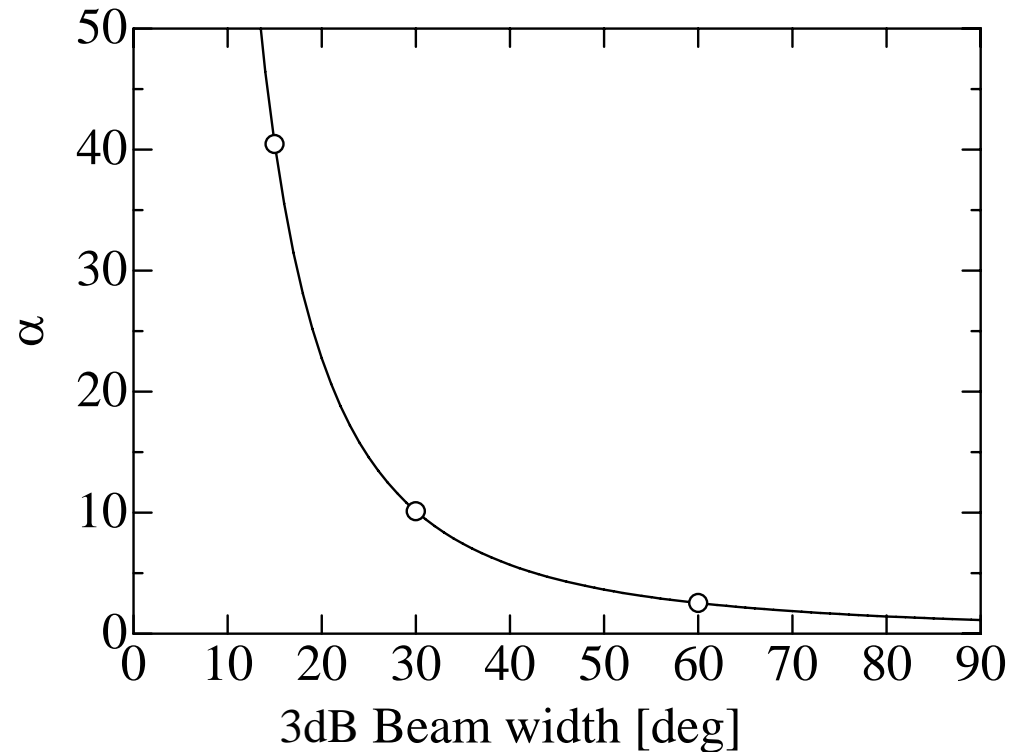
## Relationship between $\alpha$ and beam width

$$\exp(-\alpha (B/2)^2) = 0.5$$

↓

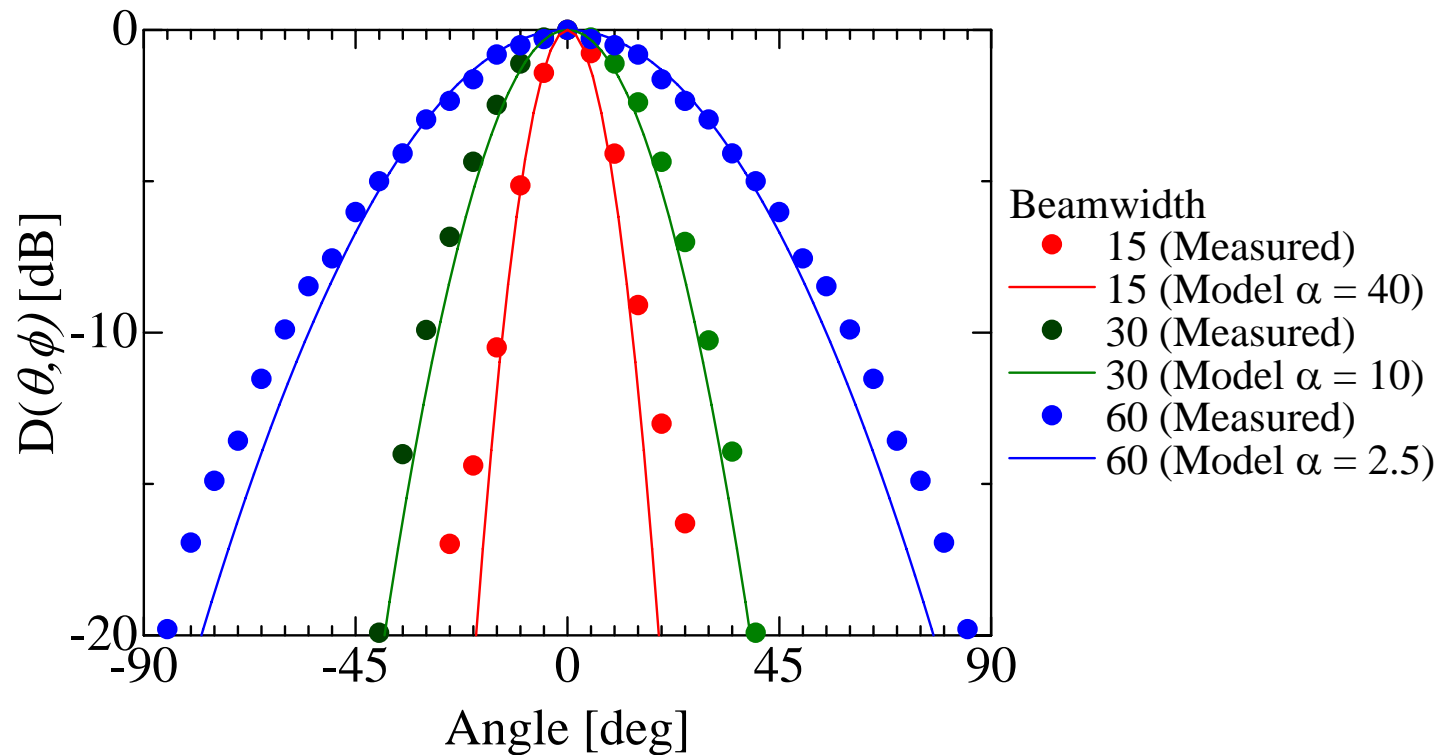
$$\alpha = \frac{4 \ln 2}{B^2}$$

$B$  : 3dB beam width [rad]



Parameter  $\alpha$  can be calculated by this equation

## Comparison of antenna patterns



Gaussian distribution is well matched to actual antenna pattern

## Proposed reference parameters for each UMD

|     | Devices         | Antenna beam-width factor ( $\alpha$ ) | Correspondent 3-dB beam-width [deg] | Maximum antenna gain [dBi] | Form factor [mm]※1 | Bandwidth [GHz]  |
|-----|-----------------|--|-------------------------------------|----------------------------|--------------------|------------------|
| UM1 | TV              | 40                                     | 15                                  | 22                         | 20 × 40            | 9<br>[57-66 GHz] |
|     | STB             | 40                                     | 15                                  | 22                         | 20 × 40            |                  |
| UM2 | TV              | 40                                     | 15                                  | 22                         | 20 × 40            |                  |
|     | STB             | 40                                     | 15                                  | 22                         | 20 × 40            |                  |
| UM3 | PC              | 2.5                                    | 60                                  | 10                         | 4 × 1              |                  |
|     | Peripheral      | 2.5                                    | 60                                  | 10                         | 4 × 1              |                  |
|     | TV              | 40                                     | 15                                  | 22                         | 20 × 40            |                  |
| UM4 | PC              | 2.5                                    | 60                                  | 10                         | 4 × 1              |                  |
|     | Wireless bridge | 2.5                                    | 60                                  | 10                         | 4 × 1              |                  |
|     | TV              | 40                                     | 15                                  | 22                         | 20 × 40            |                  |
| UM5 | Server(STB)     | 2.5                                    | 60                                  | 10                         | 4 × 1              |                  |
|     | PDA             | 10                                     | 30                                  | 16                         | 10 × 10            |                  |

※1: Conical horn antenna: Diameter × Length

## Policy used in selecting antenna parameters

- The reference antenna should be selected from the antennas used for channel measurement
- We assumed the same devices (TV, etc.) employ the same type of antenna over all usage models
- The antenna beam width should be practically reasonable



## Policy used in selecting antenna parameters (cont')

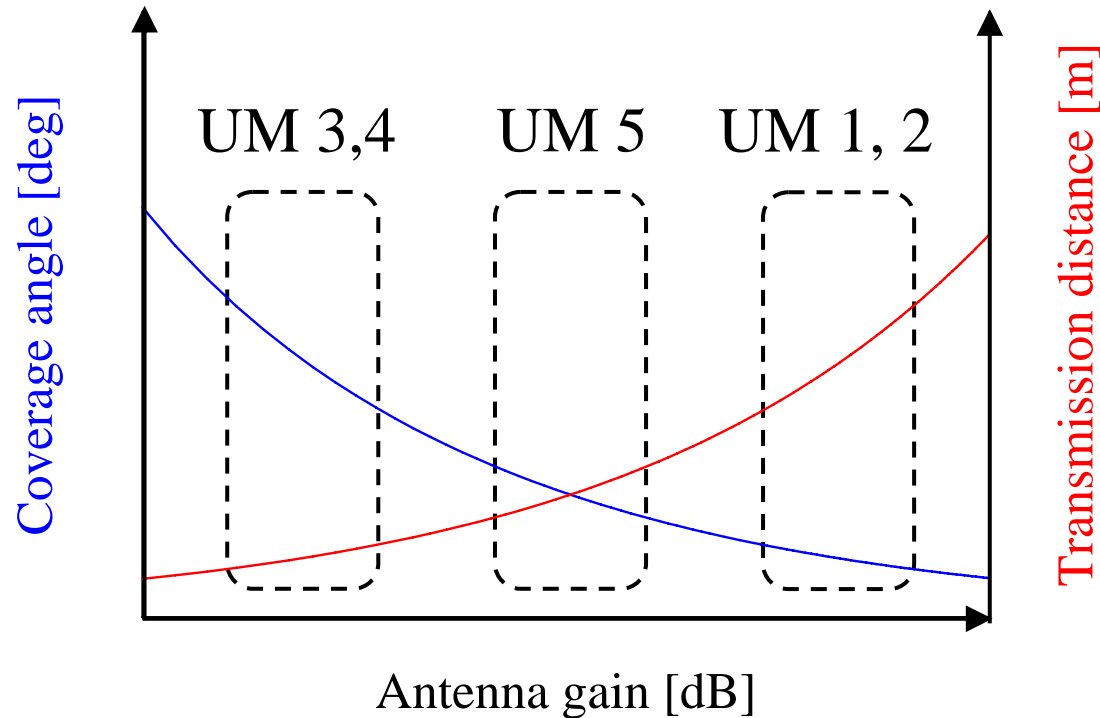


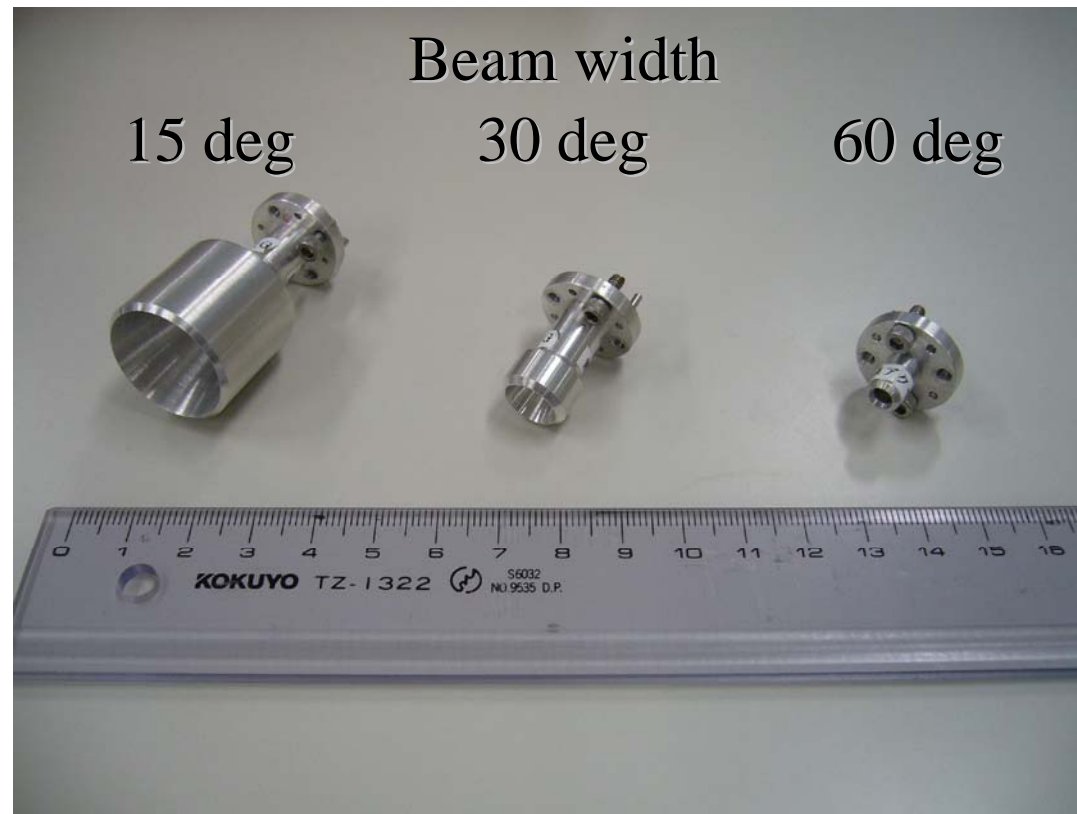
Fig. Coverage angle and transmission distance vs antenna gain

- UM 1,2 require long distance transmission
- UM 3,4 require wide coverage angle
- UM 5 requires moderate gain antenna to tolerate PDA jitter

## Summary

- Gaussian pattern was proposed as reference antenna model
- Reference antenna parameters for each UM were proposed

## Appendix: Conical horn antennas



These antennas were used in channel measurement