

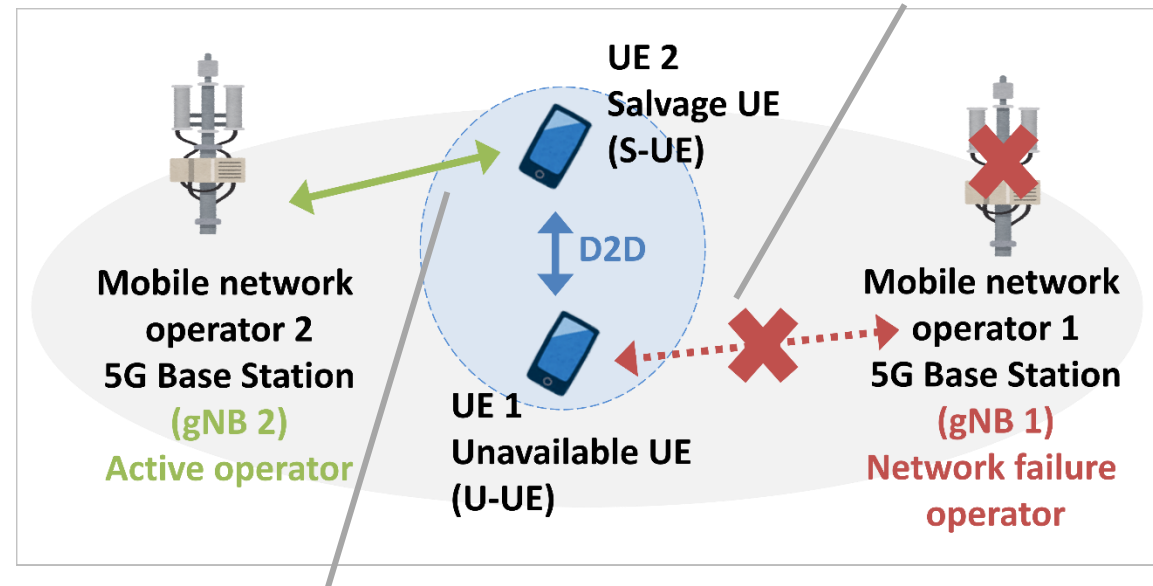
D2D Communications

OAM

IRS

Overview of Salvage Transmission Scheme

- Terminals that cannot communicate are called U-UE
- Terminals that are available and can be bailed out are called S-UEs.
- S-UE sets the upper limit of power consumption because the battery power is reduced by bailout communication.
 - Example: You can use up to 5%.
- Once the upper limit is reached, the S-UE will not participate in ST

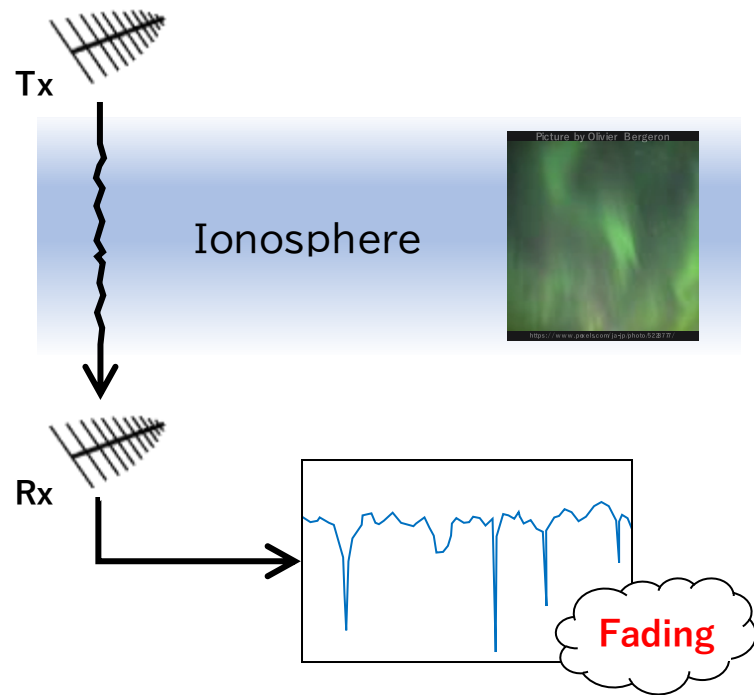


① UE 1 can not communication due to Operator malfunction (gNB1, operator 1)

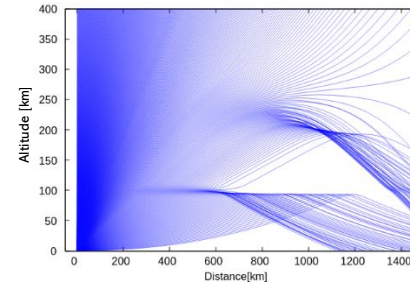
② Then UE 1 communicates with UE 2 using D2D. UE 2 sends and receives data of UE with the gNB2.

HF Communications

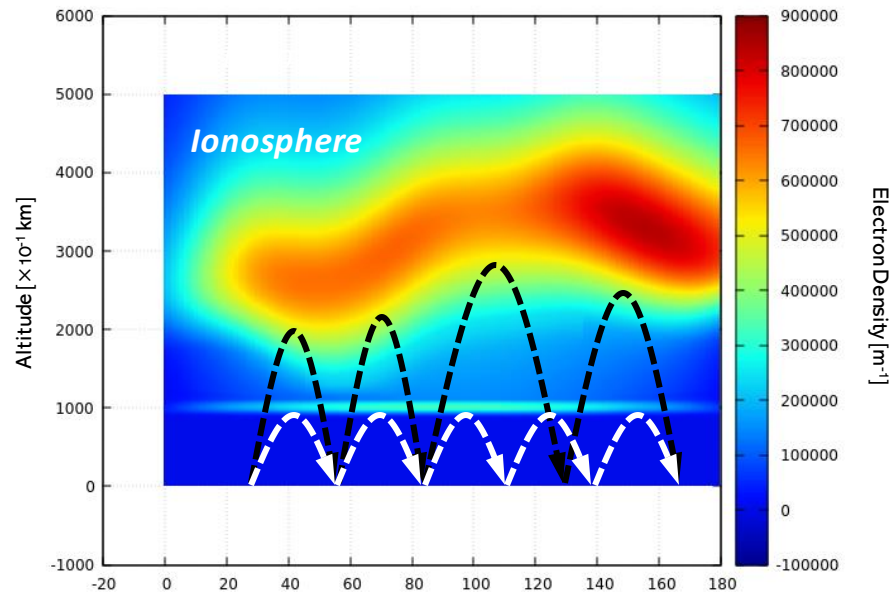
Background (1/2)



HF band long distance communication

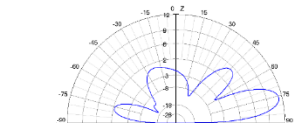
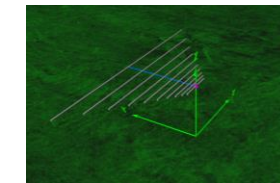
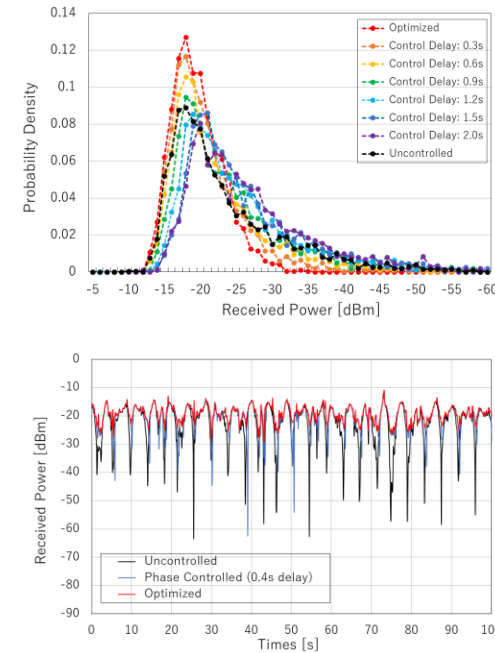
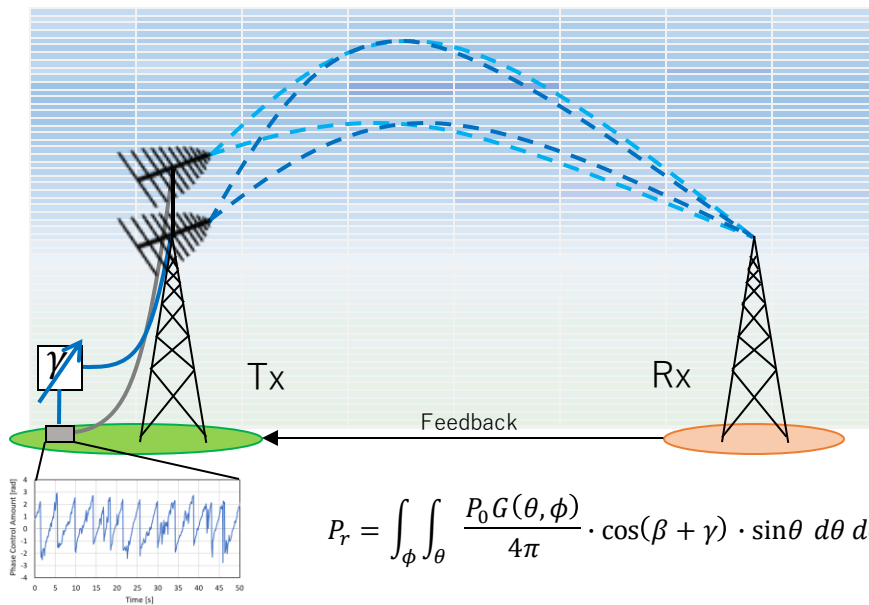


Ionospheric propagation
(Simulation result)

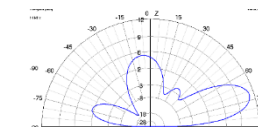


Phase Control Scheme to Reduce Ionospheric Fading (Previous research)

- Received power will be stabilized by dynamic phase control.
- The model is evaluated by ray-tracing simulation.



(a) Log-periodic antenna (14MHz, height: 20m)

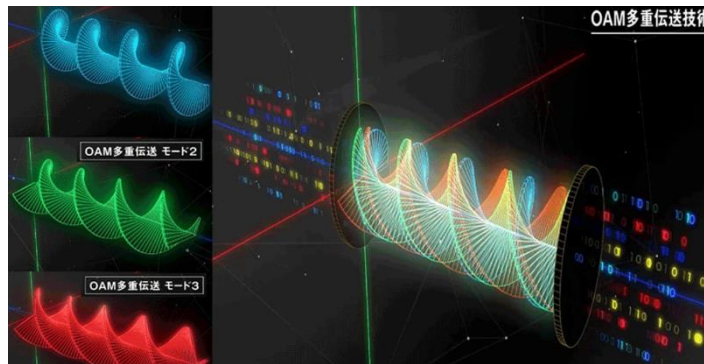


(b) Log-periodic antenna (14MHz, height: 15m)

IRS with OAM(Orbital Angular Momentum) Communications

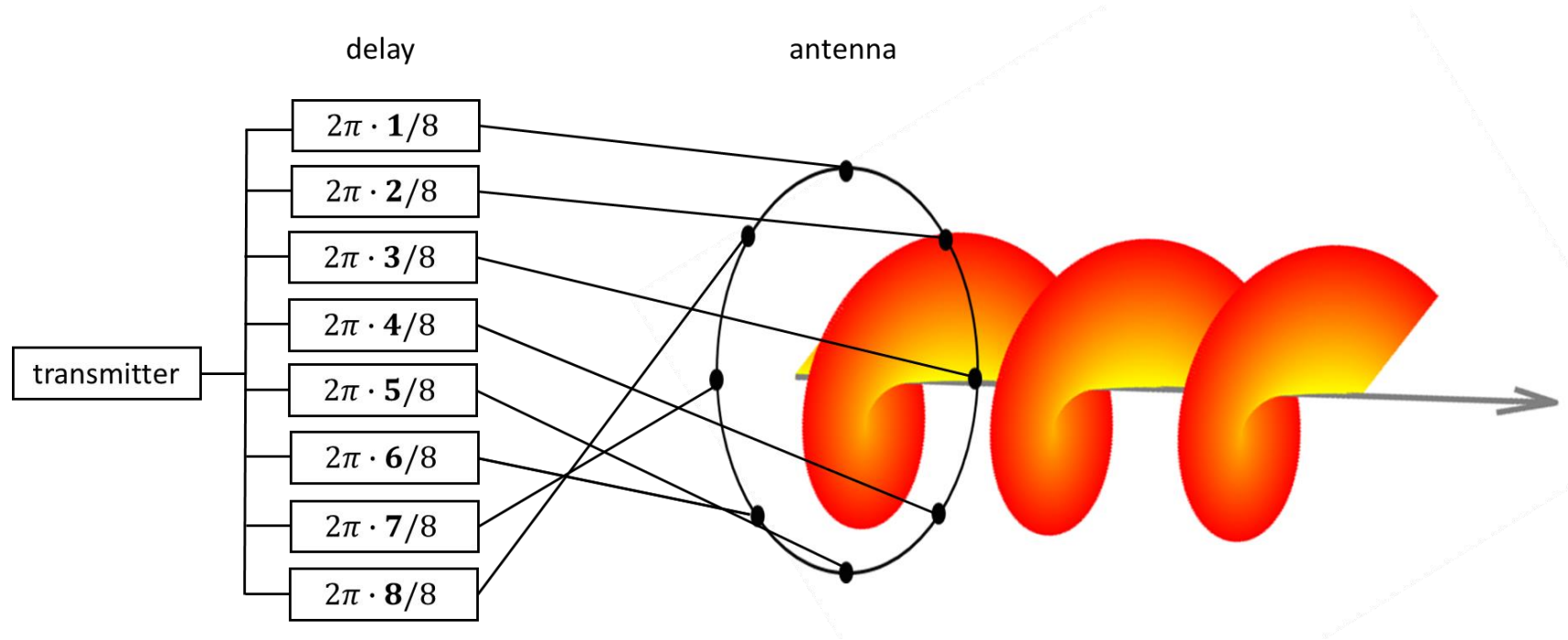
Orbital Angular Momentum(OAM)

- It is said that OAM will be used in beyond 5G, 6G
- Advantages
 - Big capacity: **119.45 Gbit/s** at a distance of 100m in the 40GHz band, referred to NTT
 - Multiplexing: OAM multiplexing of **15 streams** with a 1.5 GHz bandwidth, referred to NTT
- Drawback
 - Degrade severely due to antenna misalignment
 - Need larger radius antenna as communication distance increases



Source: NTT
(<https://www.ntt.co.jp/news2018/1805/180515a.html>)

Y. Yagi, H. Sasaki and D. Lee, "Prototyping of 40 GHz Band Orbital Angular Momentum Multiplexing System and Evaluation of Field Wireless Transmission Experiments," in IEEE Access, vol. 10, pp. 130040-130047, 2022, doi: 10.1109/ACCESS.2022.3228545.



Electric field of OAM: $\mathbf{E}_l = \mathbf{H}\mathbf{W}_l\mathbf{x}$

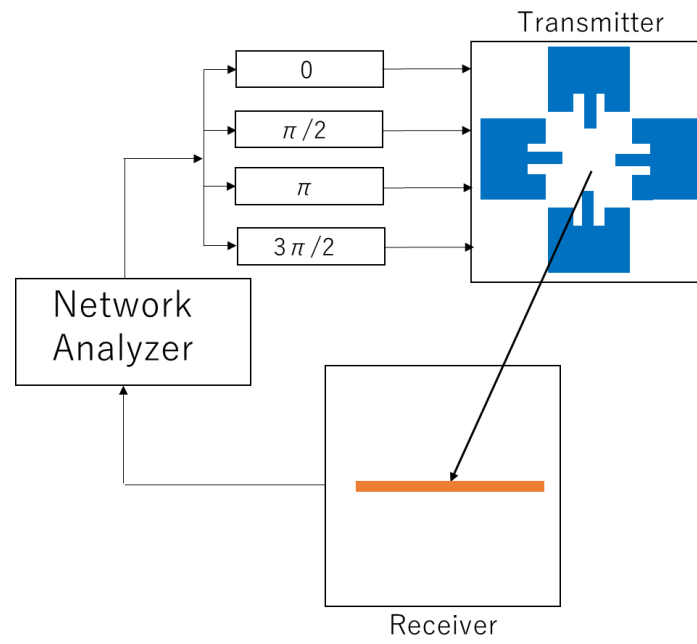
$$\mathbf{E}_l = \alpha \frac{\lambda}{4\pi\sqrt{N}} \sum_{n=1}^N \frac{e^{-jkd_n}}{d_n} e^{jl\frac{2\pi(n-1)}{N}}$$

H: Transfer function

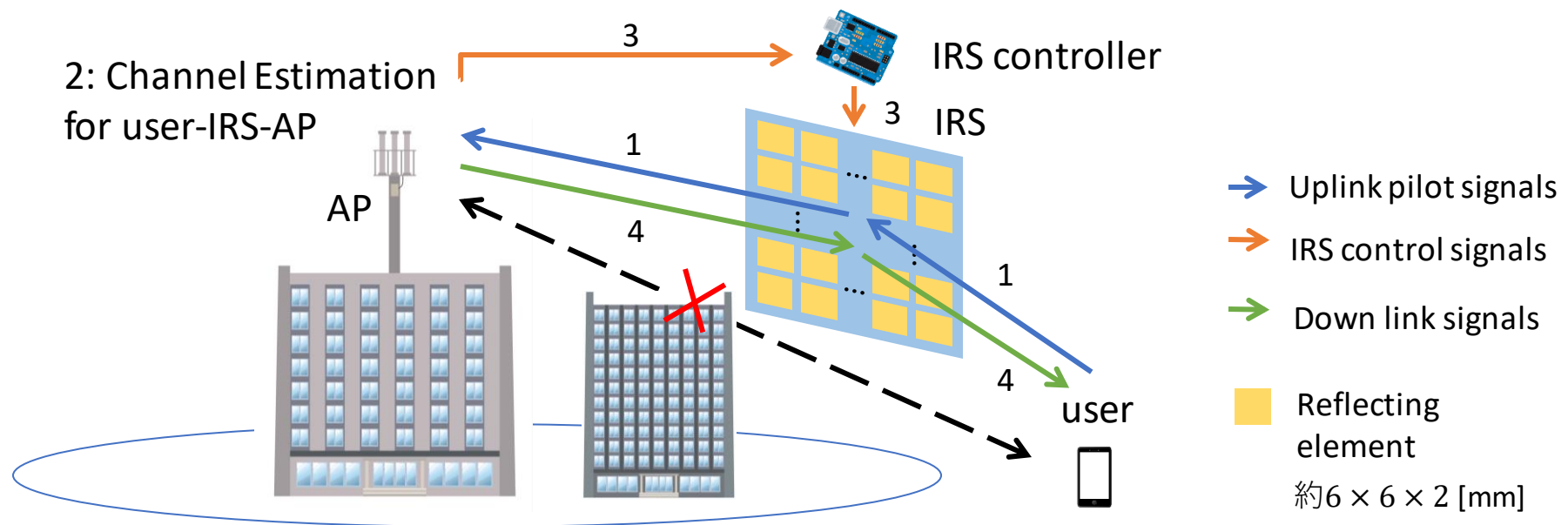
W_l: phase shift of mode l

OAM Overview Diagram

OAM experiments



Intelligent Reflecting Surface



光無線通信

Optical Mobile Communication

High Security Communication using Optical Wireless Communications

Objective

- Security Improvement
- Need both I and Q for demodulation

Application

- Government sectors
- Very Important Persons (VIPs)

Diagram

