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UEC Tokyo

Baseband Radio

for Ultimate Adaptive Communications

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Outline

- 1. What is the Baseband Radio?
 - Baseband Signal vs. Bandpass Signal
- 2. Frequency-Domain Packet Communications
- 3. Experiment on Baseband Radio
 - Adapting to Environmental Change
- 4. Future Topics







Baseband Radio

with **Software-Defined Radio**(*) and **Cognitive Radio**(**) functions

*) Kaleidoscopic change of configuration (reconfigurable)
**) Recognition of radio encironment (intelligent)





What is the Baseband Radio?













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from Low-IF OFDM Transmission to Baseband Radio Transmission

Low-IF OFDM (real signal in time domain)









Baseband Radio with Cognitive Radio Function









Creation of Transmission Signal

Frequency band to be used in this communication







A transmission Scheme Suitable for Baseband Radio: Frequency-Domain Packet Communication









A transmission Scheme Suitable for Baseband Radio: Frequency-Domain Packet Communication





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Experimental Validation of Adaptive Baseband Radio







Wired Connection (for System Check)



Frequency-domain packet communication is successfully demonstrated.

[16QAM received: SNR>30dB]

















Broadband Antenna used for the experiment





(back)









Results of the Experiment in the Anechoic Chamber









Experiment in our reverberation chamber (multipath-rich environment)



Inner view



Size: 4(m) x 2(m) x 2(m) Amplitude: Rayleigh distribution Delay spread: 90ns (controlled using radio absorbing sheets)





Results of the Experiment in the Reverberation Chamber (1)

Part 1: Without adaptation Tx power level : Fixed (without TPC) Subband allocation: Random







Results of the Experiment in the Reverberation Chamber (2)

Part 2: After adaptation

Tx power level : Controlled based on CSI Subband allocation: Optimally selected









Merits (\bigcirc) and Demerits (\bigcirc) of BR

- Extremely Adaptive for Environmental Change (Frequency-domain packet communication)
- Almost all digital signal processing matching with future SDR and CR
- Requirement of ultra high speed DAC, ADC and DSP
 (→Future technologies will overcome this requirement.)
- Non-linear problem for strong interference signal incidence
 (→One countermeasure is given in the next slide.)

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BR receiver is waiting for incoming signals with broadband range.

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Non-linear problem of front-end receiver for strong interference signal incidence









Operation Image of Countermeasure for Strong Interference Incidence



 Reduction of interference power by adaptive notch filter
 Relocation of wanted signal to other frequency to avoid the effect of the notch filter







An Example of Interference reduction using adaptive filter and data relocation









The Three Radios











Thank you very much for your kind attention.

The contents in this presentation are given in

1) Y. Karasawa, et al., "A proposal and experimental evaluation of adaptive baseband radio," IEICE Trans. Communs. (Japanese Ed.), vol. J91-B, no. 11, pp. 1359-1368, 2008.

2) Y. Morimoto, et al., "Experimental validation of adaptive radio,"

IEICE Trans. Electronics (Japanese Ed.), (accepted).