Project: IEEE P802.15 Working Group for Wireless Personal Area Networks (WPANs)

Submission Title: NICT-YNU-Meiji UWB Phy Proposal: Some aspects of Chirp Pulse Based IR-UWB Physical Layer
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Abstract: Some aspects of Chirp Pulse Based IR-UWB Physical Layer

Purpose: Response to "TG6 Call for Proposals" (IEEE P802.15-08-0811-02-0006)

NICT-YNU-Meiji UWB Phy Proposal: Some aspects of Chirp Pulse Based IR-UWB Physical Layer

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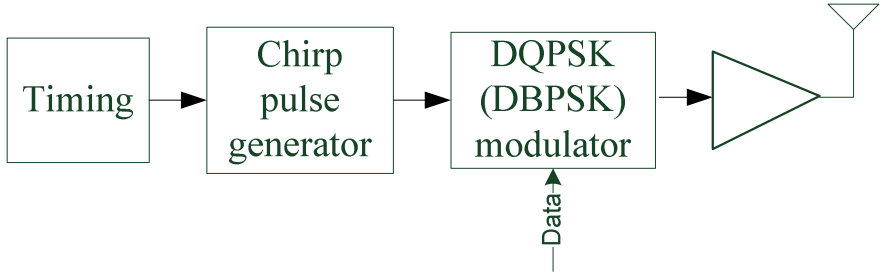
Goal

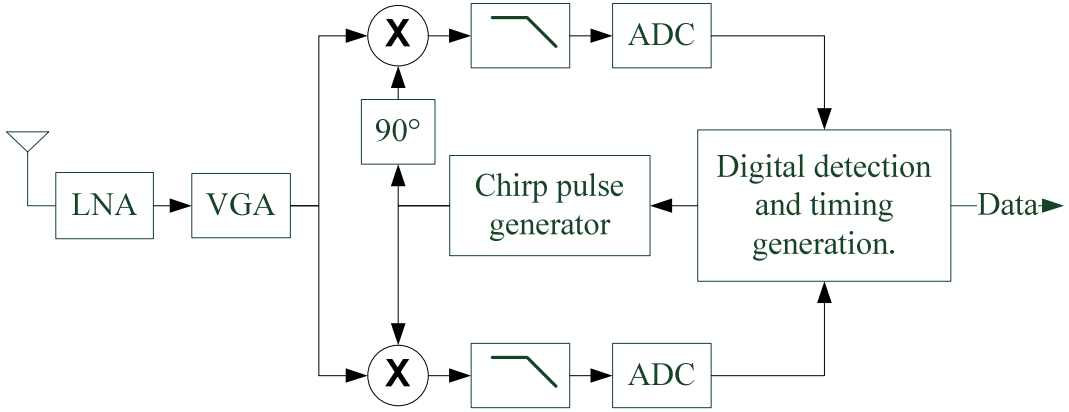
- To clarify principles of Chirp IR-UWB.
- To show performance and requirements diagrams not shown before.

System block diagram

- Tx:

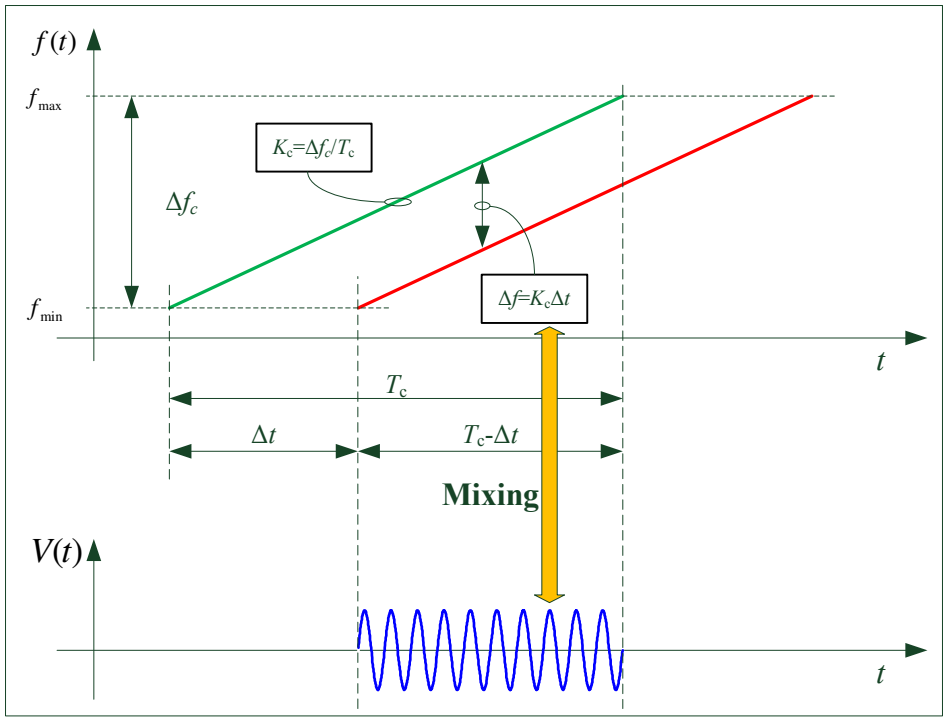


- Rx:



Why is linear chirp pulse signal like no other?

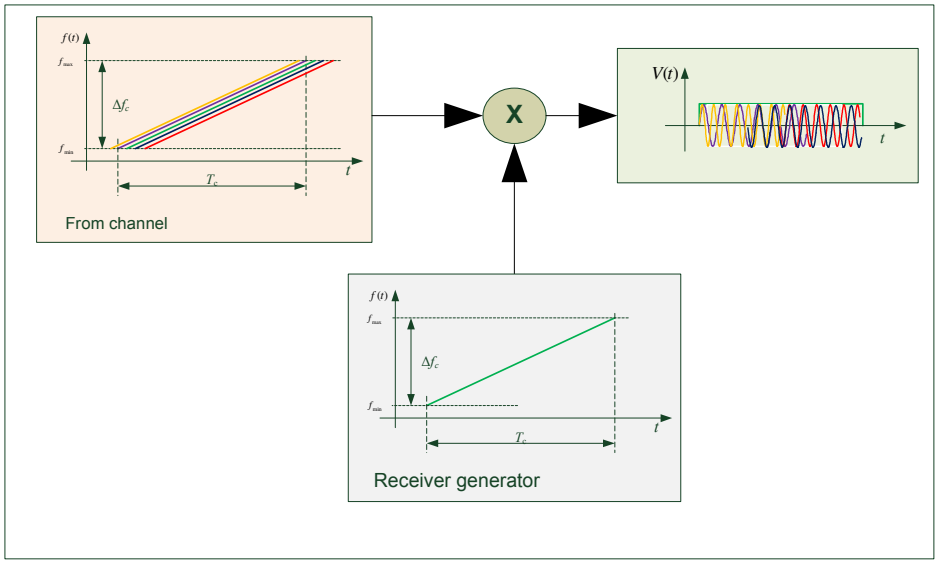
Mixing two linear chirp pulses:

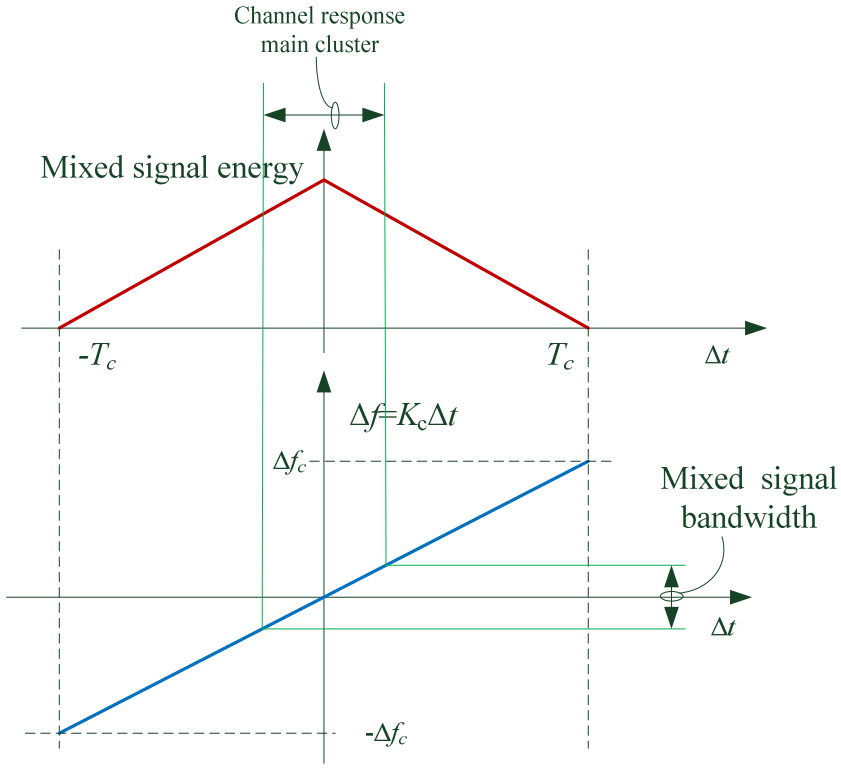


- **It de-spreads the chirp in frequency without de-spreading it in time.**
- Timing does not need to be matched too well in order to preserve most of the received signal energy after mixing and low-pass filtering.

Why is linear chirp pulse signal like no other? (cont.)

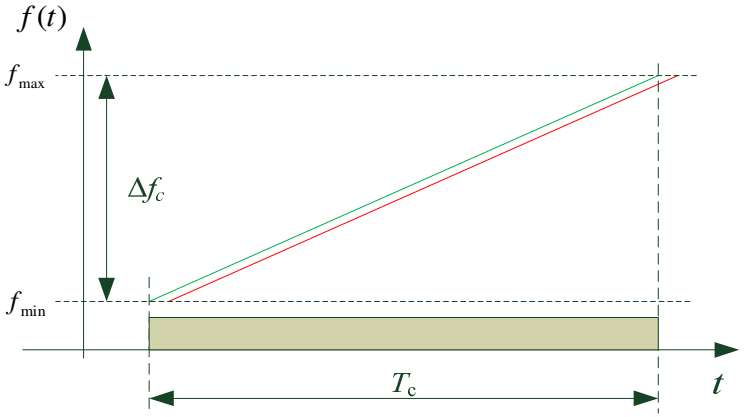
Effects on multipath:

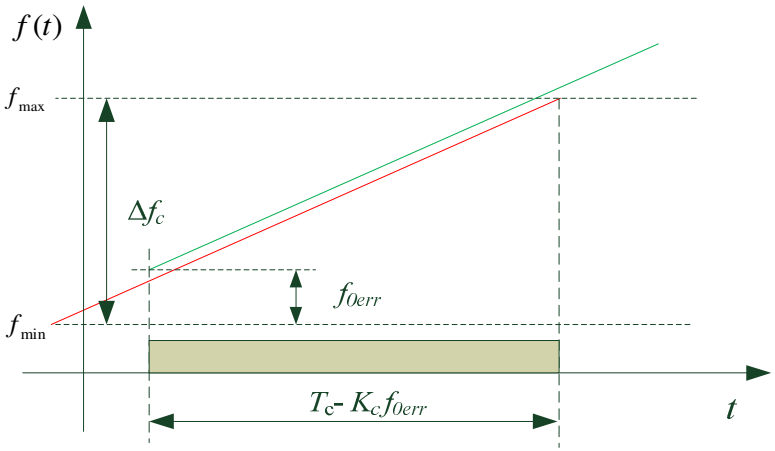




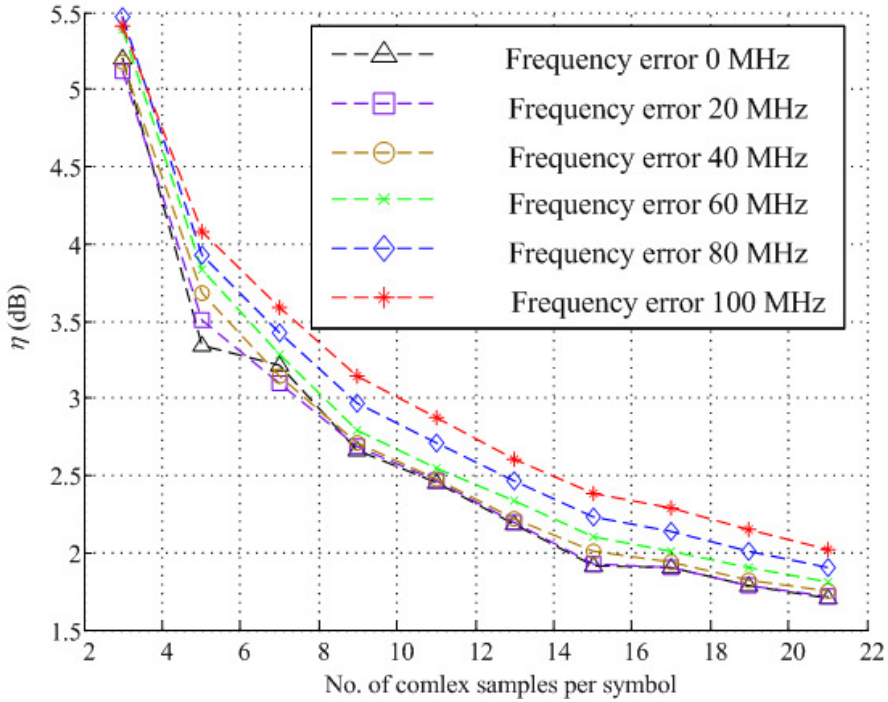
With proper choice of chirp parameters, for a given channel and optimum timing, energy of the multipath signal will be mostly preserved after mixing and concentrated in low frequencies where it ca be conveniently sampled.

Chirp pulse generation non-idealities robustness rationale

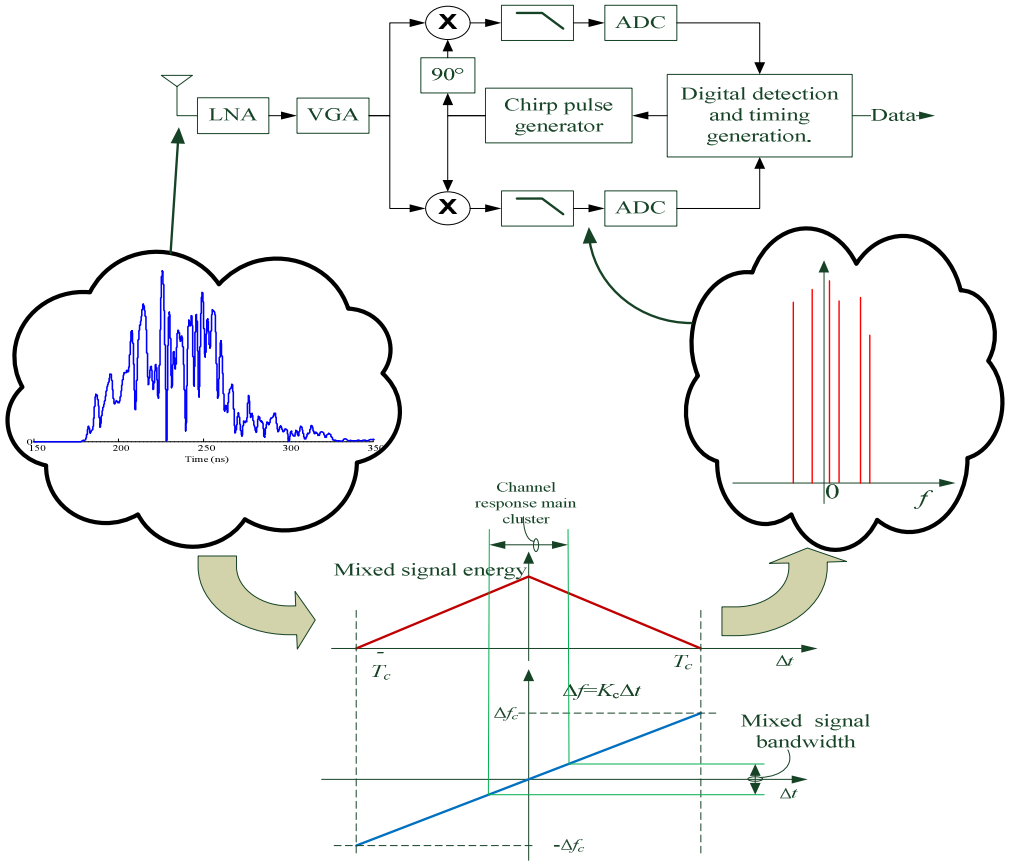




- There is no need to have very good match in carrier frequency in order to achieve phase coherence.



MUI and ISI resistance of the system rationale



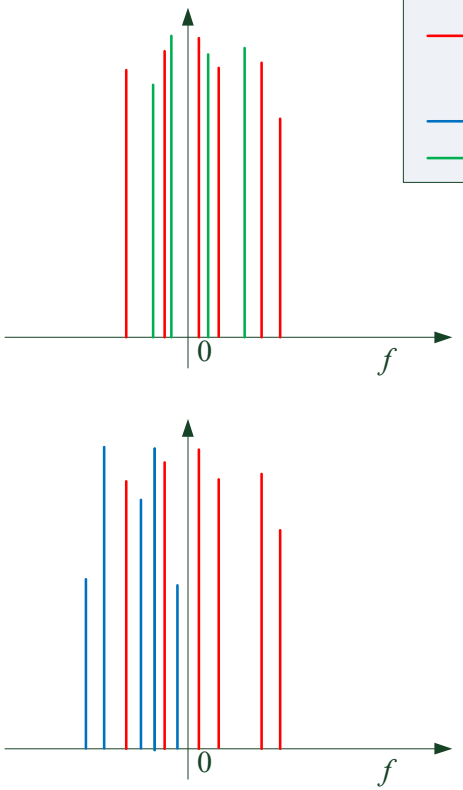
MUI and ISI resistance of the system rationale (cont'd.)

Useful signal

(Self) Interference

Current symbol:

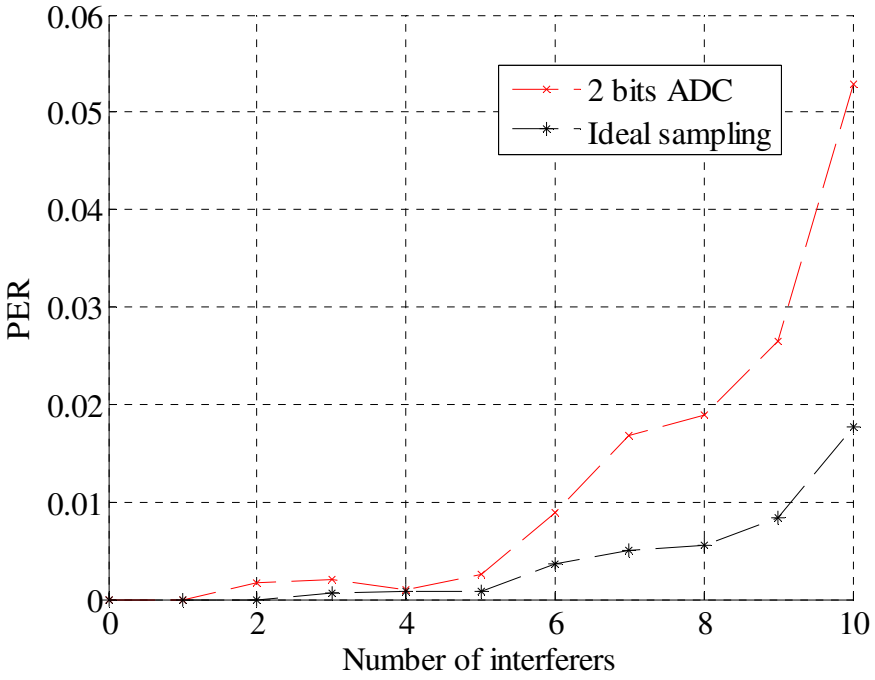
Previous symbol:



Spectra of signals after mixing and LPF

After correlation, only power of useful signal is high

Multiple User Interference (MUI) resistance of the system

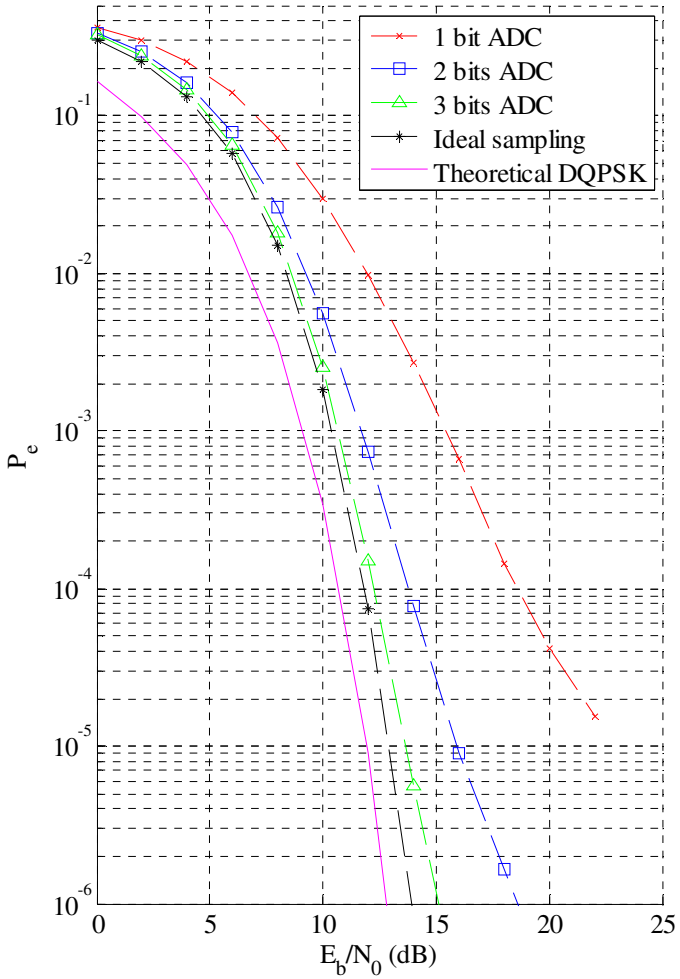


0.98 Mbps uncoded DDBPSK.

Interferers are located on the same IEEE 802.15.4a frequency channel. All interferers have equal power at the receiver to the one of user of interest.

DDBPSK without coding still meets criteria of 10 co-located piconets on the same channel + there is FDMA to increase capacity even more.

Inter Symbol Interference (ISI) resistance of the system



- 5.1 Msps (10.2 Mbps) DDQPSK at IEEE 802.15.6 CM4
- Time hopping is used with $T_{sym}/2$ guard interval.
- ISI slightly reduces effective number of bits.

Oscillator phase noise requirements of the system