CLOSE RANGE IMPULSE RADIO BEAMFORMING
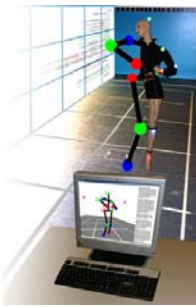
by Øyvind Dahl

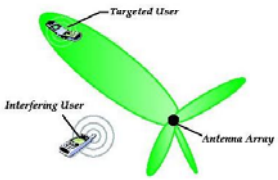
Beamforming

2

☐ Why is it useful?

Accurate position localization

EM imaging

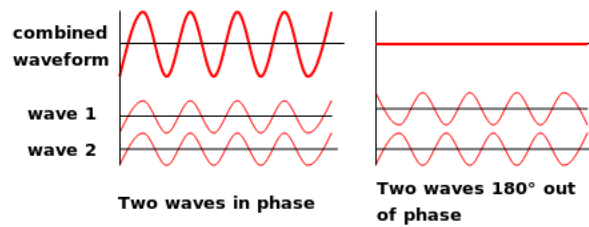Targeted transmission

Beamforming

3

- □ What is it?

Beamforming is a signal processing technique used for directional transmission or reception of signals
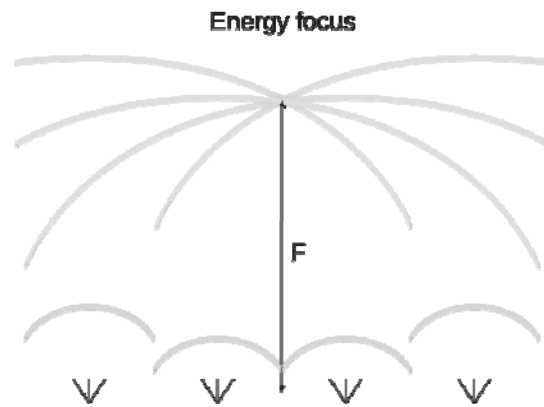
Beamforming

4

- □ How is it achieved?

combined
waveform

wave 1

wave 2

Two waves in phase

Two waves 180° out of phase

Beamforming

5

☐ Focal point beamforming

Energy focus

F

A beamformer prototype

6

Control unit

Programmable delay   Pulse generators   Antennas
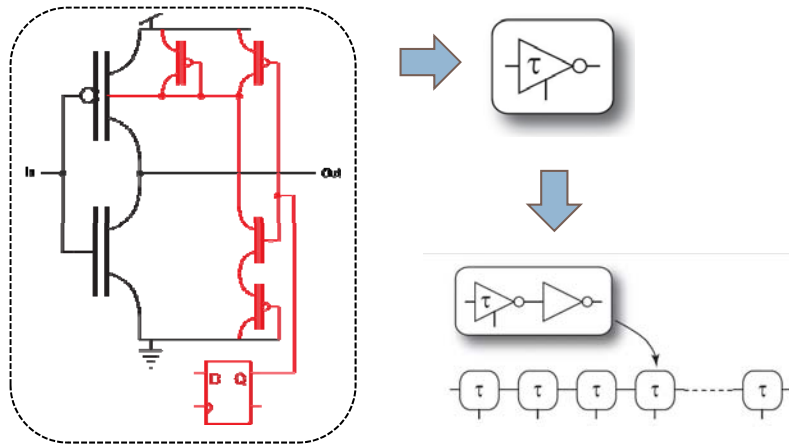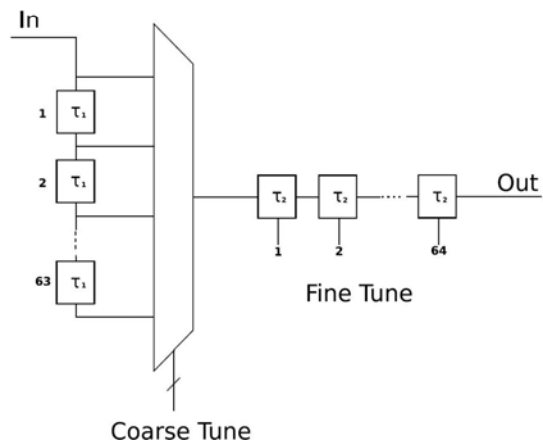
A beamformer prototype

7

□ Programmable delay

  ▫ 1 ps resolution

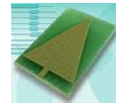
A beamformer prototype

8

□ Programmable delay

A beamformer prototype

Pulse generator design from Novelda AS
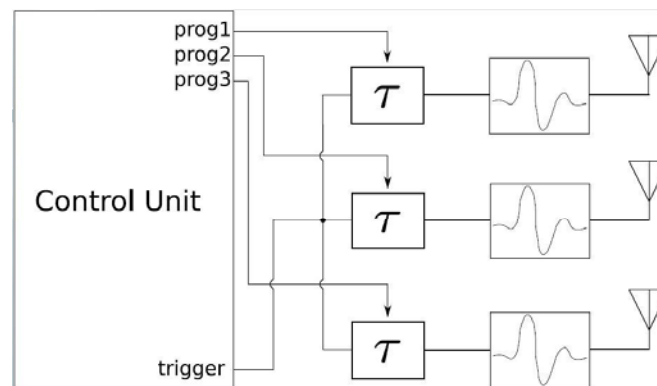
Crude antennas made in a milling machine

Serial Peripheral Interface Bus design from Håkon A. Hjortland

A beamformer prototype

☐ **Beamforming system**

A beamformer prototype
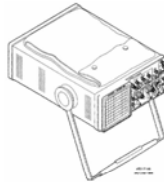
11

☐ **Prototype specifications**

- •2.2 ns programmable delay-lines
- •Resolution 1 ps
- •8 transmitters
- •USB connection

Prototype performance

12

☐ **Delay-line performance**

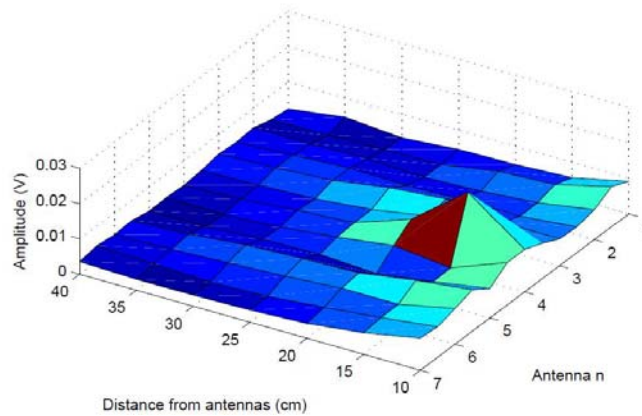Oscilloscope resolution: 3 ps

✚

Delay-line resolution: ~1 ps

Results based on averaging

Measured resolution for the delay-lines: 1.3 ps

Prototype performance

- Focal point beamforming performance

Summary

- Beamforming can

Reduce power consumption
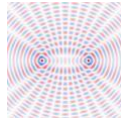

Enable EM cameras
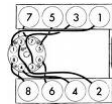

Increase position localization accuracy

Summary

15

- Beamforming is

The result of interference

Achieved by controlling the firing sequence of several transmitters