

WCNC 2002

UWB Radio: Present Challenges, Future Research

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FCC Decision 2/14/02

THURSDAY, FEBRUARY 14, 2002 C3

FCC Expected to Deal Blow to Ultra-Wideband

Telecom: Faster wireless may face constraints. Some worry the technology could cause airwave interference.

By JUBE SHIVER Jr.
TIMES STAFF WRITER

WASHINGTON—In a setback to computer and consumer product makers, federal regulators today are expected to tightly constrain a breakthrough wireless technology that backers had hoped would usher in a new era of wireless networking and tracking.

Proponents had boasted that the

TimeDomain Corp., a Huntsville, Ala., company that has been developing the technology.

In addition, the FCC staff is expected to oppose most commercial and consumer applications of ultra-wideband tracking technology out of fear it might fall into the wrong hands.

"We think a conservative approach is appropriate at the outset," a top administration official said. "We can make adjustments later."

Although military and public safety personnel will be able to use ultra-wideband's radar capabilities to see through walls and other obstructions, the FCC staff wants to limit commercial applications to

FCC Approves New Wireless System

Federal regulators approved the use of a new wireless technology that could help rescue workers find people buried in rubble or locate stresses in the side of a bridge, overcoming fears it would interfere with important navigation aids.

The Federal Communications Commission voted unanimously to approve limited use of ultra-wideband technology for handheld wireless communications, ground-penetrating radar and vehicle collision avoidance systems.

The FCC approved the marketing and operation of products using UWB technology but limited it to the range above the 3.1-gigahertz frequency and, in some cases, restricted use to law enforcement, scientific researchers and certain industries such as construction.

Reuters

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Head-to-Head Comparisons

UWB vs. NB?

Sanity Check: Comparative Communication Link Budgets (1)

Power: same

Data Rate: same

Frequency: NB carrier at UWB center frequency

Antenna pattern: dipole

Antenna losses: same

Propagation: free space

External interference: none

Reception: Matched filter/correlator in both

Receiver noise temperature: same

Modulation: same binary antipodal



Approximately equal bit error rates

UWB advantage in range/time resolution

Sanity Check: Comparative Communication Link Budgets (2)

Power: same

Data Rate: optimized

Frequency: NB carrier at UWB center frequency

Antenna pattern: dipole

Antenna losses: same

Propagation: free space

External interference: none

Reception: Matched filter/correlator in both

Receiver noise temperature: same

Modulation: optimized



UWB advantage: Higher data rate and/or
lower bit error rate

UWB advantage : Range/Time resolution

Sanity Check: Comparative Communication Link Budgets (3)

Power: same

Data Rate: same

Frequency: NB carrier at UWB center frequency

Antenna pattern: dipole

Antenna losses: same

Propagation: free space

External interference: other CDMA users

Receiver: Matched filter/correlator in both

Receiver noise temperature: same

Modulation: optimized CDMA



UWB advantage in number of users

UWB advantage in Range/Time resolution

Sanity Check: Comparative Communication Link Budgets (4)

Power: FCC regulation ↓ Ad NB

Data Rate: same

Frequency: NB carrier at UWB center frequency

Antenna pattern: dipole

Antenna losses: mismatch problems ↓ Ad NB

Propagation: terrestrial indoor

Fading Margin ↓ Ad UWB

Receiver Mismatch ↓ Ad NB

External interference: other radio systems ↓ Ad NB (?)

Interference mitigation: SS processing gain ↓ Ad UWB

Receiver noise temperature: same

Modulation: optimized spread spectrum



UWB advantage in Range/Time resolution

What are the UWB advantages?

More bandwidth for a given center frequency

that can be used for some of the following:

- natural frequency diversity for multipath mitigation
- interference mitigation via spread-spectrum techniques
- improved imaging/ranging accuracy
- more users and/or higher data rates

What are the UWB advantages?

A lower center frequency for a given bandwidth
that can be used for:

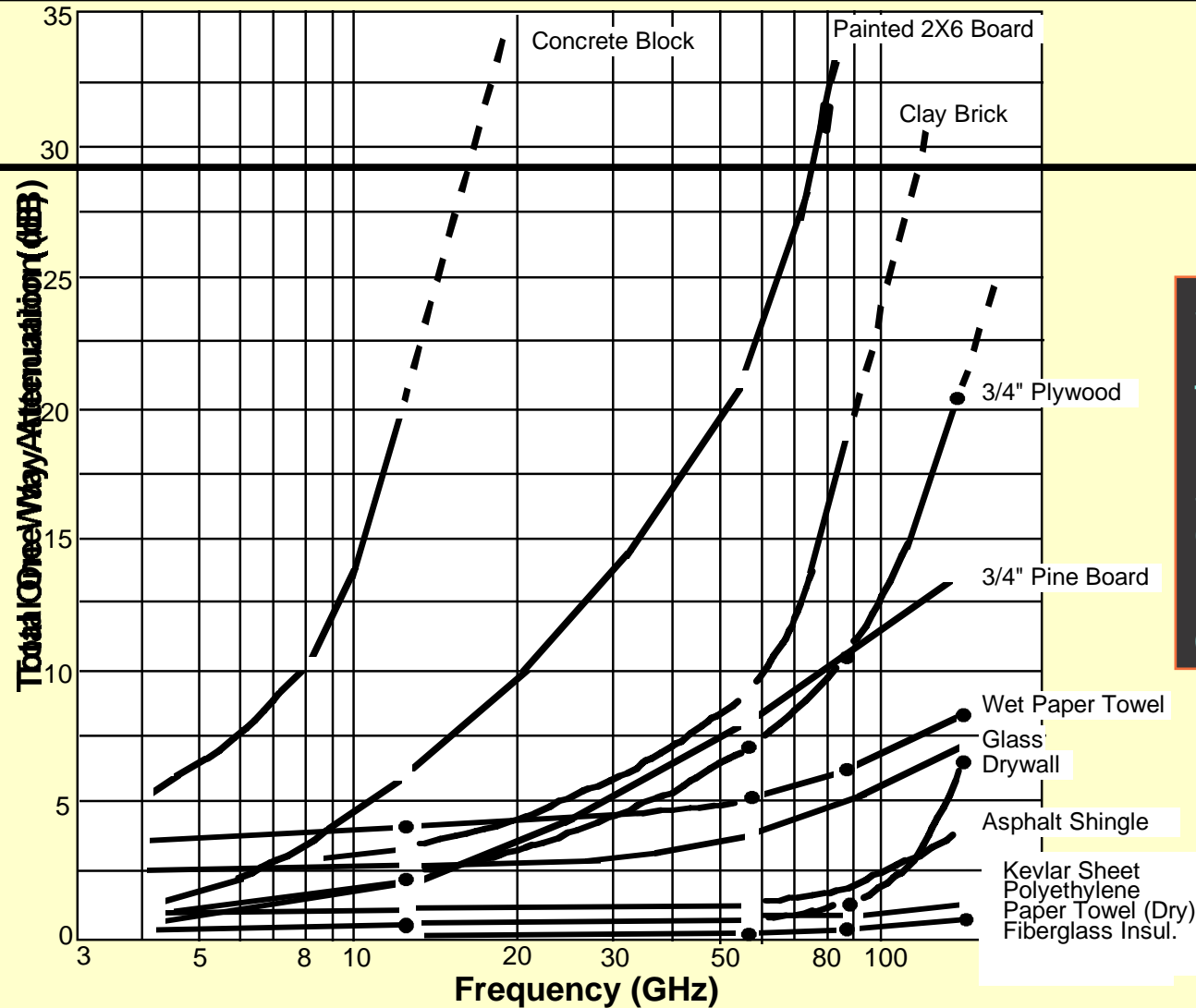
- better materials penetration while maintaining capabilities associated with the given bandwidth.

BUT

Possible UWB Disadvantages

- Lower transmitter power
- UWB antenna mismatch
- UWB matched filter/correlator inefficiency
 - Rake inefficiency
 - Template mismatch
 - Reduced ranging accuracy
- External interference from other systems

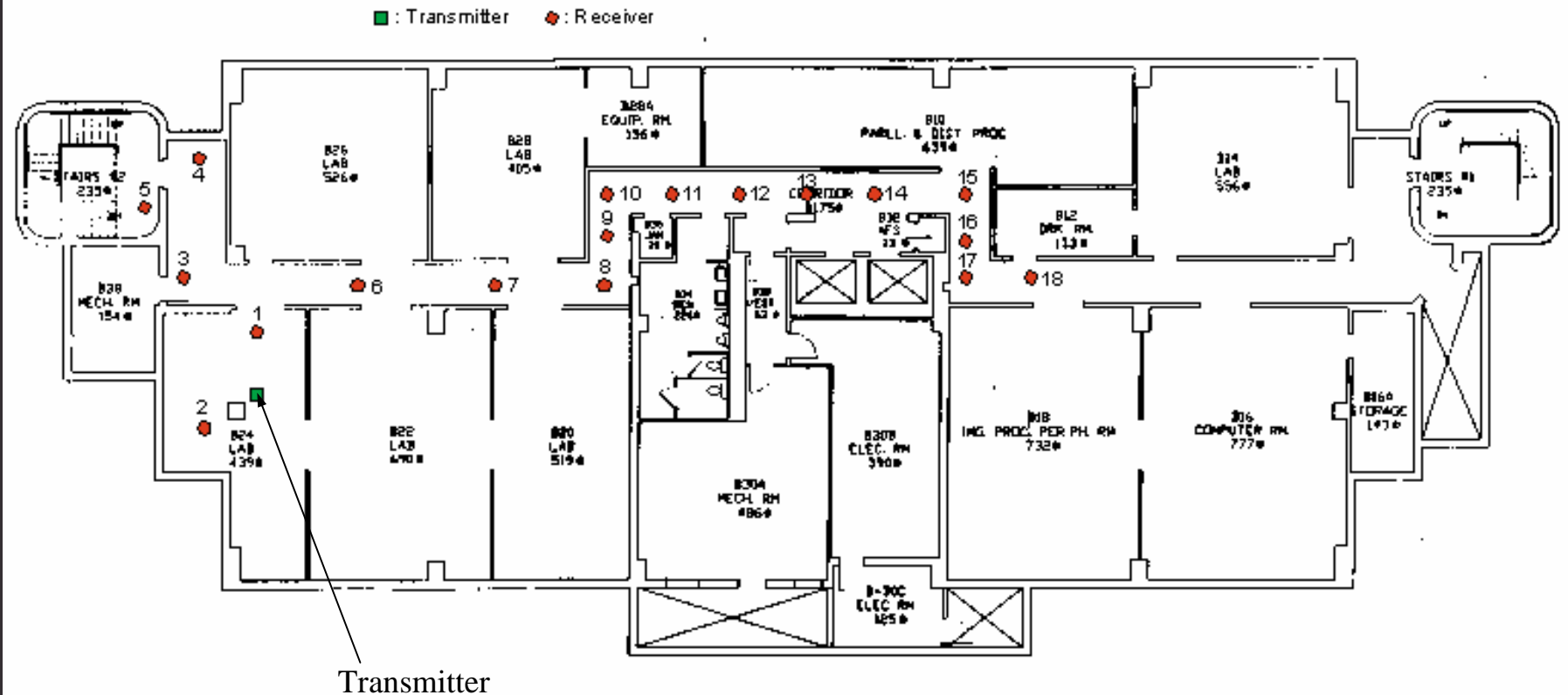
Materials Penetration



See: L. M. Frazier,
"Radar Surveillance
through Solid
Materials,"

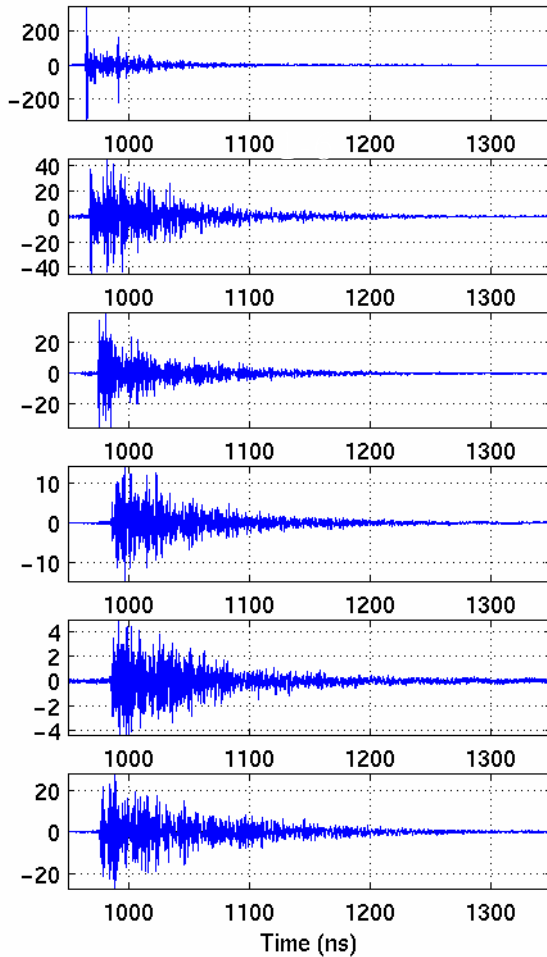
SPIE Photonics East
Conference, Boston,
MA, November, 1996.
(Paper 2938-20)

Test Site (Basement, EEB, USC)

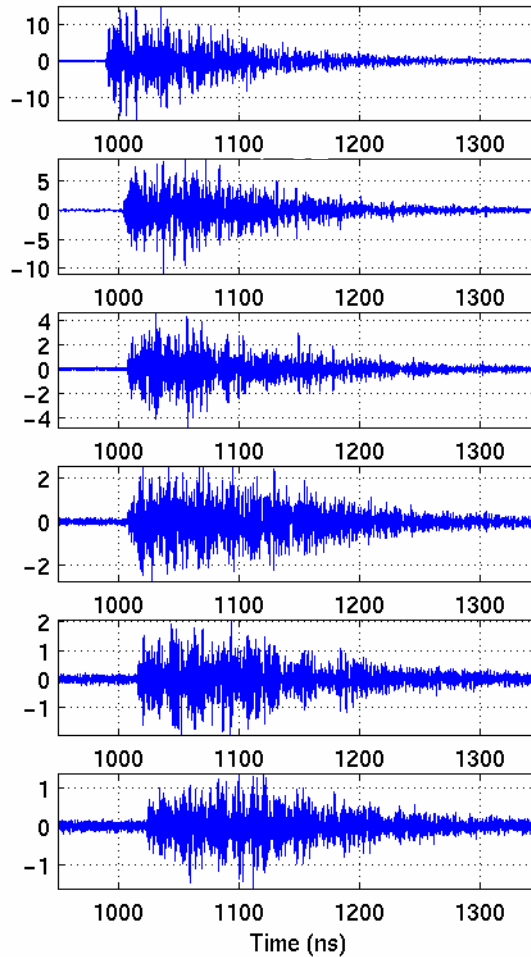


Measured Signals

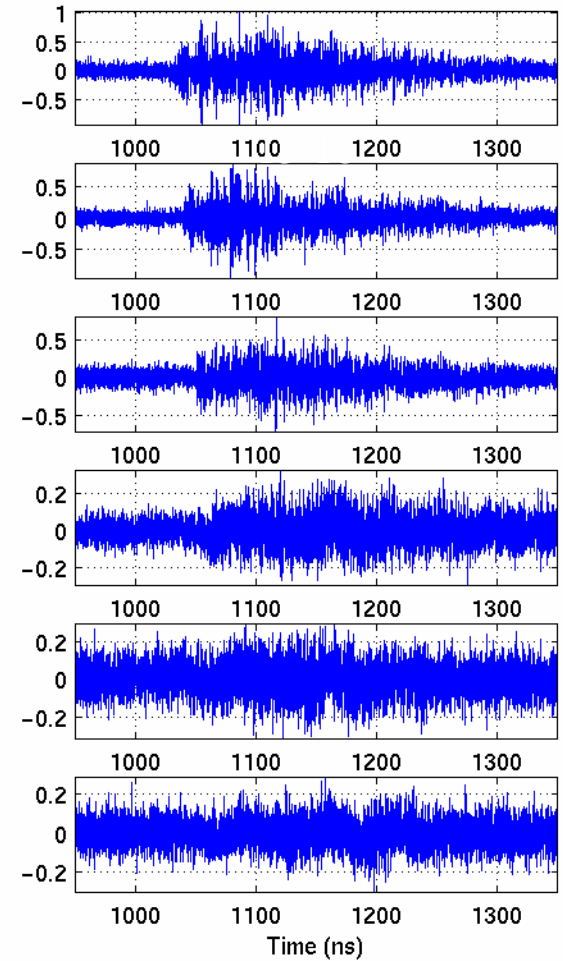
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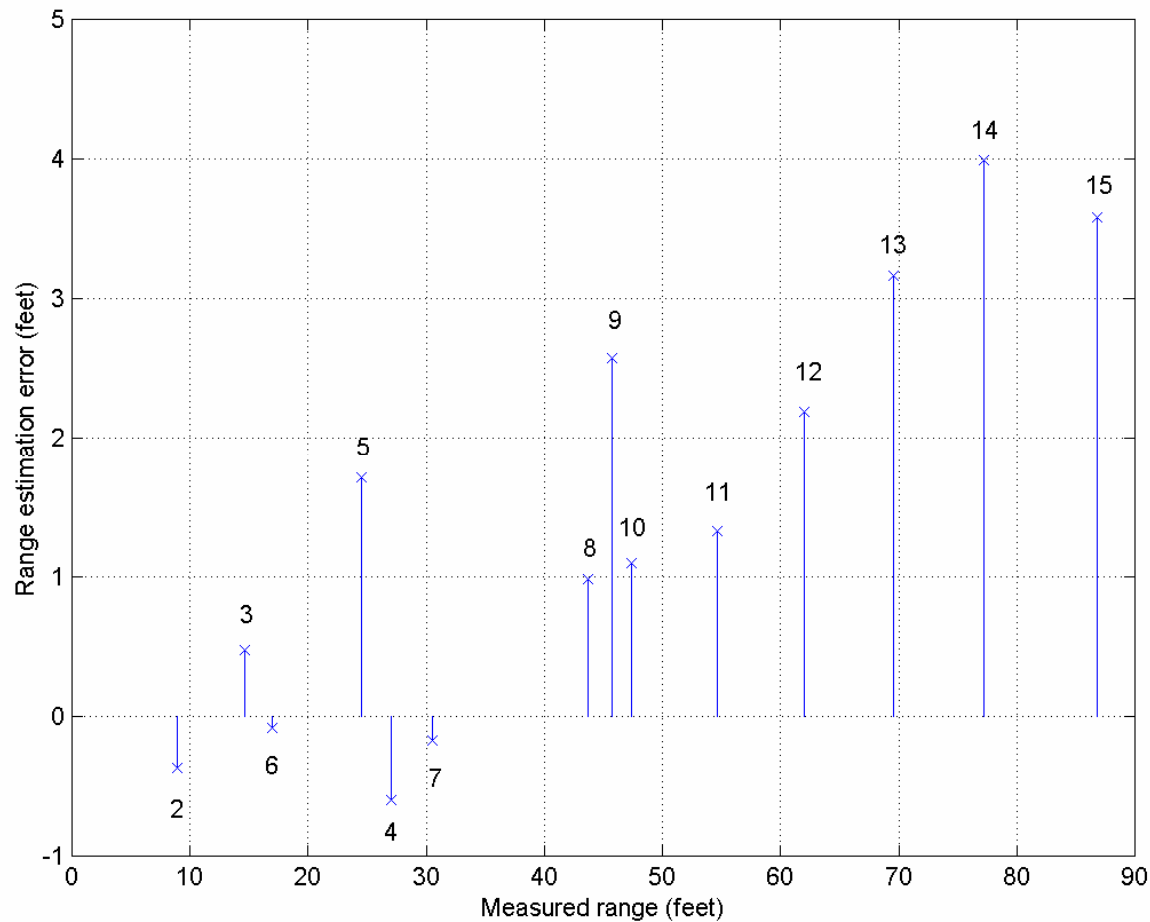
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Ranging Algorithm Performance



Research Issues

- UWB antenna matching
- Efficient receiver processing
- Computationally efficient ranging algorithms
- Interference excision over ultra-wide bandwidths
 - Handling on-chip interference
 - UWB imaging algorithms
 - UWB networking (NETEX)
- UWB propagation modeling and measurements
- UWB node teaming for long-distance transmission

**For more information, copies of
papers, links to other sites, etc.,
visit the UltRa Lab's web site at**

<http://ultra.usc.edu/ulab/>