

# TIME DOMAIN

THE PULSE OF THE FUTURE

## Time Modulated Ultra-Wideband

**Federal Wireless Users' Forum**

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**May 2001**

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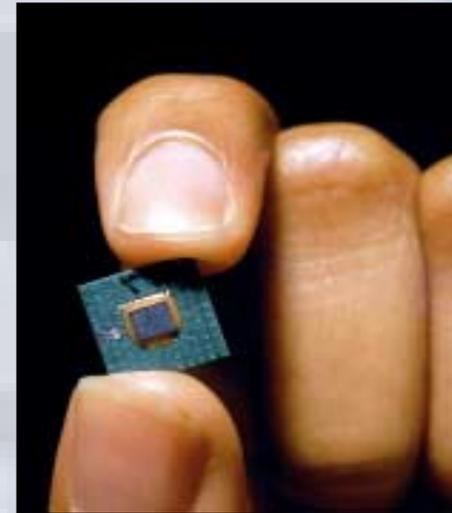
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# Purpose of Presentation

- ▶ The Value of UWB
- ▶ Time Domain's Noise-Like UWB
- ▶ Regulatory Issues

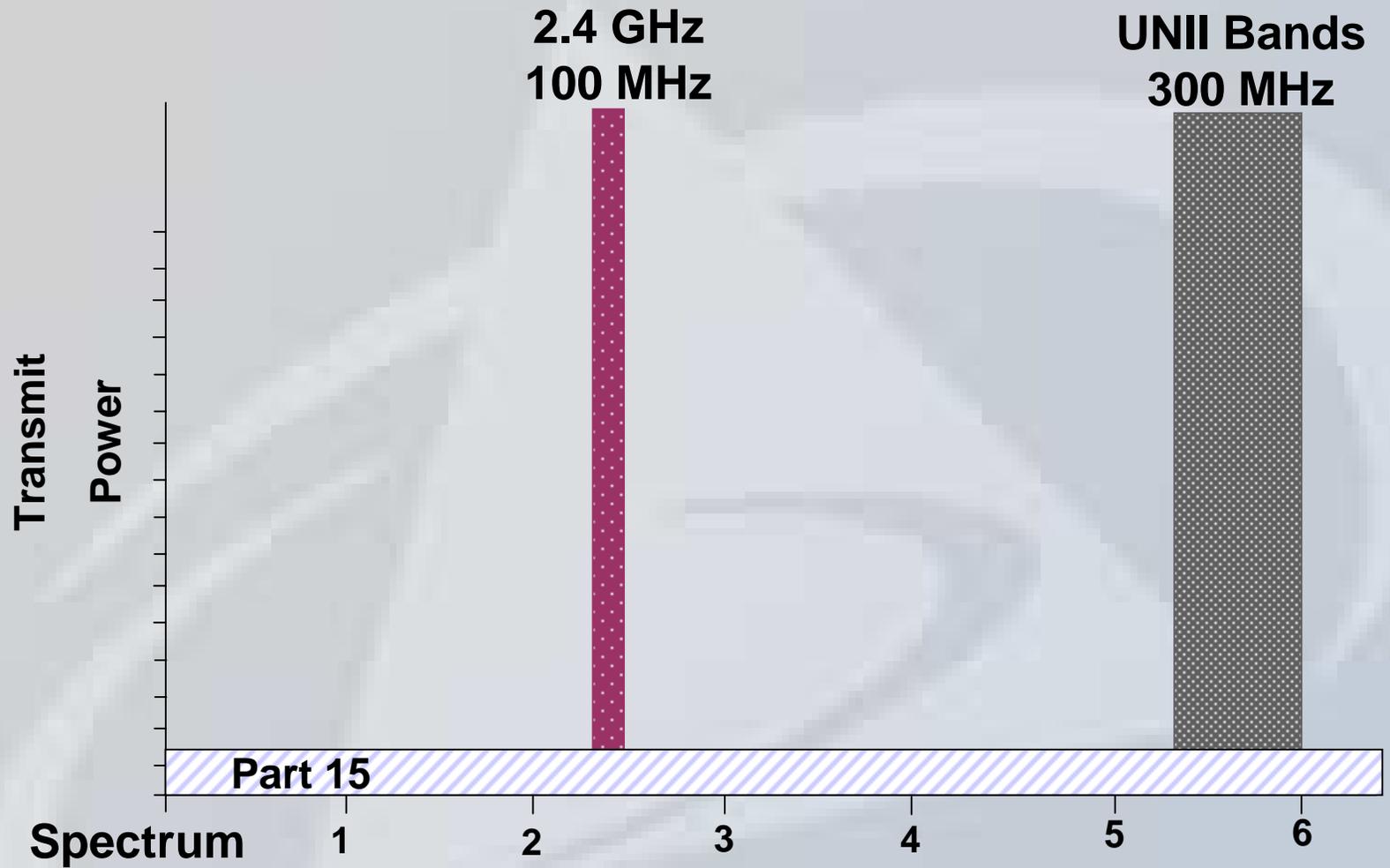
# Time Domain UWB – Three Technologies in One

- ▶ Enables vast improvements
  - ▶ Wireless Communications
  - ▶ Precision Tracking
  - ▶ Radar Sensing



PulsON,  
A Chip Based Solution

# Using Unlicensed Spectrum (1 – 6 GHz)

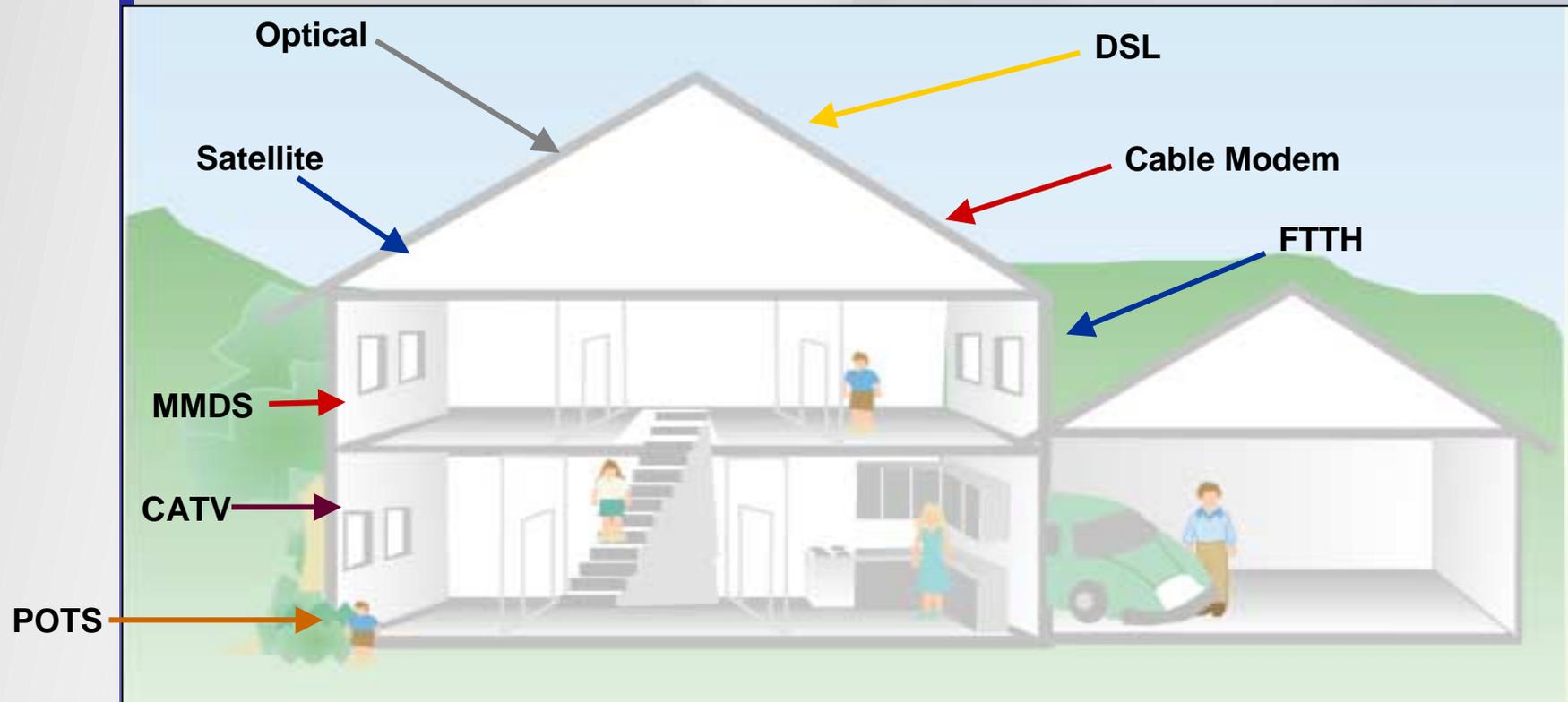


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# What is UWB's Role in the Future of Broadband Wireless

Broadband To The Home...



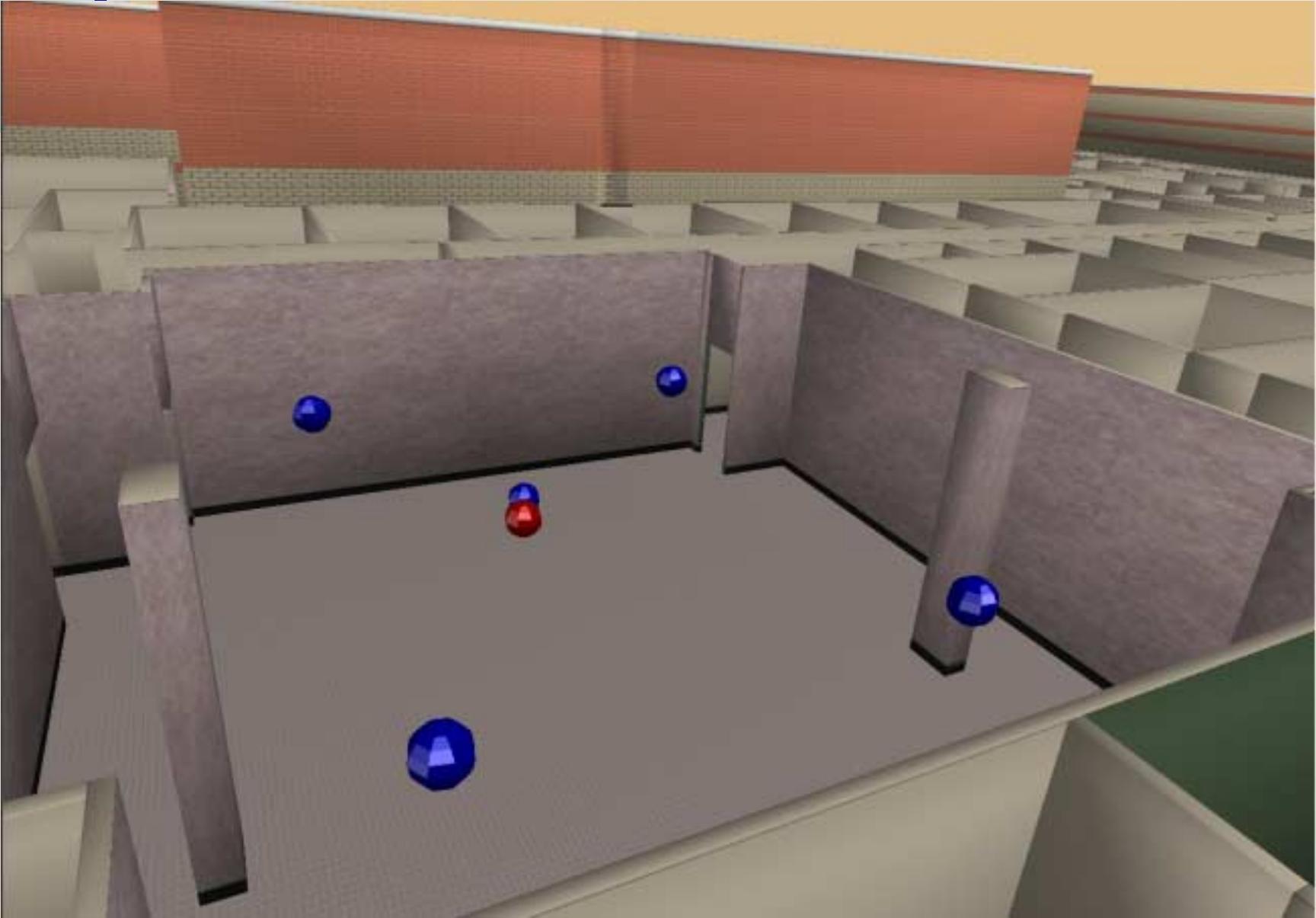
The Challenge: "Broadband Thru The Home"

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# Precision In-Building Tracking

- ▶ Only system providing sub-10 foot in-building tracking in three dimensions
  - ▶ 3D error < 4 inches RMS
  - ▶ Potential to change industries
- ▶ Self-configuring network using portable radios
  - ▶ Firefighters & warfighters can carry their infrastructure with them



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# Through-Wall Sensing

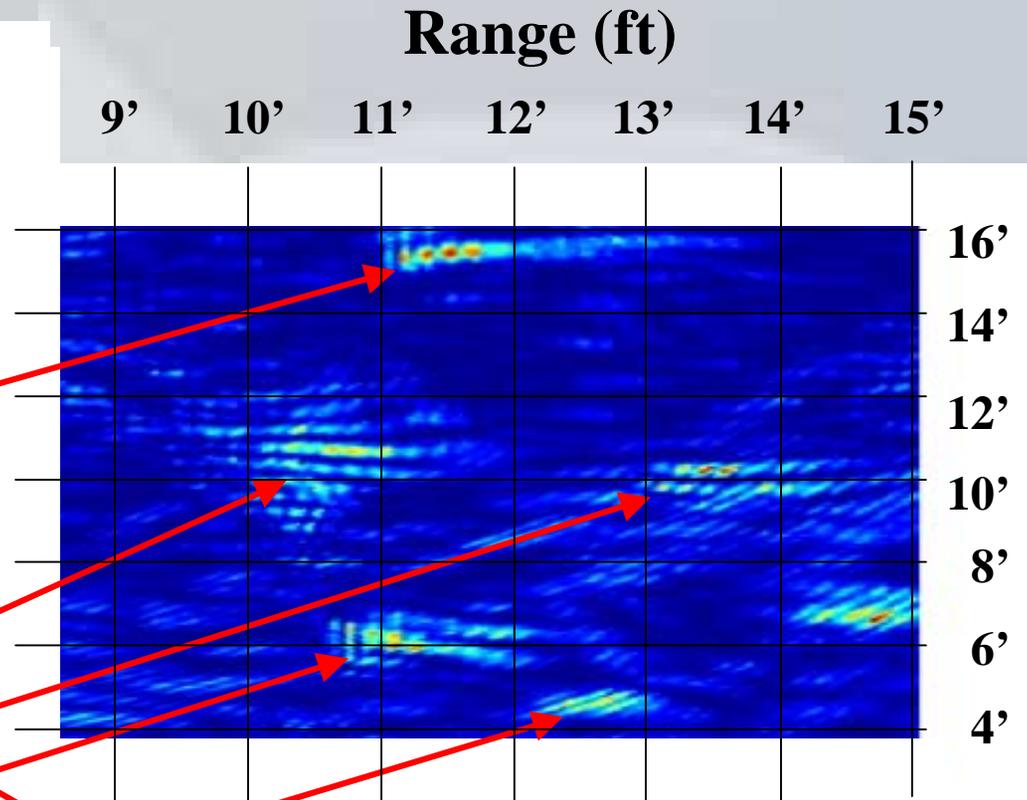
- ▶ Detection of motion through multiple walls
  - ▶ Range and angle
- ▶ Target Markets
  - ▶ Law enforcement
  - ▶ Urban Combat Troops
- ▶ Other applications
  - ▶ Avalanche
  - ▶ Collapsed buildings



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# SAR Concept



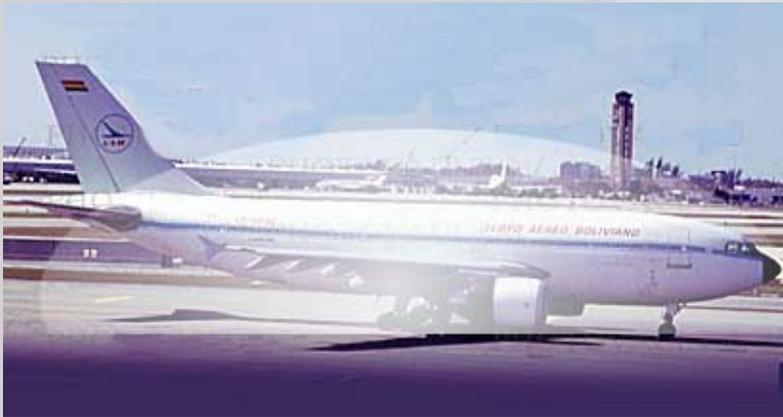
8 mm X 8 mm Range Cells

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# Other Sensing Applications....

Zones of security...



For outside assets...



And high liability areas...

# Some of Time Domain's Federal Projects

- ▶ STRICOM
  - ▶ Precision Tracking for Realistic Urban Combat Training
  - ▶ Integrated Communications
  - ▶ Mobile Ad Hoc Networking
- ▶ NIST ATP
  - ▶ Precision Tracking
- ▶ US Army's Night Vision Laboratory
  - ▶ Through-Wall Sensing Radar
- ▶ DARPA
  - ▶ Self-Healing Minefield
- ▶ Navy
  - ▶ MOBI

# Time Domain's Technical Approach



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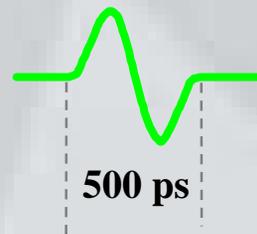
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# Time Modulated UWB

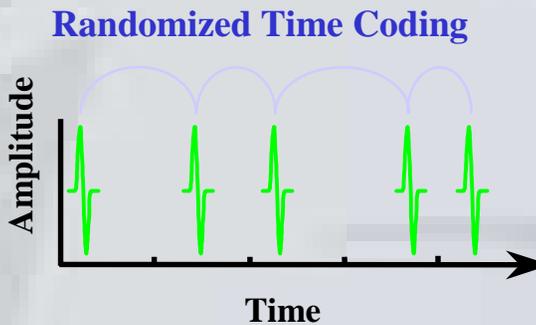
- ▶ An Approach to Noise-Like UWB
- ▶ Maximize Performance
  - ▶ Within Buildings and In Cluttered Areas
  - ▶ Radar Resolution
  - ▶ Spectrum Sharing Potential
  - ▶ Number of Channels
- ▶ Minimize Radiated Power

# Time Modulated Ultra-Wideband

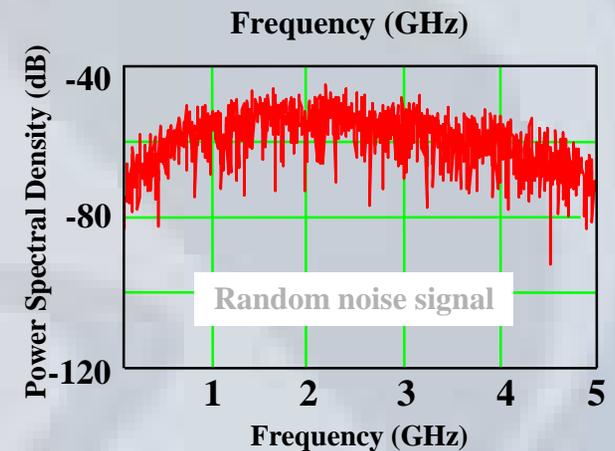
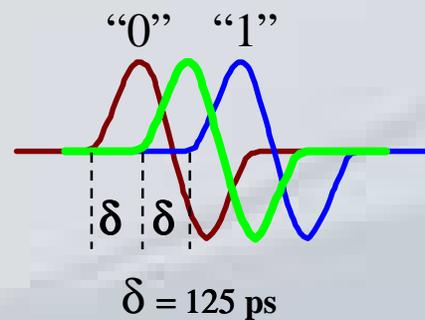
- ▶ Not a sinewave, but millions of pulses per second



- ▶ Time coded to make noise-like
  - ▶ Channelization
  - ▶ Anti-jam
  - ▶ Smooths spectrum

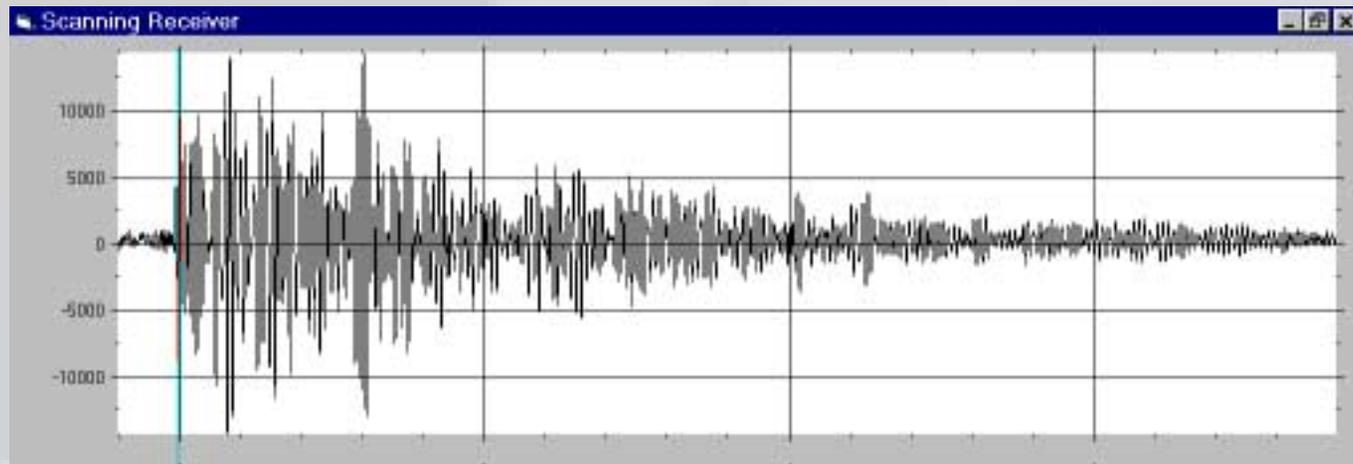


- ▶ Pulse position modulation



# Signal Matched to the Cluttered Environment

- ▶ Impulse response measurement



- ▶ Multipath is time resolved by UWB signal

# Spectrum Sharing Potential

- ▶ Noise-Like Signal
- ▶ Very Low Power Spectral Density
- ▶ Very Low Power
  - ▶ Commercial Applications Will Be Limited to Part 15 Class B Unintentional Emitter Levels (Less Than  $-41$  dBm/MHz)

# PulsON 200

## *The Worlds First UWB Chipset*

**Key Benefit:** Enables development of UWB based wireless devices.



<b>Process / Voltage:</b> (asic)	.18 $\mu$ CMOS, 3.3V LVTTTL
<b>Power Consumption:</b> (complete chipset)	5W Peak
<b>Packaging:</b>	(4) 56 pin PBGA, 300 pin PBGA
<b>Production Status:</b> (first silicon)	3Q01

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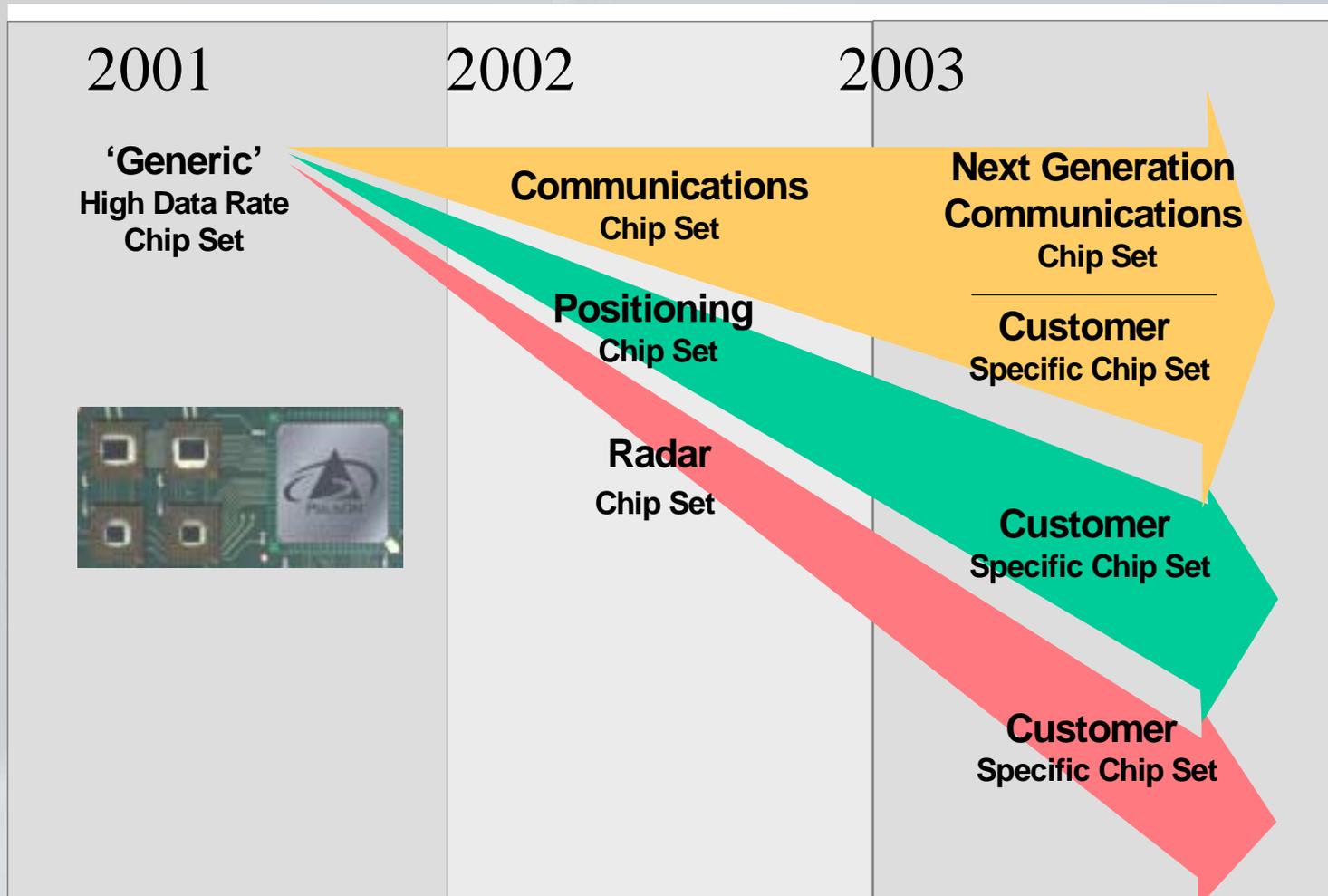
# The Product

**The PulsON 200 Chipset is comprised of three components:**

- **The PulsON Transmitter (2)**  
A precision SiGe chip that slices time into picoseconds
- **The PulsON Receiver (2)**  
The Receiver, cast in SiGe
- **The PulsON CMOS Logic Chip**  
A software definable RF Processor



# Chip Design Path



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# Time Domain PulsON300

**Performance**



# Regulatory Status

- ▶ “A fascinating technology with exceptional regulatory implications”

*Chief Engineer, OET, FCC*

- ▶ Narrowband concepts & terminology don't work with UWB
  - ▶ Center frequency
  - ▶ Necessary bandwidth
  - ▶ Spurious emission
- ▶ Legal, except for restricted bands

# FCC NPRM

- ▶ General comment cycle in late 2000
- ▶ Special issue comment cycles
  - ▶ Non-GPS federal systems (March 2001)
  - ▶ GPS comments due (April/May 2001)
- ▶ Report & Order late summer, but ....

# Generalized Findings

- ▶ With the exception of low pulse repetition frequency UWB emissions, systems responded to noise-coded UWB emissions as if they were AWGN-like
  - ▶ Systems include GPS & PCS
- ▶ No submissions have shown the occurrence of “harmful interference”

# Aggregate Issue

- ▶ Why isn't the night sky as bright as the day?
- ▶ Can't be an aggregate issue on the large scale if the average propagation path is less than free space
- ▶ Except over very short ranges, free space paths don't exist
- ▶ At the power levels that the FCC may authorize, applications must be short range applications

# Why UWB...

- ▶ UWB can solve critical problems facing the Federal user
  - ▶ Short range high bandwidth communications links
  - ▶ Precision tracking & location
  - ▶ Short range radar sensing
- ▶ Unique capabilities
- ▶ Bandwidth by sharing spectrum

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