



A DARPA Perspective on Broadband Wireless Systems

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6 September 2000**

2000 International Symposium on Advanced Radio Technologies



Outline

- **Setting The Stage**
- **DARPA Programs**
 - **Current**
 - **Global Mobile Communications (GloMo)**
 - **Small Unit Operations Situation Assessment System (SUO SAS)**
 - **Airborne Communications Node (ACN)**
 - **Future**
 - **Future Combat Systems (FCS) Program**
 - **Adaptive Spectrum Utilization Concept**
- **DARPA / Industry Cooperation**



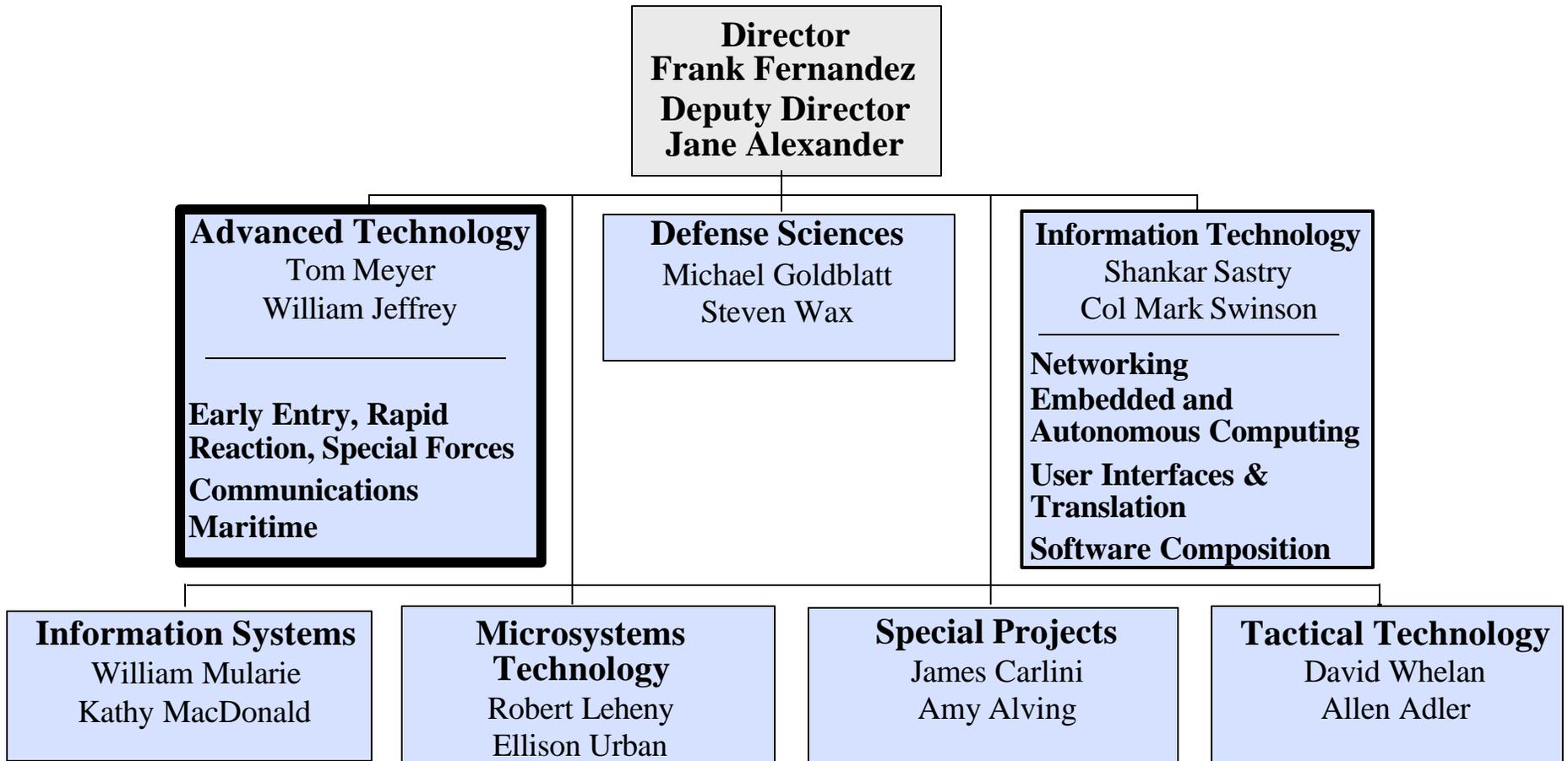
DARPA Mission

Innovation in support of National Security

- **Solve National-level problems**
- **Enable Operational Dominance**
- **High Risk Technology Development, Exploitation**
-- ***Avoid Surprise***



DARPA Organization



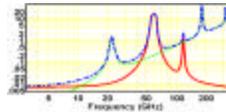


Wideband Technology Components

Commercial Thrust

Additional Defense Thrust

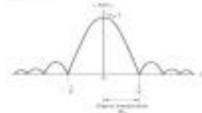
Frequency



Microwave to Wideband

Mobility

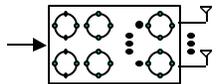
Waveforms



Multiple Access

Low Probability of Detection

Coding



Bandwidth Efficiency
(Turbo Codes)

Featureless Waveforms

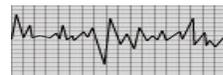
Multipath



Diversity Exploitation

Mobility

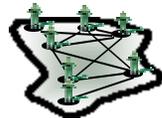
Interference



Spatial & Symbol Processing

Anti-Jam

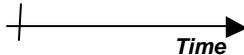
Networks



IP

Mobility, Adhoc,
and Assurance

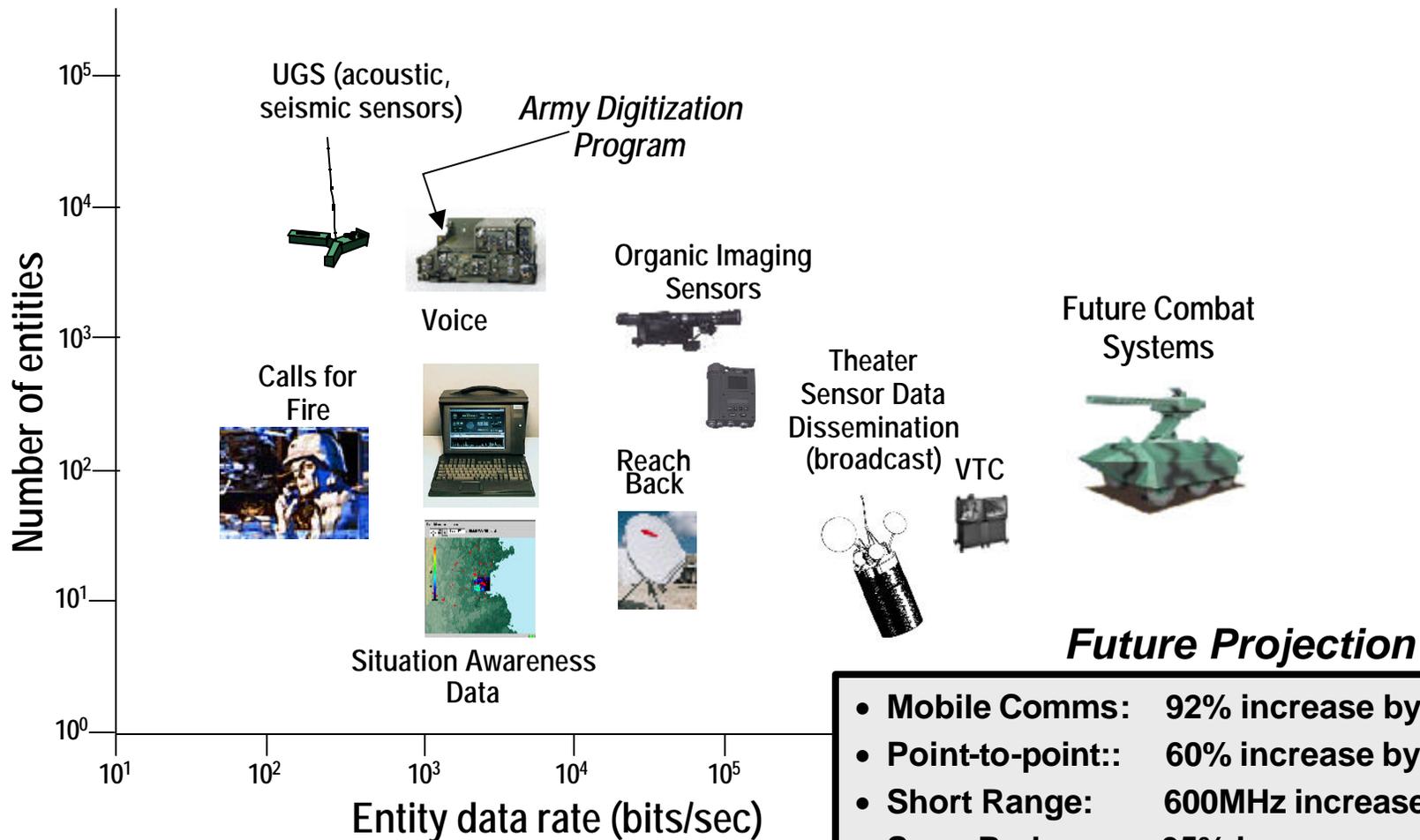
Latency



QoS



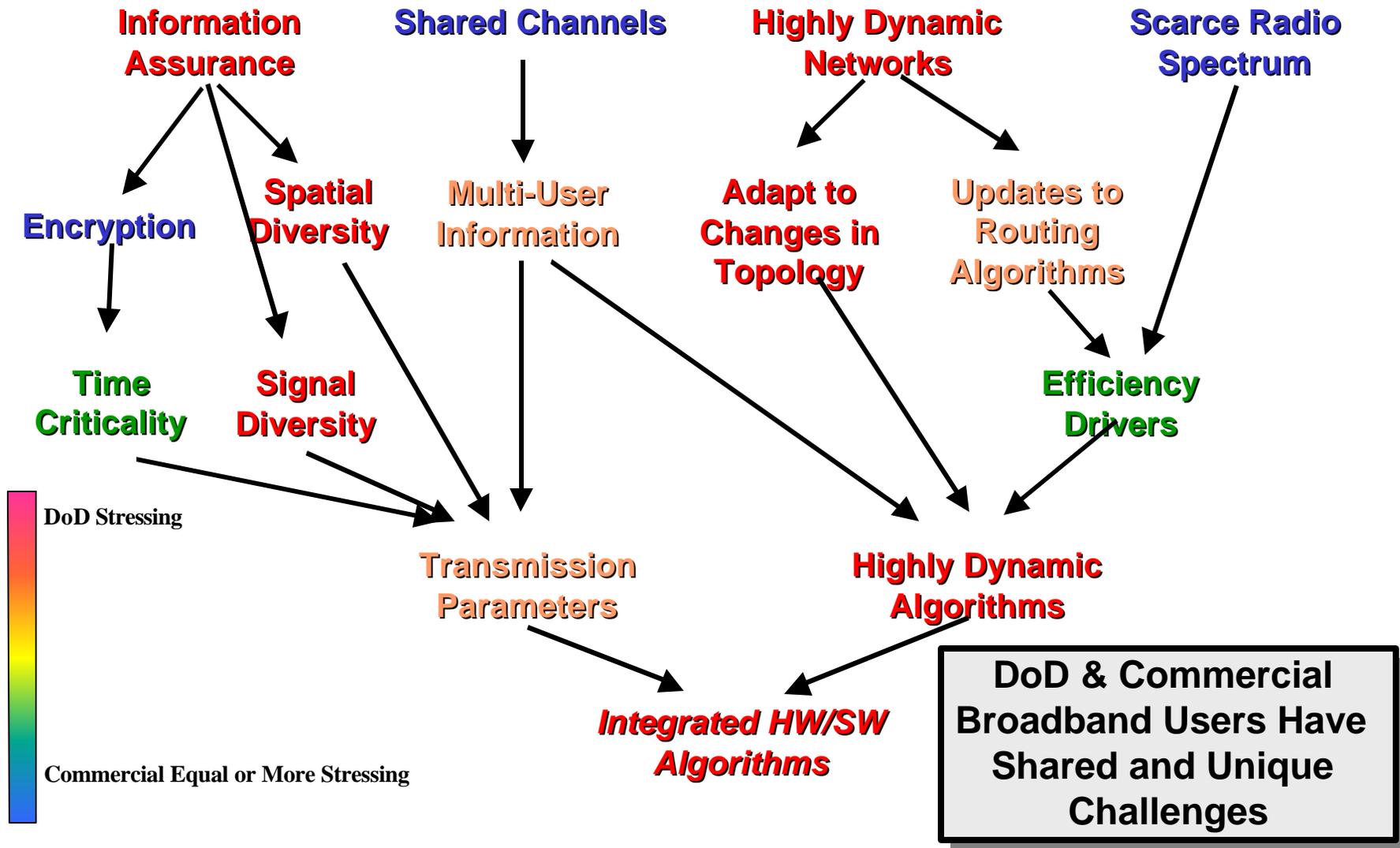
Military Broadband Requirements



- **Mobile Comms:** 92% increase by 2005
- **Point-to-point::** 60% increase by 2007
- **Short Range:** 600MHz increase by 2005
- **Surv. Radars :** 35% increase
- **Fire Con Radars :** 68% increase
- **SATCOM:** 500% increase



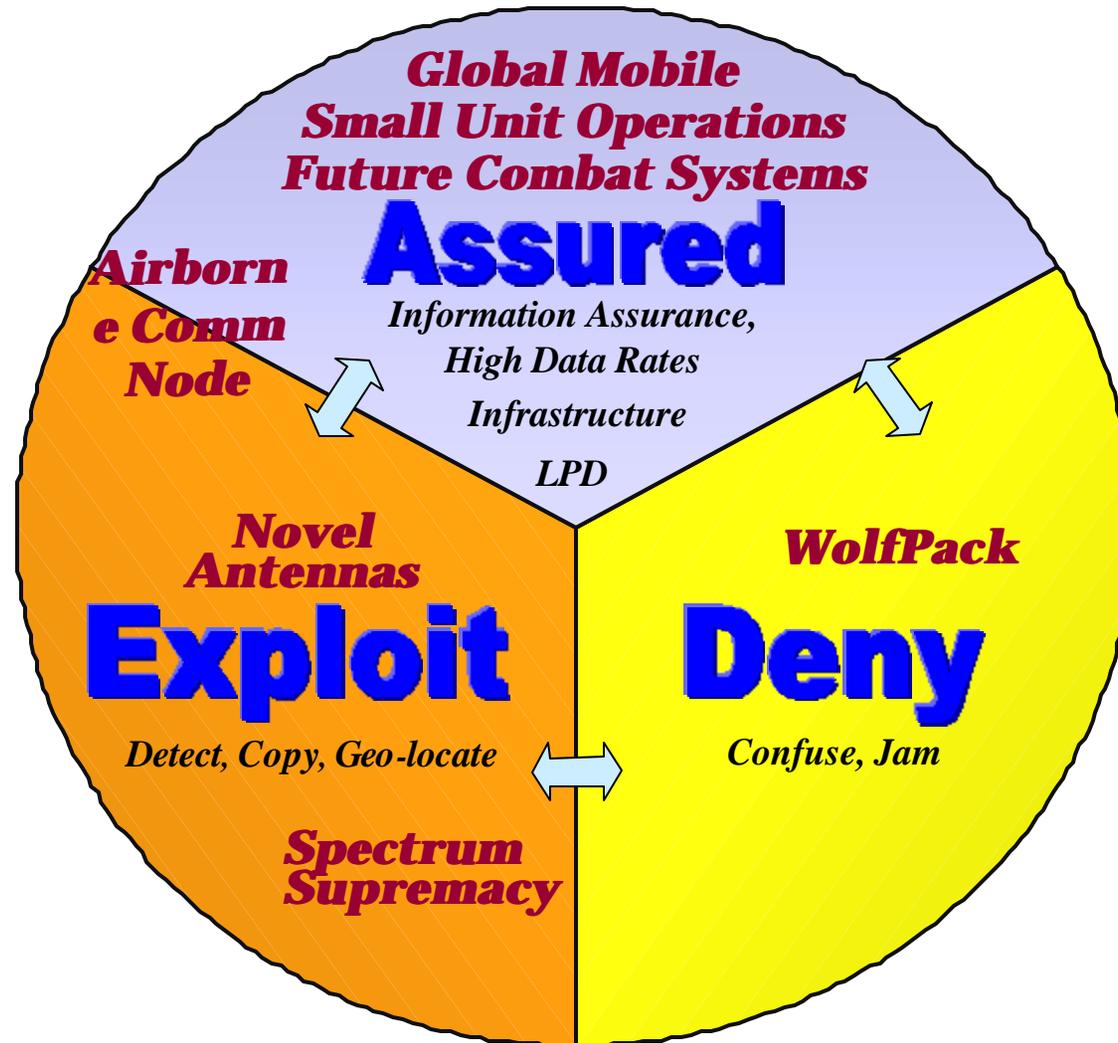
Wireless Communications Technical Challenges





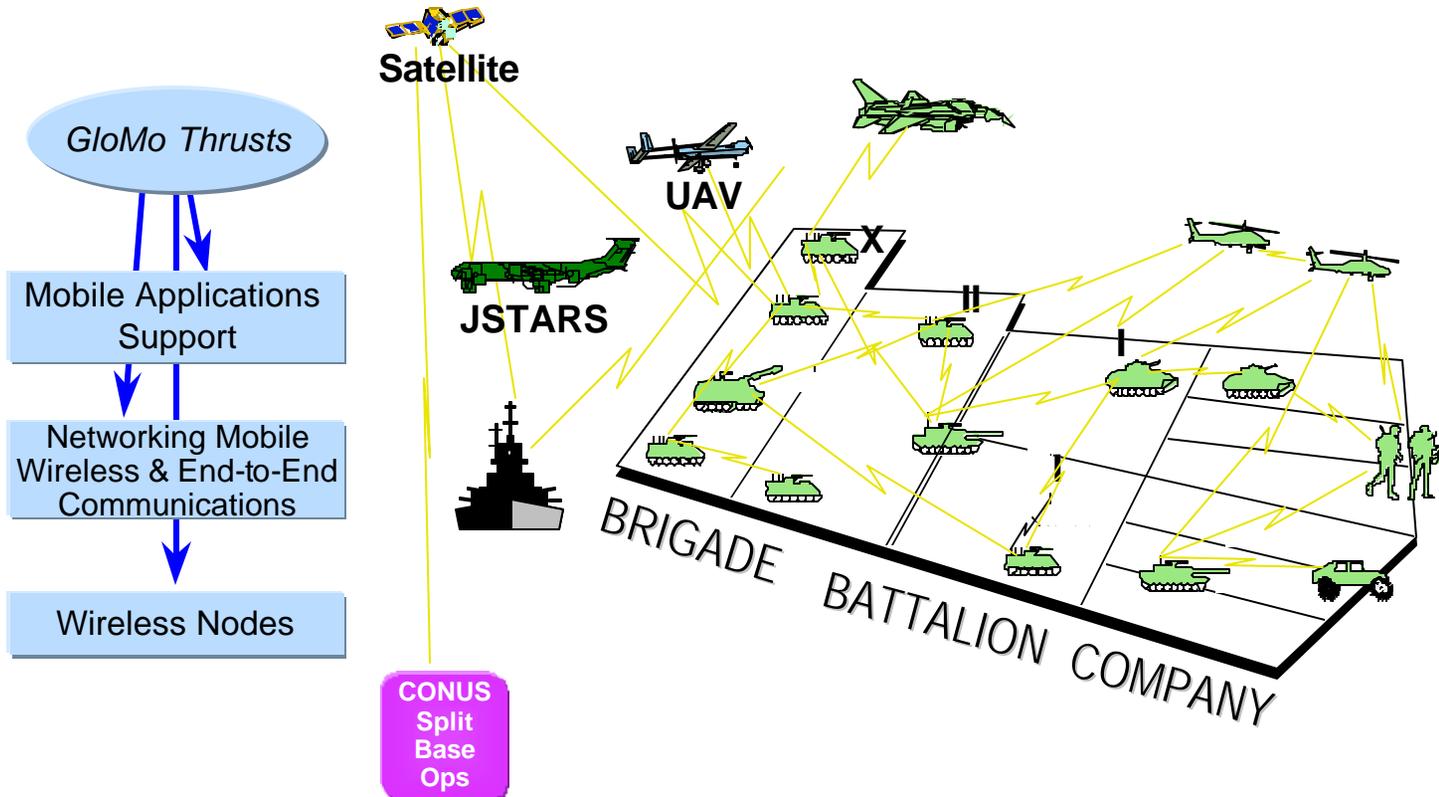
DARPA Communications Focus

- *Programs, Functions*





Global Mobile Information Systems (GloMo)



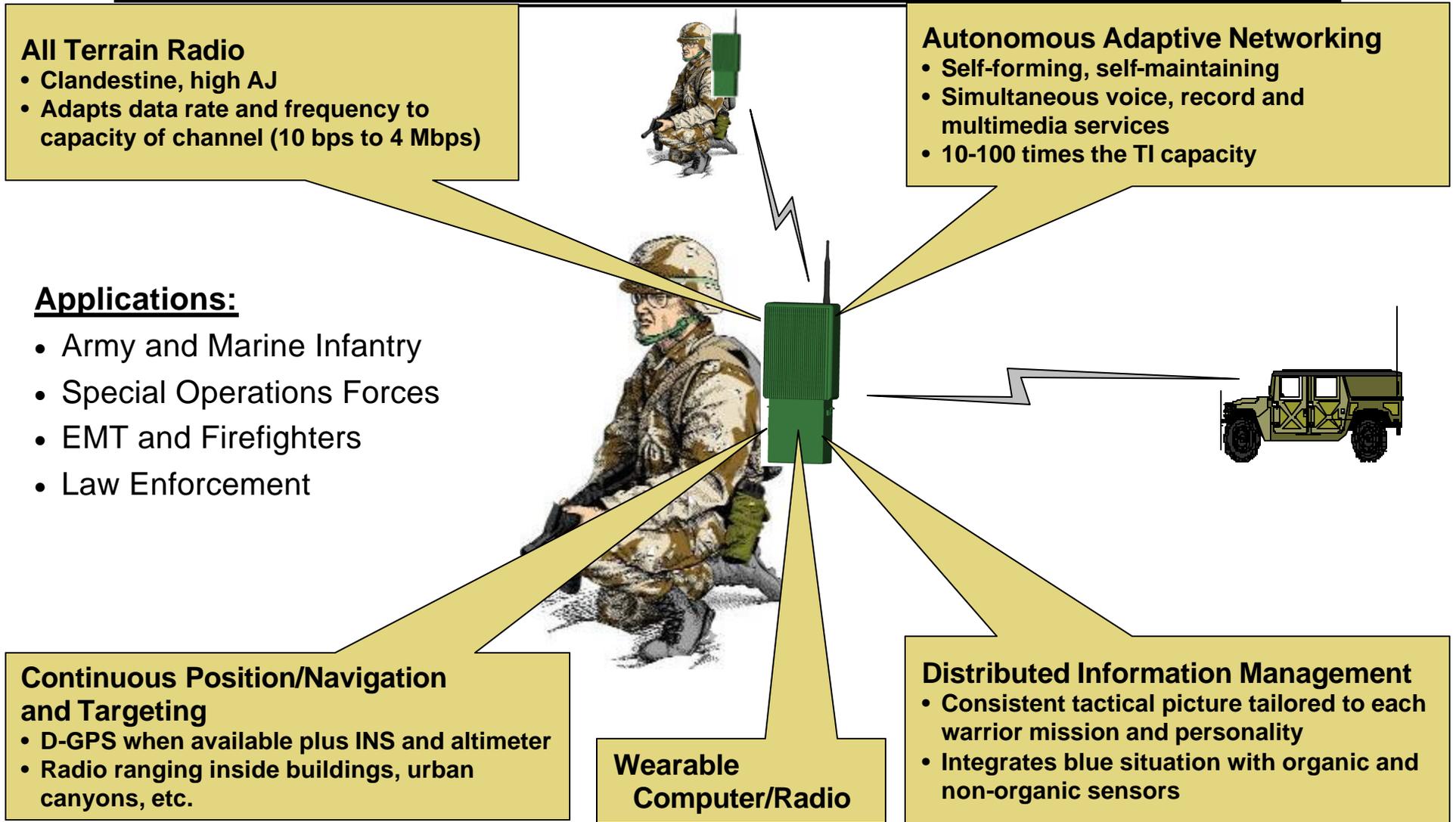
Defense Wireless Environment

- No pre-deployed infrastructure or fixed base stations
- Environment is subject to significant changes (weather, terrain, foliage, EMI)
- Mobile operations
- Significant variation in link quality and sporadic connectivity

GloMo technology enables mobile users to automatically form ad hoc networks and exchange voice, data and multimedia information



Small Unit Operations Situation Awareness System Program (SUO SAS)



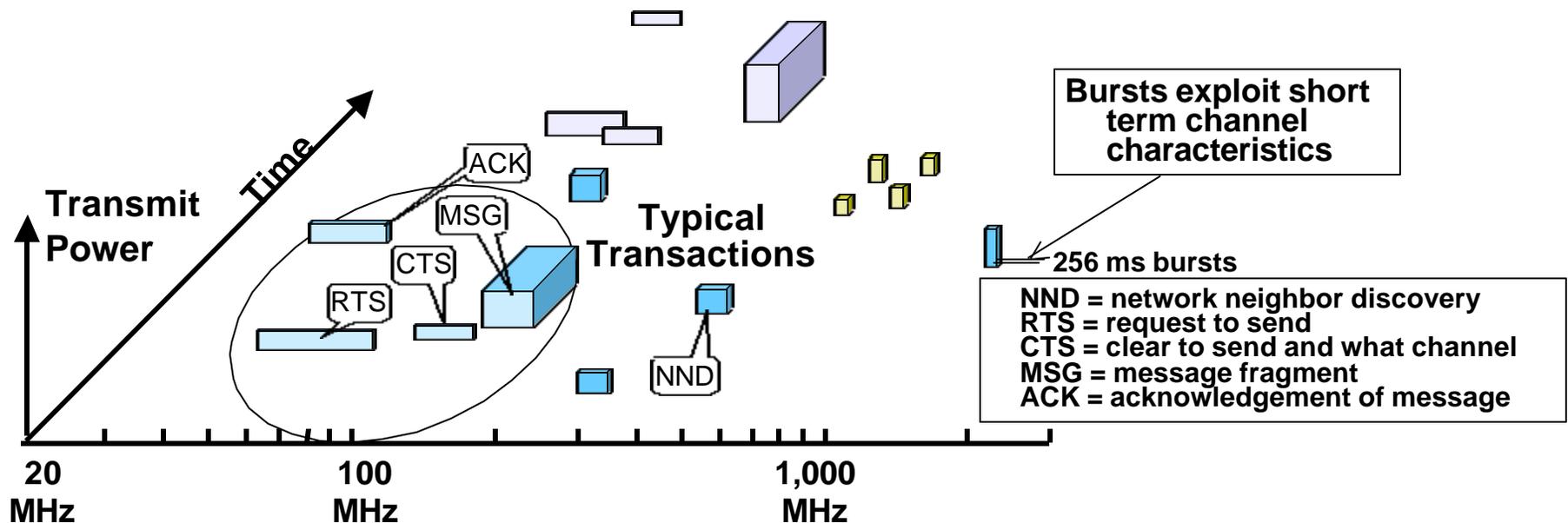
SUO SAS is a mobile communications system with high data-rate capacity that is optimized for restrictive terrain



Dynamic Broadband Waveform Technology (SUO SAS)

- Operating Frequency Range: 20 MHz to 2.5 GHz
- Hybrid direct sequence / frequency hopping
- Spectrum adaptive data rates
 - Data Rates: 96 kbps - 6 Mbps
- Security

- Each radio monitors activity on the signaling channel and can predict some link states
- Each radio selects a channel to use in response to a RTS





Airborne Communications Node (ACN) Concept

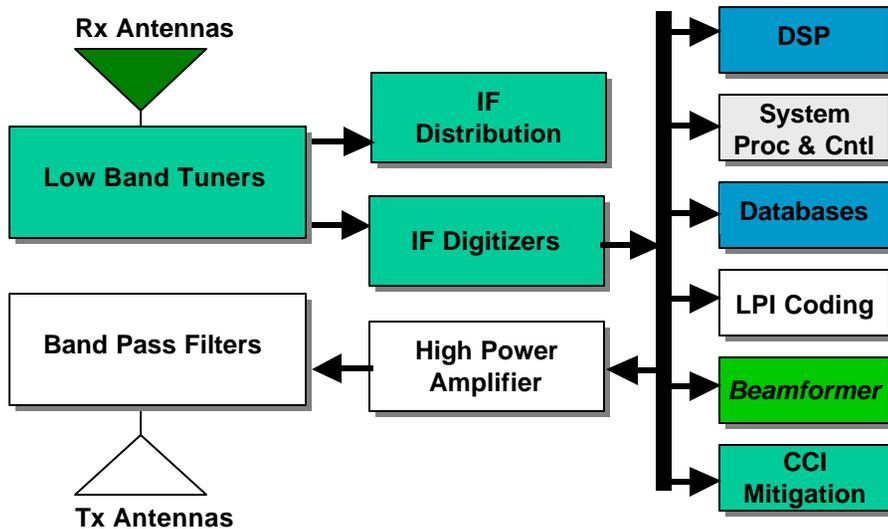


ACN provides continuous communications services to widely dispersed (Beyond Line of Sight) mobile forces

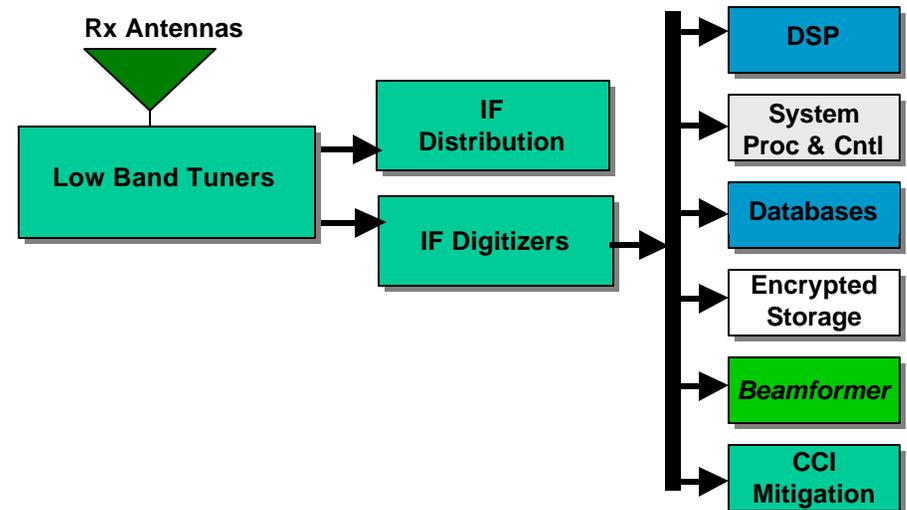


ACN: A Convergence of Communications and SIGINT

Communications



SIGINT



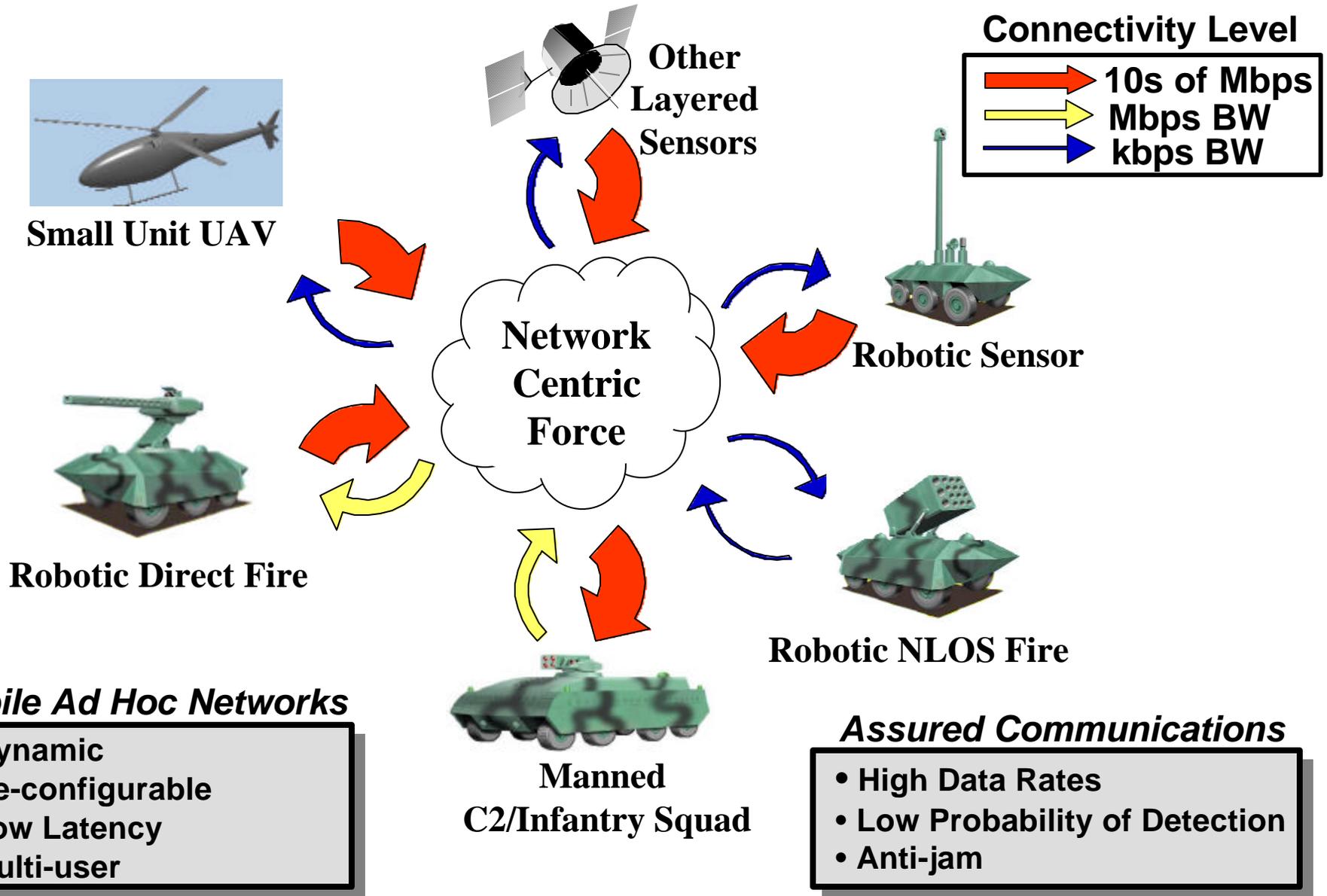
- Opportunity for multi-mission platforms
- Synergistic capabilities
 - SIGINT can find “holes” in spectrum for transmission

Common Functionality

- Antenna Beamsteering
- Wideband RF Front End
 - 20 MHz -> 18 GHz
 - 90 dB Dynamic Range
 - 50 - 100 MHz BW
- High Speed MODEM
 - 3 - 10 GFLOP
 - AM, FM, QAM, QPSK



Future Combat Systems - Assured Real-time Connectivity

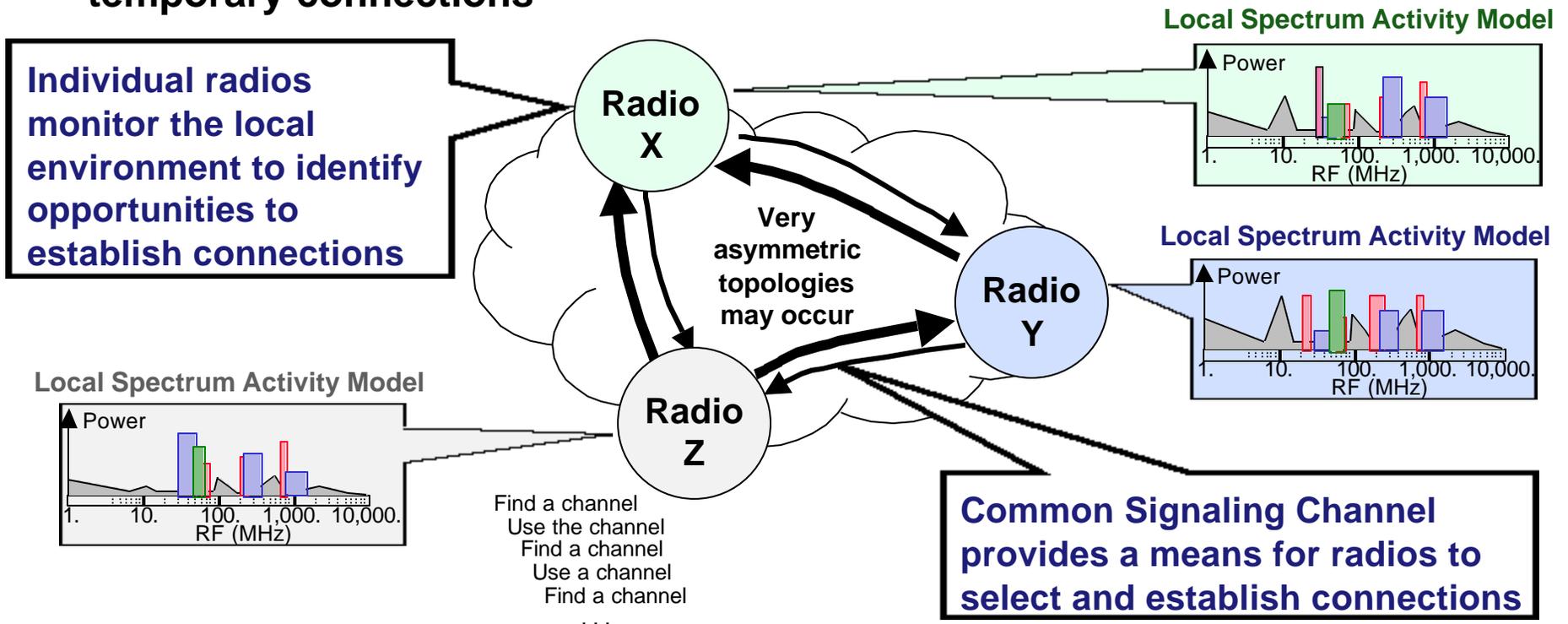




Adaptive Spectrum Utilization

• Concept:

- Adaptive Spectrum Sharing - employ unused spectrum (frequency, time and power) when and where available using special waveforms, protocols and etiquette to overlay and underlay frequencies without interference
- Tactical Adaptation- adapting locally, at the individual link level, for temporary connections



Spectrum Adaptation can be done locally, without interference, and be stealthy



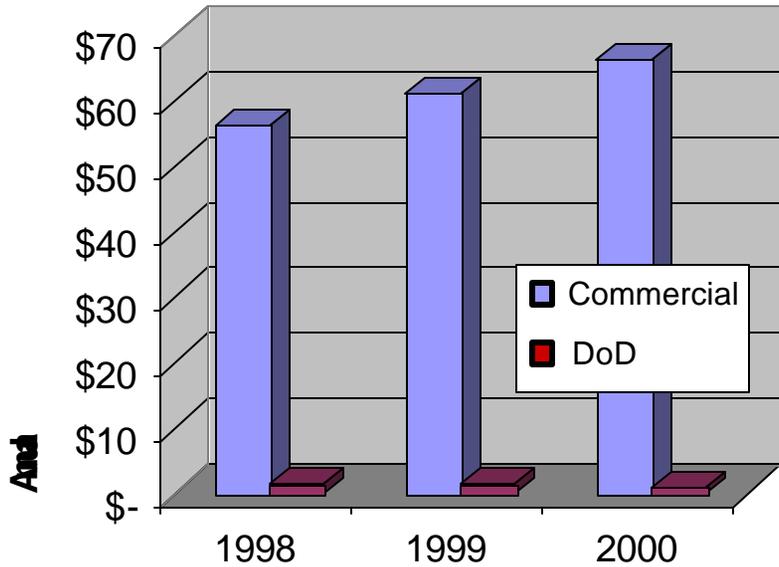
DARPA-Industry Cooperation

- **Common technical requirements exist between commercial and military broadband wireless systems**
 - **Military unique needs drive extensions in the areas of assured connectivity, LPD waveforms and jam resistance**
- **Future military wireless systems will be “modular”**
 - **Military users benefit from the rapid assimilation of low cost commercial sector technology developments**
- **DARPA is investigating ways to rapidly transition technology to/between DoD and commercial applications**
 - **DARPA is familiar with the role of technology “Venture Capitalist”**
 - **Cooperative relationships are encouraged**
 - **Additional information can be found on DARPA’s web page (www.darpa.mil)**

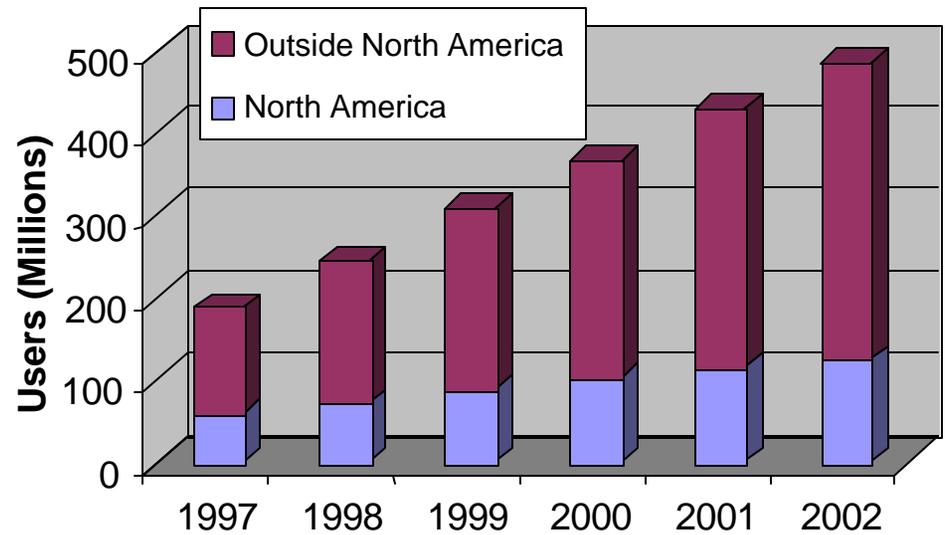


Commercial Communication Trends

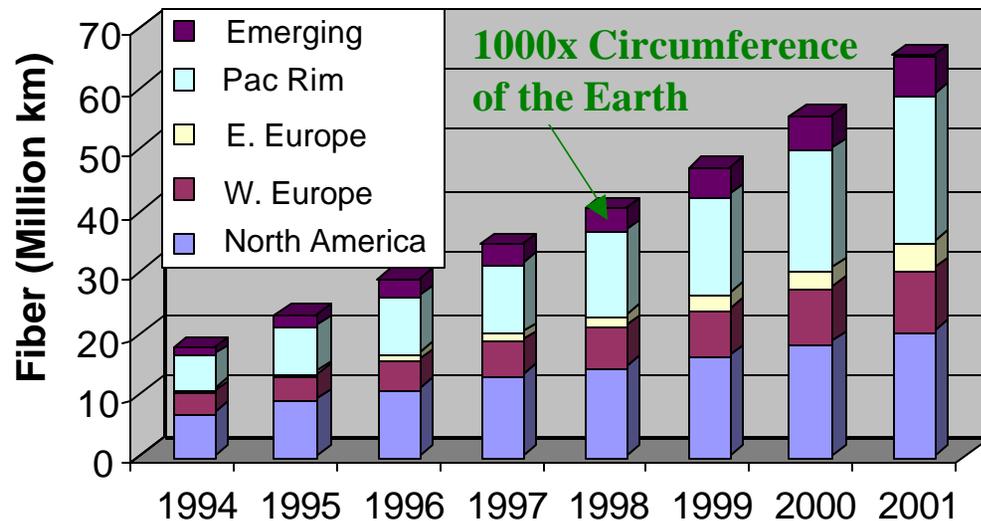
Annual US Comms R&D Spending



Worldwide Cellular / PCS Subscribers



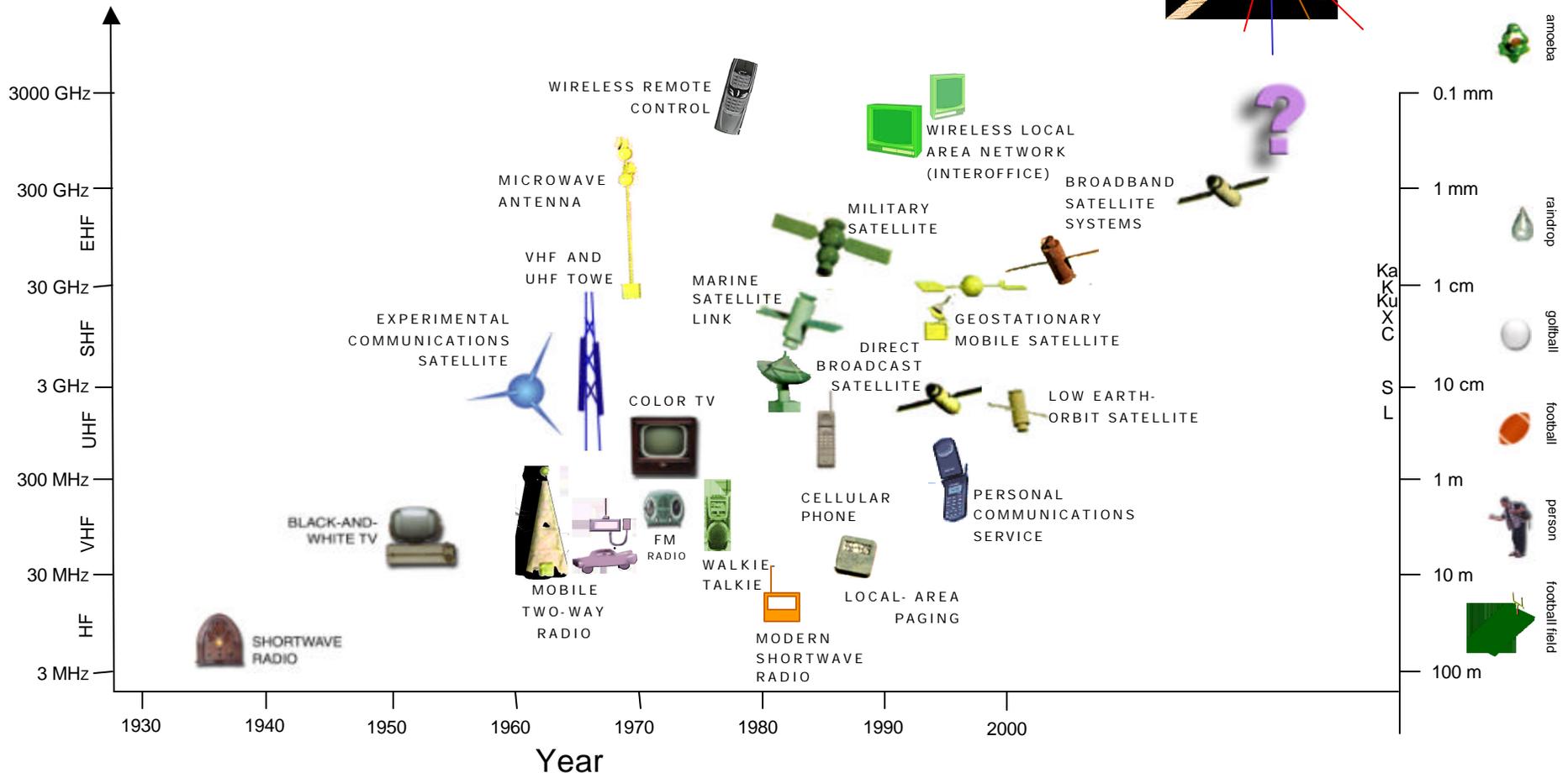
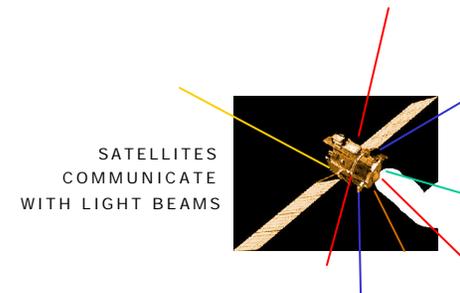
Worldwide Deployment of Fiber Optic Cable





Channel Capacity Commercial Solution: Increase Bandwidth

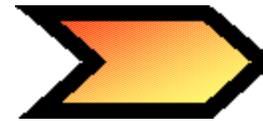
Commercial trends have been to higher data rates, requiring greater bandwidth, leading to higher frequencies





Military Frequency Allocation

World-wide Military Frequency Allocation is going down



Requires: More efficient use of the remaining asset

