

Disruption Tolerant Networking Summary Brief 15 Sept 2005

Wireless
Network
After Next

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Rescue
Radio

Defense Advanced Research Projects Agency
Advanced Technology Office

Retro-Directive
Noise
Correlating
Radar

Radio-Isotope
Micro-power
Sources



Next Generation Communications



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Relying solely on classic IP for tactical/edge military networks risks catastrophic failure

Military wireless nets episodically connected because of terrain, weather, jamming, access schedules; resulting in rapid topology changes

Problem: Internet protocols *will* drop intermittent end-to-end connections

Solution: Move messages towards destination via store & forward

Problem: Best path towards destination depends on many parameters

Solution: Support multiple routing algors (advanced, battery, satellite, anastomol)

Tactical military radios may not know destination addr

Problem: IP must know the endpoint addr before it will send a msg

Problem: IP uses DNS lookup to resolve addrs, costs precious transmission opportunities, DNS may not be connected, routers may not have translation

Solution: Late binding of name to endpoint address

Tactical/edge military networks may be a mix of IP and non-IP radios

Problem: IP crossing non-IP domains requires translation/bridging

Solution: Bundle mechanism a general solution which converges different transports for reliable communication

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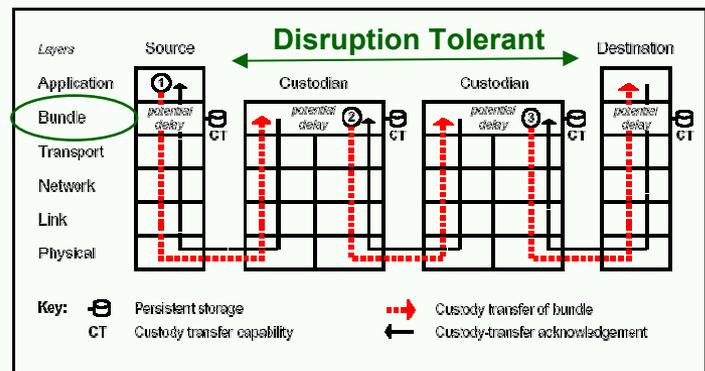
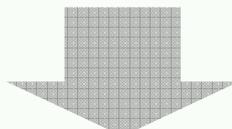
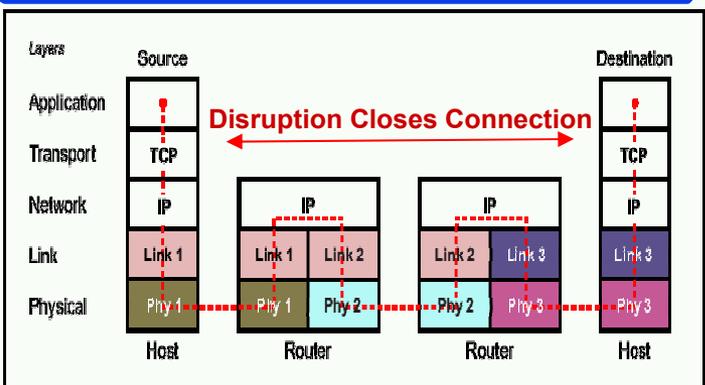
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DTN supports tactical network operations during & across network connectivity lapses/disruptions. IP doesn't and can't.

Develop Disruption Tolerant Networking Technologies Required for Deploying Distributed Battlefield Networks.

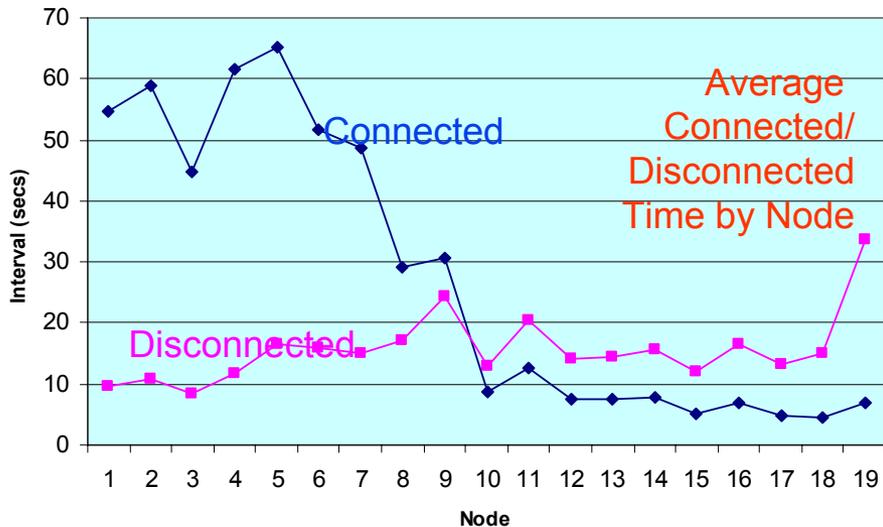
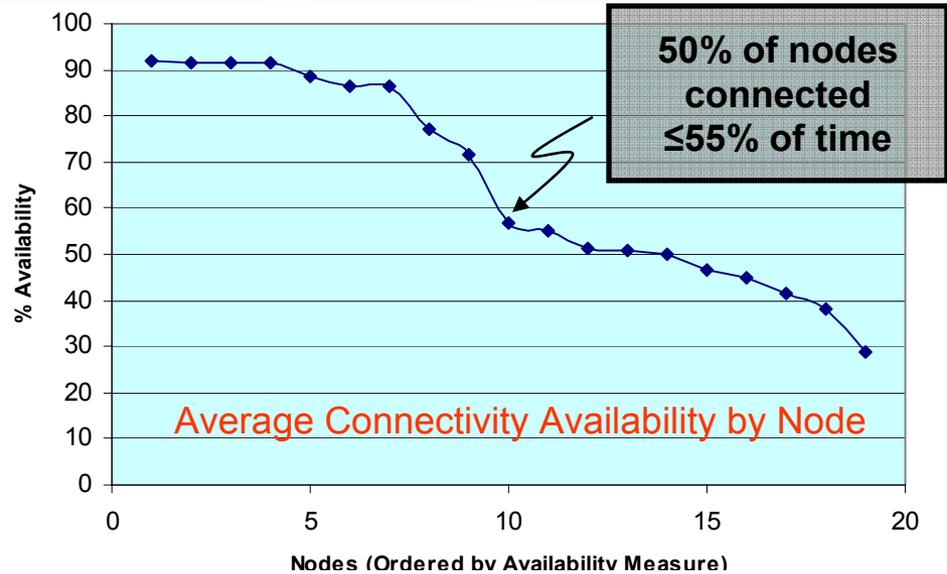
Technology Needs

- **Bundling:** Organize info into “Bundles” for delivery
- **Fuzzy Scheduling:** Make network routing decisions when path availability/optimality is unknown
- **Late Binding:** Enable network traffic delivery when end-to-end address and routing is unknown
- **Reasoning-based Resource Planning and Utilization:** Move intelligence into network to make sensible delivery choices
- **Trusted Delivery:** Provide authentication in the absence of connectivity to PKI



<u>Feature</u>	<u>Internet</u>	<u>DTN Enhancement</u>
Scope	Needs global nodes/ routes awareness	Needs only local node/topology awareness
Connectivity	Must be end-to-end	May be episodic
Network Complexity	Extremely simple	Introduces complex elements

Toughen the Network, Not Just the Radio!

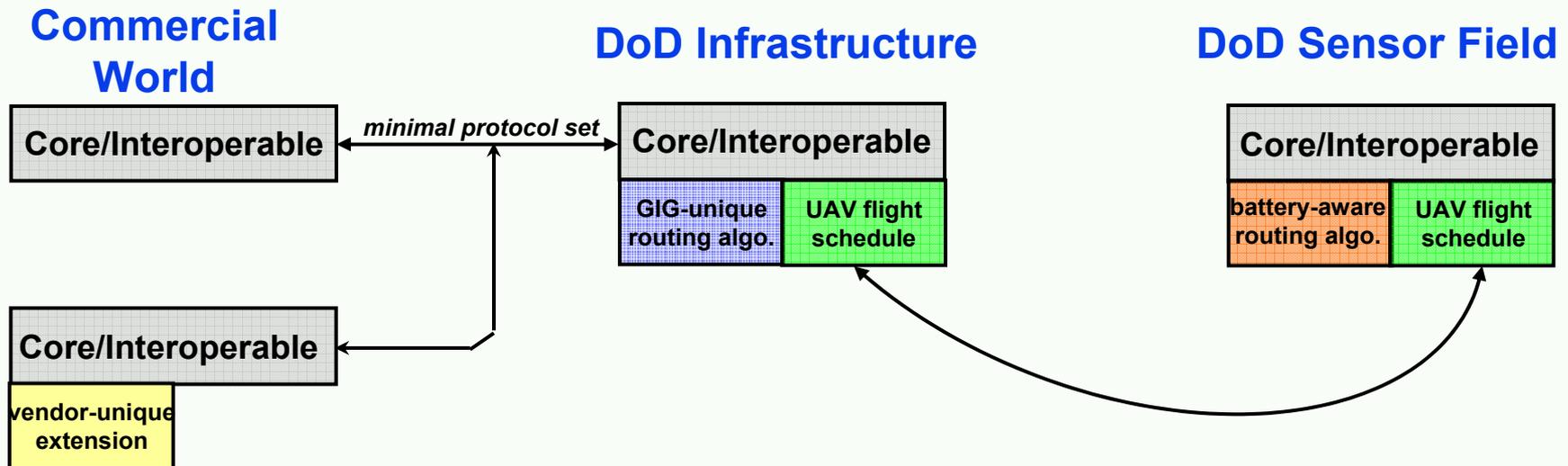


- Position Reports Used as Measure
- Highly Favorable Metric Used
Loss of 2 Successive (1 Sec Interval) Reports Considered as Disconnected

Wireless networks need diverse routing behaviors:

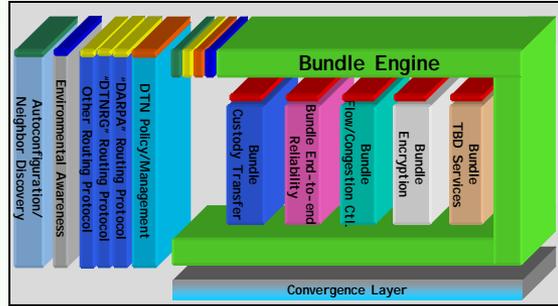
- “Open Biggest Battery First” (*Battery-powered systems*)
- “Use Advantaged Node Last” (*Transient aircraft nodes*)
- “Open Least Tx Energy Path First” (*Energy-starved systems*)
- “Open Least Used Reasonable Path First” (*Fairness*)

Need a mechanism that *extends (doesn't replace) COTS products*



Common Components Specific Instantiations

Common
Components



Environments	Tactical	IPN	Sensor Net	Other (TBD)
Specific Instantiations				

- Contracts awarded as of February 2005
- Kickoff meeting held 1 March 2005
- Mid-term PI meeting 2 August 2005
- University DTN testbeds (GaTech/UMass) urban ops experiment with multipath and rapid topology change (route breakage)



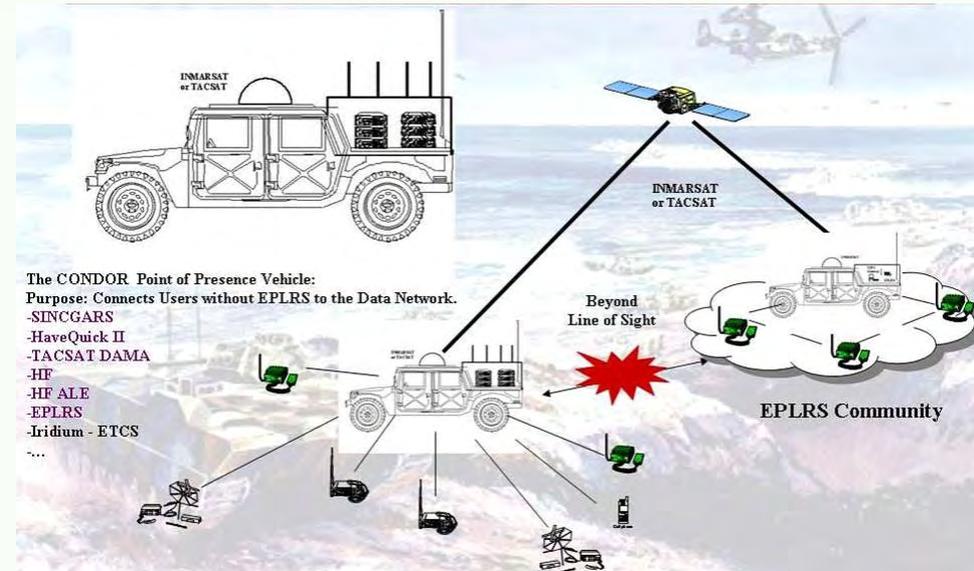
Stargate (PXA/Mote Sensor)



DieselNet: routers in 40 busses in Amherst

No one ever thinks they need DTN – until they try to build a network with IP radios

- JTRS saw need from DTN program inception
- Need demonstrated in FCS-C Demo3 (19-20 Aug 2003)
- AF Store and Forward among tactical users
- Vint Cerf strongly advocated to DISA & J6 for the GIG
- SPAWAR/Seaweb/Naval Special Warfare
- UNOLS/SWAP oceanographic MANET (ship-to-ship, ship-to-shore)



Marine CONDOR exercises – experimental DTN embedded in router

- gather data about network disruption in real environment
- see how DTN integrates with Marine Corps operations – how does DTN affect conops?
- early feedback to DARPA from a service
- help understand how time-value of data interacts with network disruption

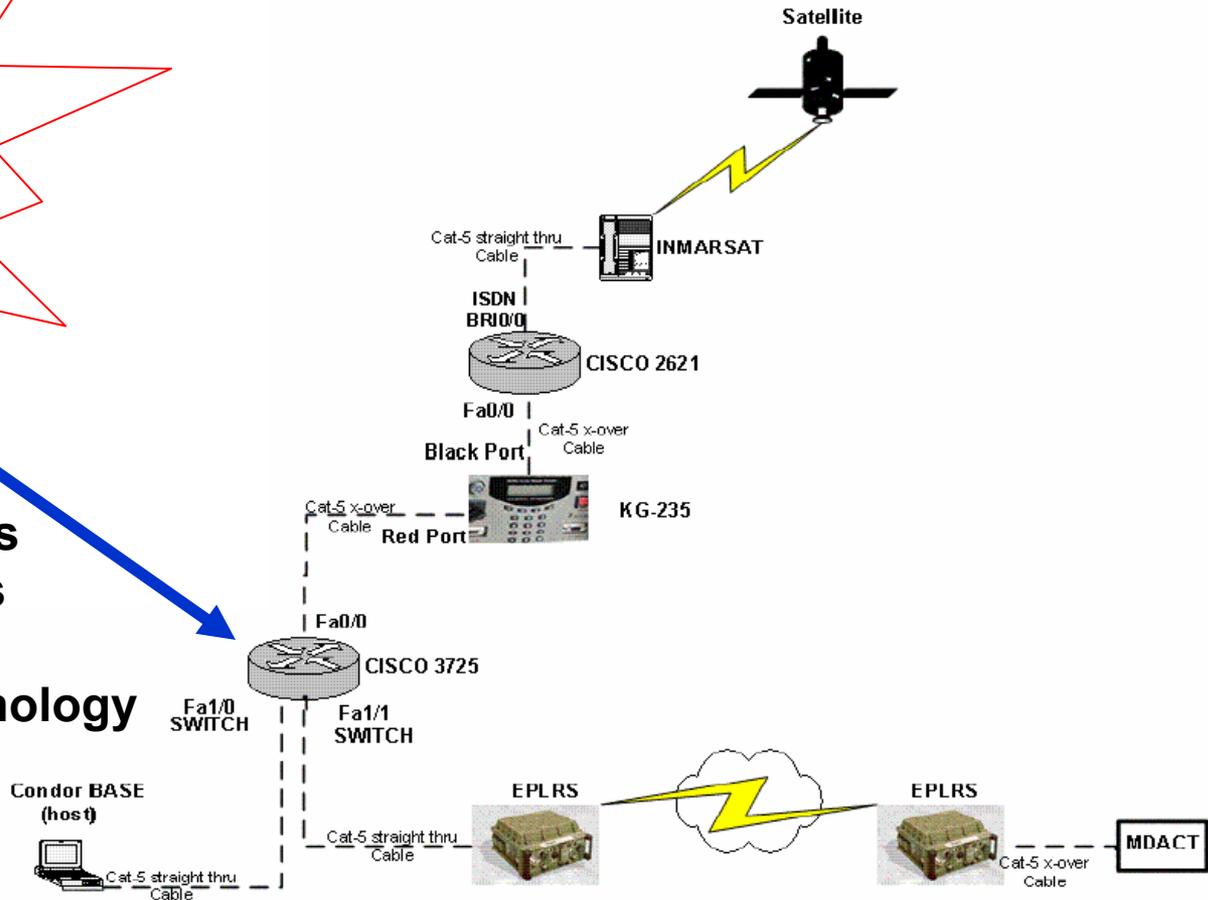
Minimal add'l power requirements
 No new space requirements
 Practical for others to use
 Exploits COTS CISCO technology
 (optional linux function card)
 EPLRS control not required

CONDOR Gateway Cable Map

DTN integrated directly into CONDOR Cisco Router

Benefits

- Minimal power requirements
- No new space requirements
- Practical for others to use
- Exploits COTS CISCO technology
- EPLRS control not required



How: Cisco Linux function card
COTS Hardware

- Sole demonstrated undersea wireless network
challenged environment – power, pressure, size, noise, bandwidth
difficulties similar to MANPACK radio (power, size, noise)
- Working towards transitioning several PORs – Sea Eagle, Sea Shield
(DARPA **CNAV**), DADS, 2010 Mine, Sub Comms @Speed&Depth
- Reality check for DTN in ‘brutal’ environments
Not a bolt-on – need a stripped down bundle protocol
Must be integrated into system with routing – may need to add to system to
support DTN
- Needs DTN for reliable networking
- Testbed – system to sea 4 times/year

***Can DTN be made to work in such
constrained environments?***

