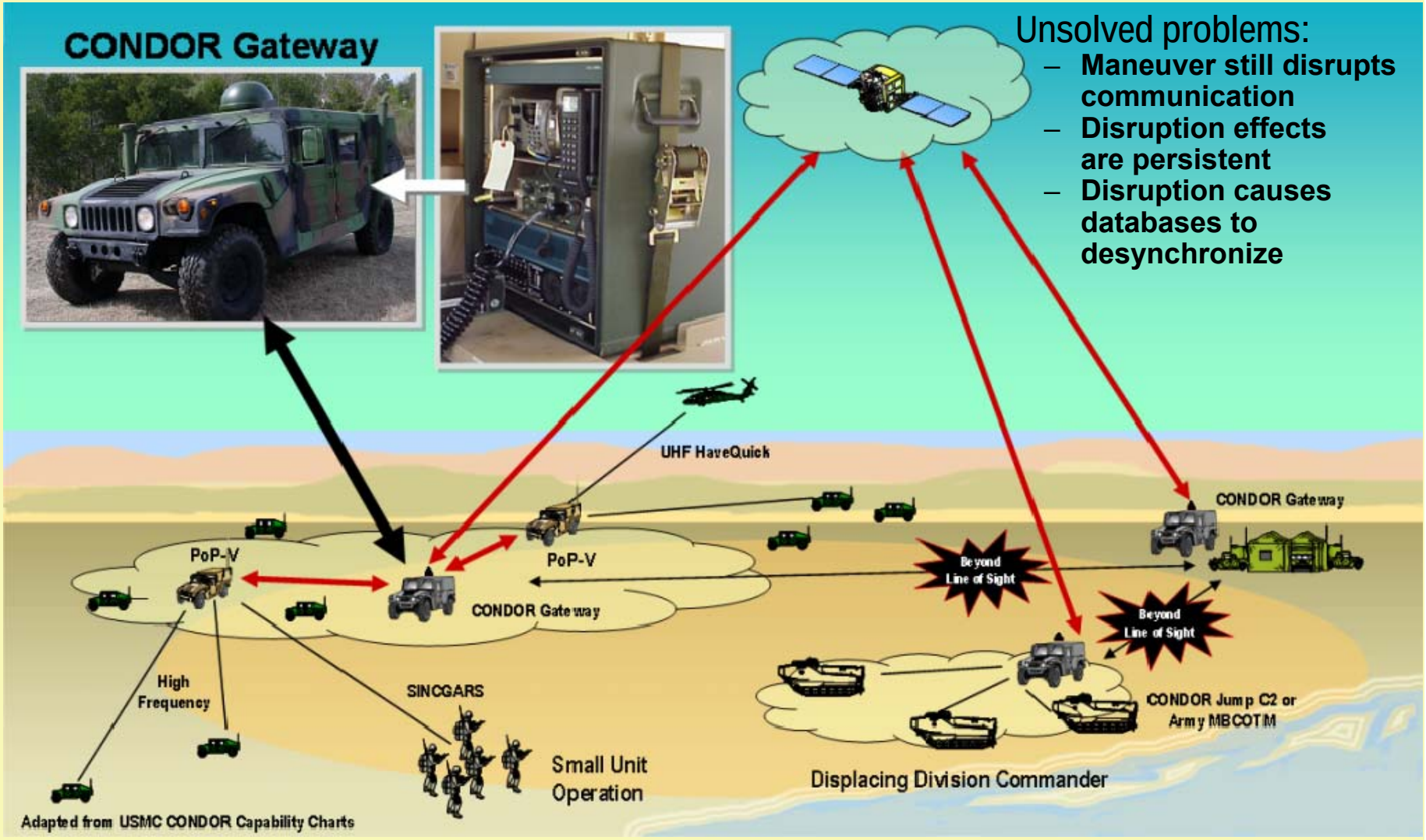
Disruption Tolerant Networking for CONDOR

Robert Durst
Salil Parikh
Keith Scott
Jason Andresen
Karl Tritchler
Tom Ullrich
Tim Bultman

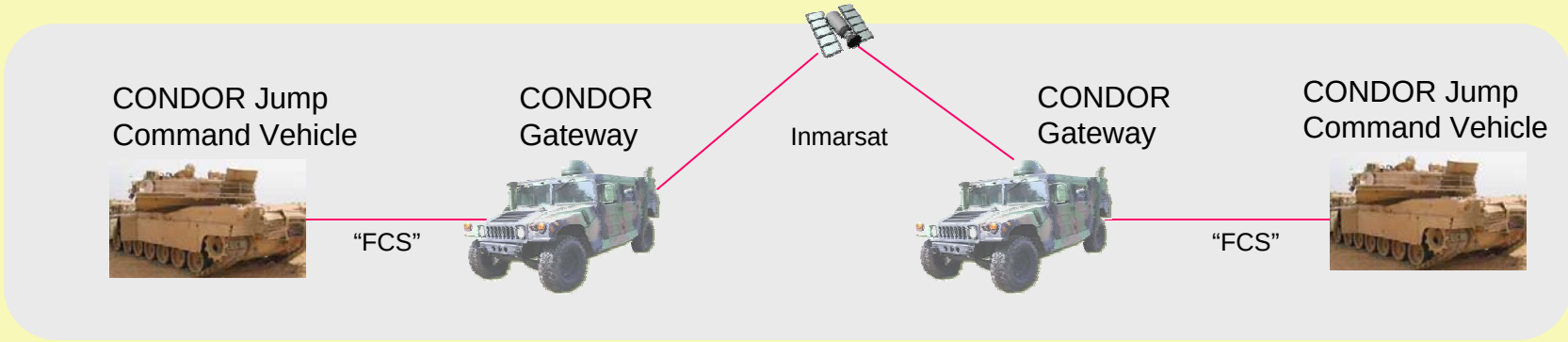
Marine Corps Approach: CONDOR
(C2 On-the-Move Network, Digital Over-the-Horizon Relay)

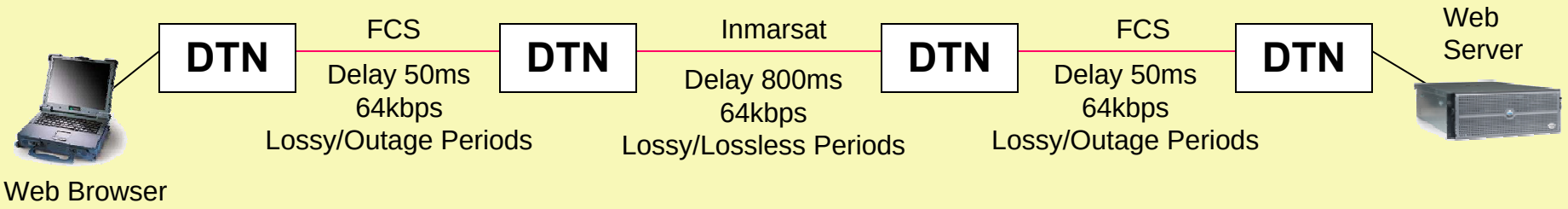


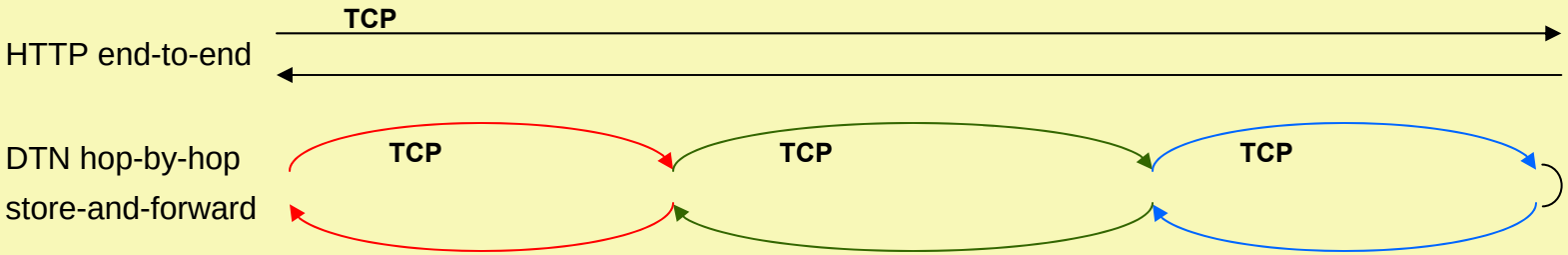
DTN for CONDOR: How can DTN help the USMC *NOW*?

- DTN can help maintain reliable communication across periods of unreliable connectivity through in-network store and forward
- DTN is useful for data transfers in which the time-value of the information exceeds the duration of the network disruption(s)
  - Likely wins: imagery, logistics information, email, chat(?)
  - Unsure: real time position/location information
  - Unlikely: fire-control
- DTN must support a relevant set of applications to enable forward C2
  - COP maintenance in disrupted environments
  - Web access
  - Chat
  - Email
  - Whiteboard?

DTN in Emulated CONDOR Context

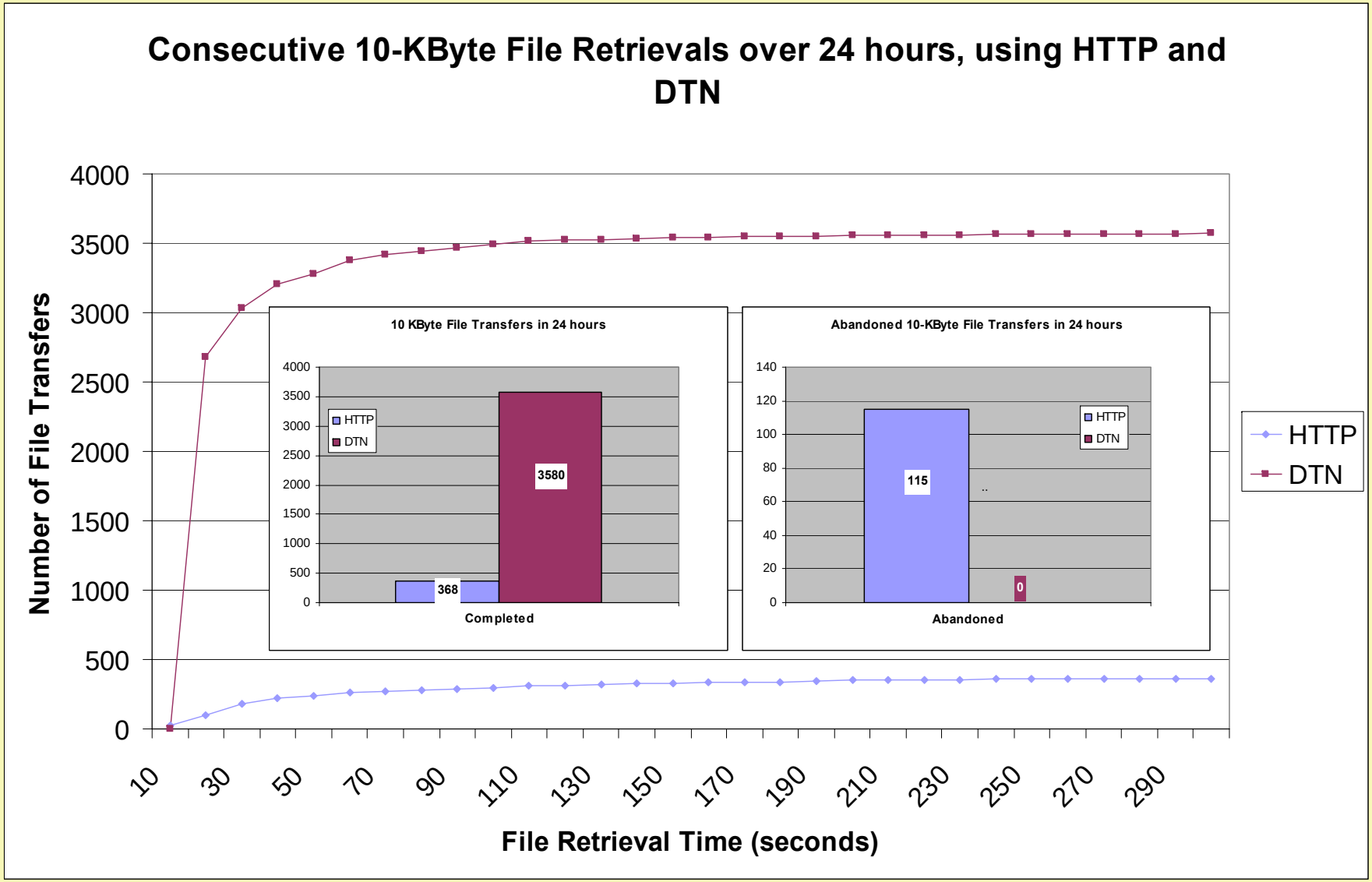






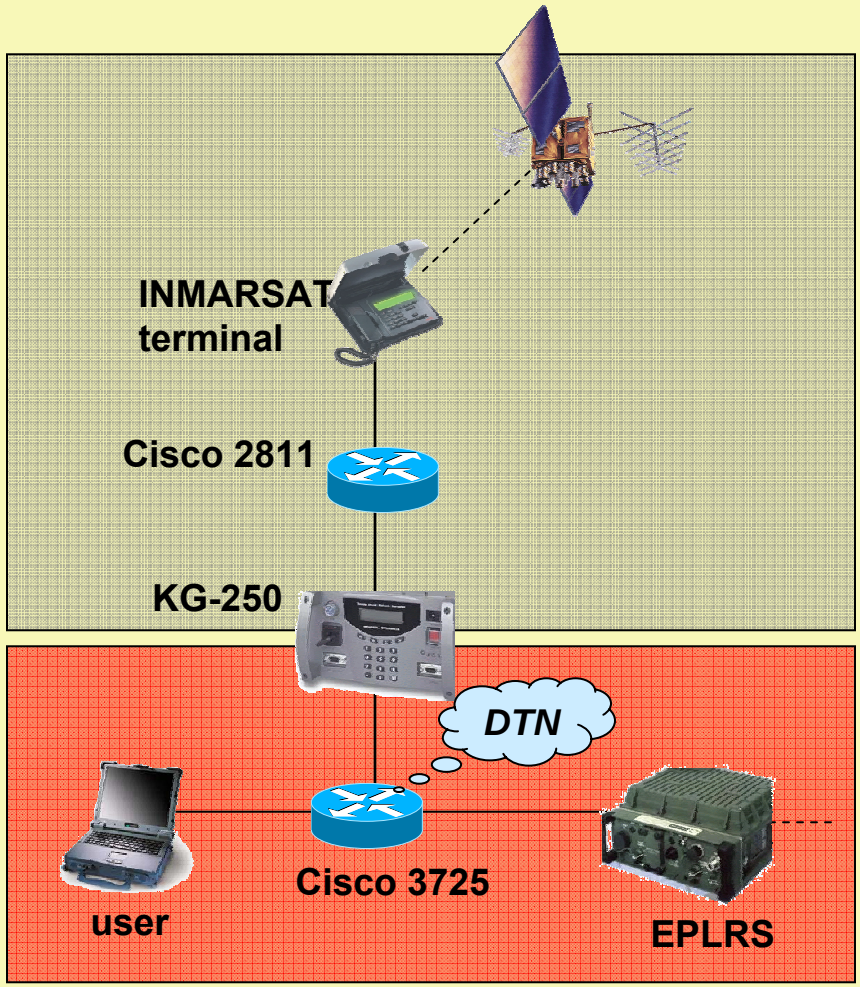
See also: M. Demmer, K. Fall, "Implementing Delay Tolerant Networking" for similar experiments

Distribution of File Retrieval Times



On lossless links: 7.15 seconds per transfer using TCP, ~10 seconds using DTN

DTN CONDOR Integration



CONDOR Gateway cable map

Goals

- Incorporate DTN functions into CONDOR in a deployable form
- Minimize imposition on size, weight, power

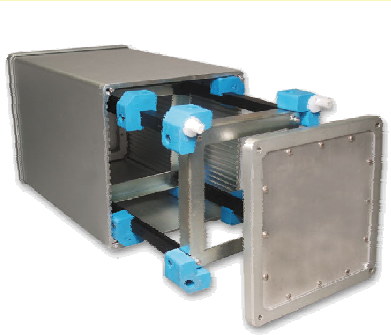
Current packaging approaches

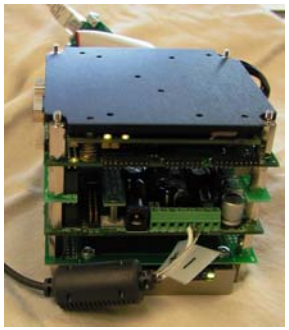
- Cisco Intrusion Detection System module (FY05)
- Stand-alone PC/104 unit (FY06)
- Cisco Mobile Router add-in (FY06)

Applications in work

- C2PC support
- Web Services
- Web Proxy
- Chat Proxy
- SSL Support

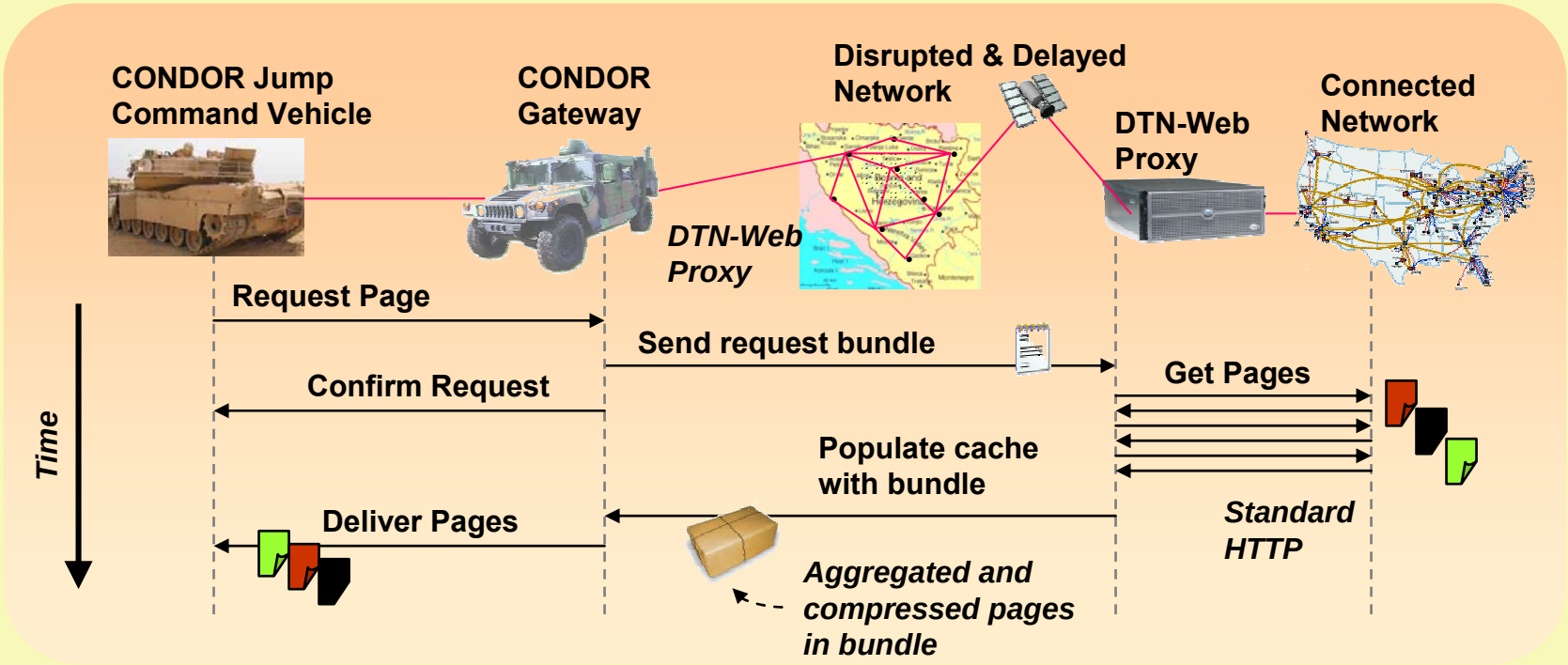
DTN CONDOR Alternative Packaging





- **CIDS/Application Oriented Networking Module**
  - **Standard Cisco module**
  - **AON architecture**
  - **Powered through host Cisco router**
- **Stand-alone PC-104 unit**
  - **All solid-state, extended temp range, NIMA-sealed unit (6” x 5” x 5”)**
  - **Router-independent**
  - **Vehicular power (9-60vDC)**
- **Integrated DTN and Cisco Mobile (“Grizzly”) Router**
  - **Same PC-104 stack as above**
  - **Integrated with Cisco PC-104 extended temperature router**
  - **CONDOR Red-side router replacement**

DTN-Web Proxy Operation

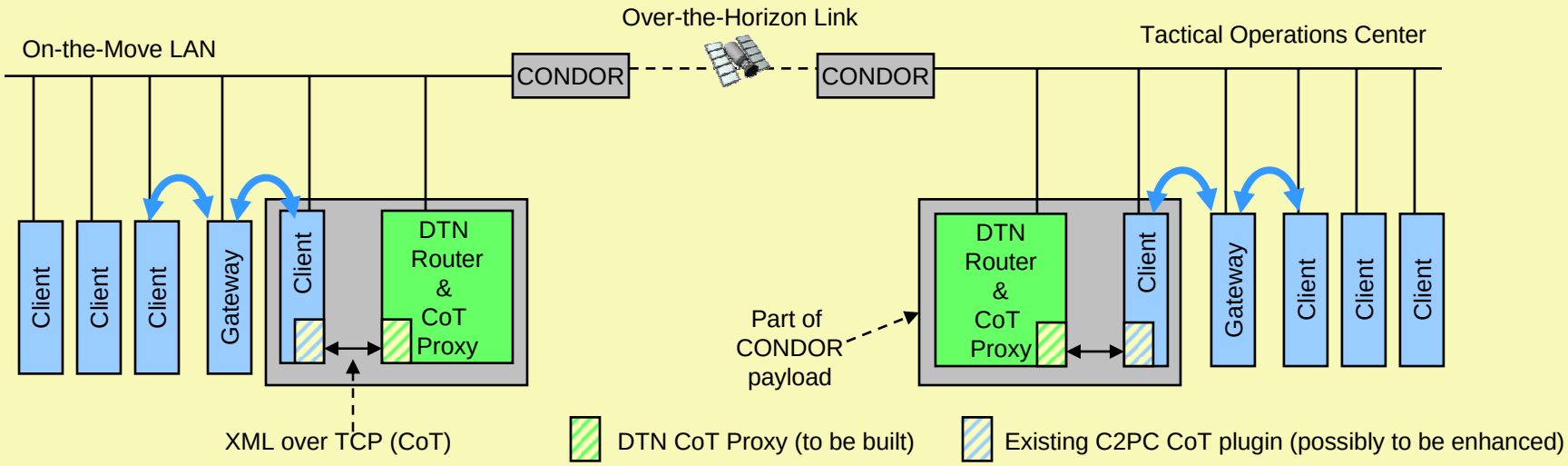


- DTN's web proxy provides transparent access to DTN services
- Adds user-directed search to further reduce interactivity

DTN Support for Chat

- Transparently deal with “net splits” and “net joins” by automatically rejoining when connectivity is re-established.
- Keep temporarily untransmittable messages queued for a specified amount of time and then allow them to pass normally if the network reconnects before the message expire.
  - Optionally add tags (timestamps) to old messages to avoid confusing other users in the network.
- Use a proxy server between IRC servers to allow users to use their existing clients and servers.
  - Use local IRC server at CONDOR to insure timely uninterrupted local chat using conventional communications protocols
  - Use DTN Chat-server proxy between local and remote servers
- Current status:
  - Designed, implemented DTN Chat-server Proxy that interacts with a (any) local chat server and appears to be another server
  - Provides server to server proxying via DTN
  - Working, but not yet stable enough for deployment

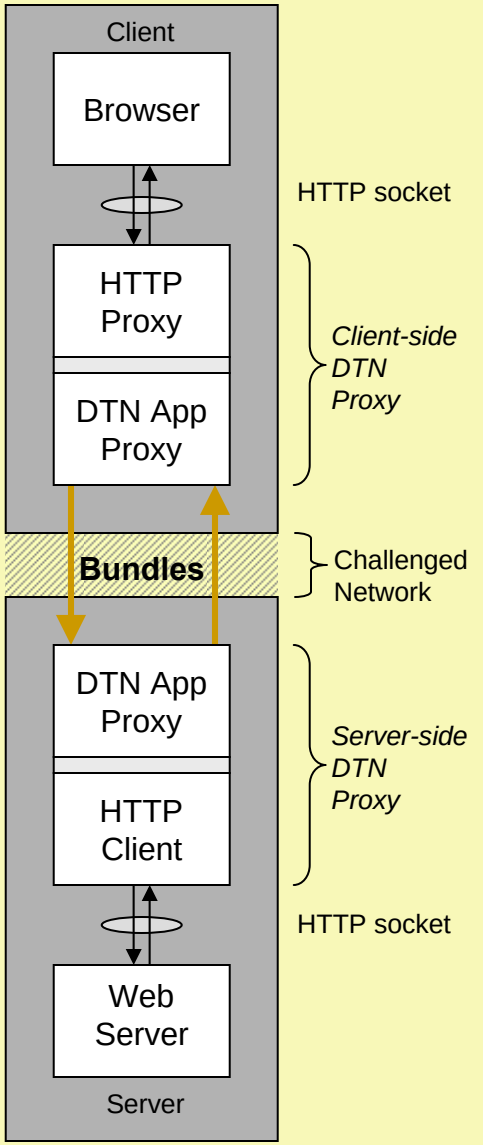
Experimental Design (Work in Progress): DTN Proxy for C2PC Using Cursor on Target (CoT)



- **No direct Gateway-to-Gateway traffic across Over-the-Horizon link.**
  - **CONDOR red-side router configured to block C2PC traffic**
  - **DTN's CoT proxy maintains sync between Gateways indirectly via CoT**
- **Open questions:**
  - **How to transition from Gateway-to-Gateway to DTN-CoT Proxy when Over-the-Horizon link is invoked?**
  - **How best to synchronize a Gateway by way of a C2PC Client (via CoT)?**
  - **How to ensure all events of interest are accessible? How to limit sync *only* to events of interest (e.g., PLI, tracks, overlays, possibly location-specific)?**

Web-Service Apps in DTN Setting

- Typical browser-based SOAP apps are unsuited to delayed or disruption-prone environments
  - Subject to HTTP synchronous request-response limitations
- App logic needs modification
  - To use polling, events, messages
  - To be cache-friendly, use configurable timers
- App-specific DTN proxy
  - Serves as DTN gateway
  - Performs caching function
- Issues
  - Transparent solution unlikely, only general guidelines for design
  - Client configuration complications
- Apps under examination
  - MarineLink
  - Lightweight Collaborative Whiteboard



DTN Support for SSL

- Needed to support Outlook Web Access (currently used by USMC for email)
- Initial design (not yet implemented/tested):
  - SSL uses record-oriented protocol over TCP for all exchanges
  - Proxy encapsulates SSL records in Bundles
  - Proxy presents an “HTTPS Proxy” interface (or can be “interception” style)
  - Proxy handles reordering/reassembly of SSL records at decapsulation point.
- Potentially a general approach to support HTTPS/SSL traffic
  - Initial characterization of OWA delay sensitivity planned using delay emulator

Next Steps…

- How can we best complete and transition this work to the USMC? What should we be doing now to ensure smooth handover?
- What steps can be taken to ensure that the transition to operational use is smooth and effective?
  - Exercise/evaluation by USMC Comm Officers?
  - Maintenance and support arrangements?

Thanks!

Questions?