

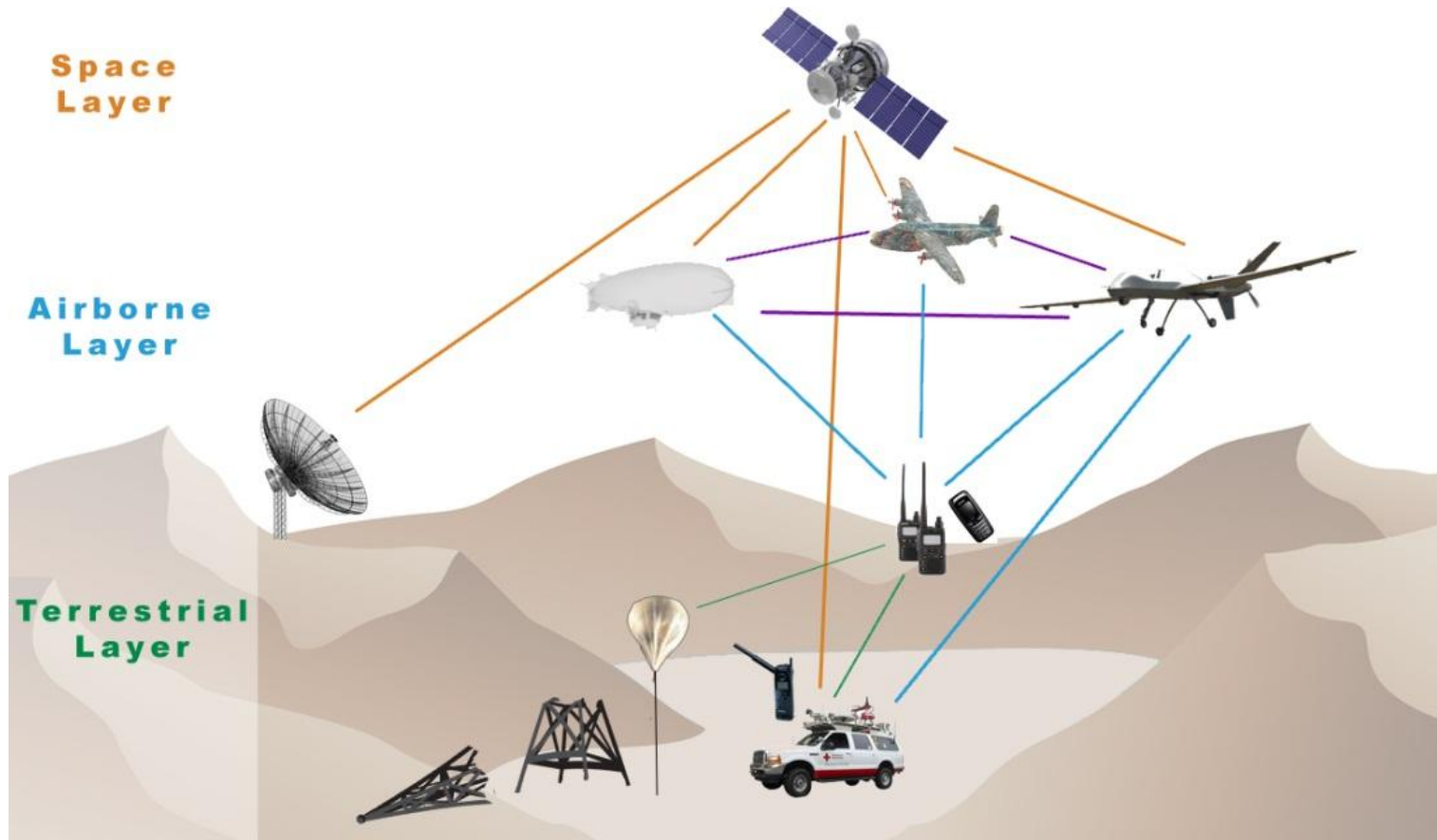
# Recovering Broadband and LMR Communications After Large Disasters

Focus on Civilians

**APCO Broadband Summit**  
Washing, DC  
USA  
May 14, 2013

**Dr. Daniel M. Devasirvatham**  
President  
Wi-Plan Wireless Consulting  
San Diego, CA  
(858) 366-8994  
[DanielD@Wi-Plan.com](mailto:DanielD@Wi-Plan.com)  
[www.wi-plan.com](http://www.wi-plan.com)

# Recovery Communications - Overview



**The three layers for communications restoration**

# The Layers and Operational Model

Recognize three layers for Disaster recovery communications

- (1) Space Layer: Quickly covers large areas with SATCOM
  - Goal: Strategic communications/management/situational awareness
  - Compact VSAT terminals with data and some VOIP, first to decision centers, then to the field with local rebroadcast
  - Low capacity portable terminals. Some tactical voice & data communications
- (2) Add Airborne Layer to increase recovery information flow
  - Goal: Replace damaged infrastructure/transmitters with airborne equivalents
  - Allows common access network terminals such as land mobile radios to function at limited capacity to enable significant tactical communications
- (3) Begin traditional Terrestrial Layer communications recovery
  - Goal: Gradually bring up ground infrastructure supported tactical comms
  - Bring in NIFC resources, cells-on-wheels, FEMA Multi-Radio Vans (MRVs), rig up alternative antenna sites, etc., as done traditionally

# Convergence of Civilian and Public Safety Comms

---

- Super Storm Sandy highlighted the importance of civilian communications
  - Loss of about 25% of cellular sites in the affected areas
  - Loss of power (most serious problem)
- Civilian population cut off from vital information
  - Even in the most densely populated areas of the 5 boroughs of NYC
  - Makes recovery assistance harder
  - Loss of contact with loved ones (+medical issues, elderly jeopardized)
- FirstNet has been set up to deploy Band 14 LTE
  - First Responders broadband could also be affected by major storms
  - First Responders also roam onto and use civilian LTE/Cellular
  - Providing alternative infrastructure to PS LTE could be complemented by Civilian LTE
- Use Same Relay platforms to restore (LMR and) Cellular
  - Can also be used to restore PS LTE and Civilian Cellular/LTE
  - Note: no LMR sites were disabled by Sandy

## Recovering Cellular Communications

---

- Complete Systems on Wheels (SoW) now available
  - Include a mini Evolved Packet Core (EPC)
  - Configure for Airborne operation and network with appropriate relays
  - Service Providers could pay for SoWs for their networks/bands to be also flown
  - May need to be configured to accept all users in their bands
- Avoiding the Overload Problem:- CMAS first
  - Start in information broadcast-only mode:- use Cellular Mobile Alert System (CMAS)
  - First Responders get deployment and emergency action information
  - Civilians get emergency relief information
- Enable SMS / Text messages/ Text-to-911
  - NG-911 (Next Generation 911) calls in text mode could be primary
  - Allows people to contact 911 to ask for help, send and receive personal messages
  - Allows the sending and reception of First Responder Instructions
  - Latency not important; Much more likely to get through, Conserves battery power

## Airborne Multi-Radio Vehicles (A-MRV)?

---

- Multiband, Multi-system Multi-mode radios, and antennas
  - Like FEMA MRVs; but for airborne communications
  - VHF, UHF, 700/800 LMR
  - 700, 800, 1900 MHz, Broadband & Cellular
- Antenna patterns, frequencies, waveforms, power levels
  - Use the new 3.5 GHz band proposed by the FCC for Relays?
  - Automatically adapt to track other relays while minimizing interference on ground
  - Adjust down-tilted beams of base stations to cover only needed areas
  - Replacement coverage, & extending coverage of operational systems
  - Cognitive systems to provide local coverage while minimizing interference to working systems elsewhere?
- Intelligent Self-organizing Networking (SoN) built-in
  - Context aware cognitive radio could be big in the future.

## Summary

---

- Space and aerial platforms have a crucial role to play in large disasters!!
- There are still some engineering issues to be nailed down
  - Link Budgets, Coverage, interference, Relay Networks
  - User admission control, networking
- Challenge powering cellphones after extended power outage
- Don't forget AM and FM radio for information broadcast
- Input from Public Safety is vital
- Develop CONOPS, SoPs, MoUs, FAA flight procedures
- Further work needs to be done to make this a national, state, and local strategy

## Resources

---

Daniel M. Devasirvatham: “Recovering Communications After Large Disasters”, Wireless Innovation Forum SDR’11-WInnComm Europe Proceedings, pp 61-65, June 2011. Also APCO Public Safety Communications magazine, pp 26-28, May 2011.

Proceedings of the Disaster Recovery Communications Workshop, Wireless Innovation Forum, San Diego, March 15, 2012 <http://groups.winnforum.org/p/cm/ld/&fid=260>

Devasirvatham: “Interference and Capacity Considerations for Aerial Deployments in Disasters”, FCC Panel on Aerial Deployments, October 31, 2011

Devasirvatham: “Interference and Coexistence in Recovery Communications After Large Incidents”, SDR’12-WInnComm-Europe, Brussels, June 29, 2012

Devasirvatham, Neel, Tompsett, Link: "3 Layers of Communications Recovery", Mission Critical Communications Magazine, pp 62-65, March 2013, (Invited)

Neel et. al: “Context Aware Cognitive Radio”, Wireless Innovation Forum European Conference, Munich, Germany, June, 2013

**Wi-Plan Wireless Consulting**

(858) 366-8994

[DanielD@Wi-Plan.com](mailto:DanielD@Wi-Plan.com)

[www.wi-plan.com](http://www.wi-plan.com)