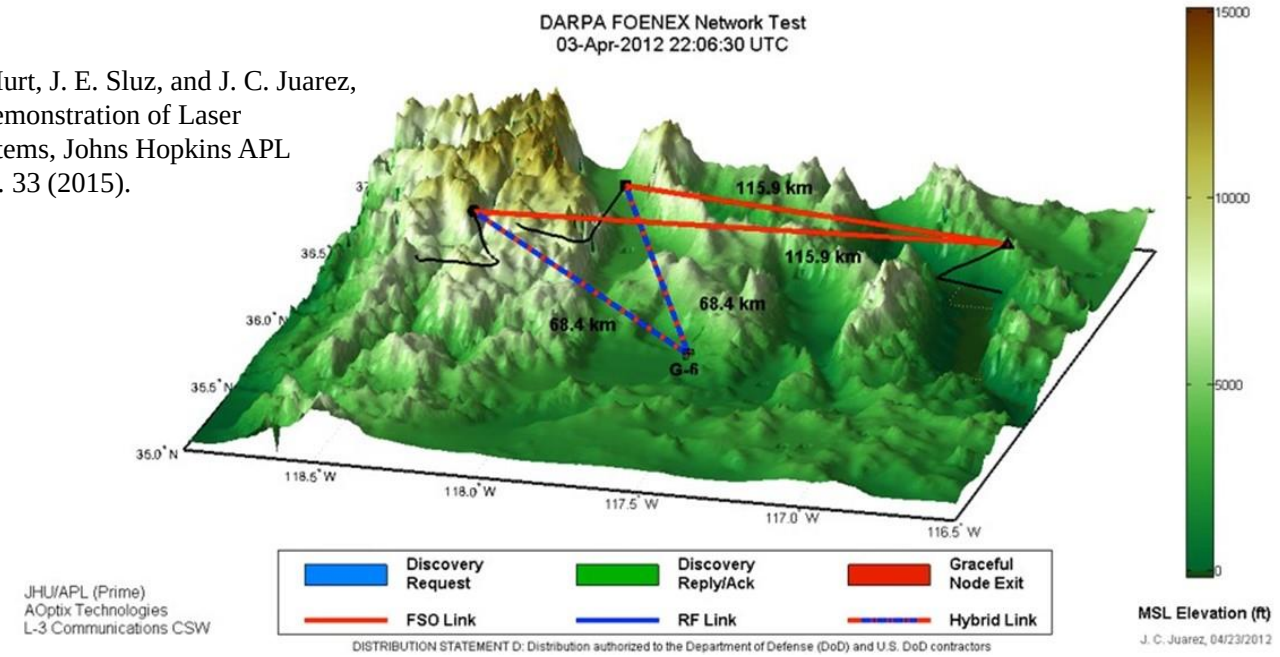
Progress Towards Reliable Free-Space Optical Networks

D. W. Young, H. H. Hurt, J. E. Sluz, and J. C. Juarez, [3]Development and Demonstration of Laser Communications Systems, Johns Hopkins APL Technical Digest, Vol. 33 (2015).



Dr. Larry Stotts
Stotts Consulting LLC

13 July 2017

FOENEX Program Objectives

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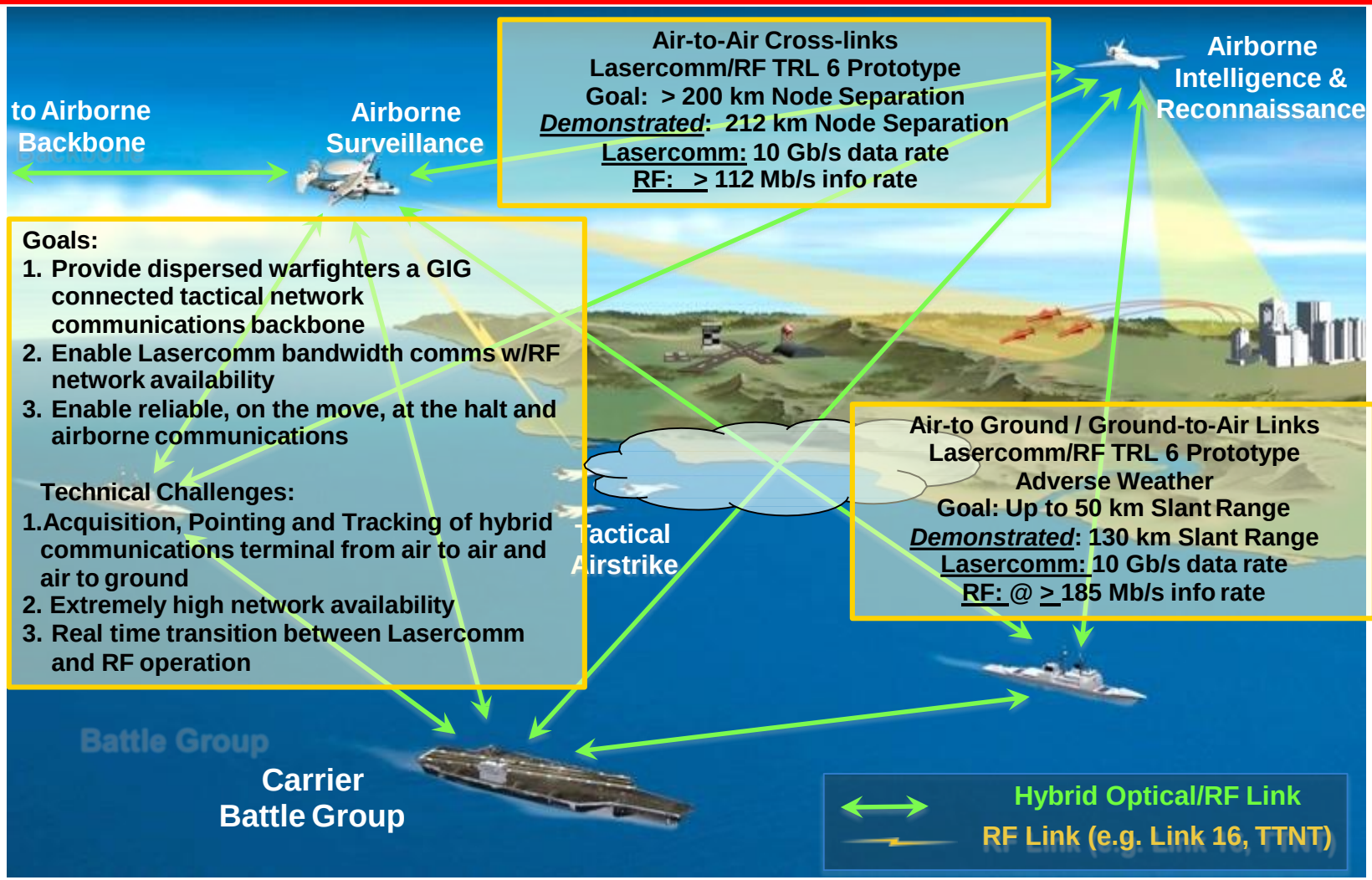

Primary Goal: Demonstrate a four-node hybrid Lasercomm/RF airborne mesh network which provides high availability, high bandwidth, end-to-end connectivity

FOENEX Hardware Configuration

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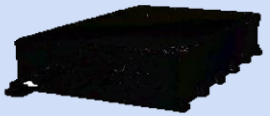
Network router/ formation, retransmission system (XIA)

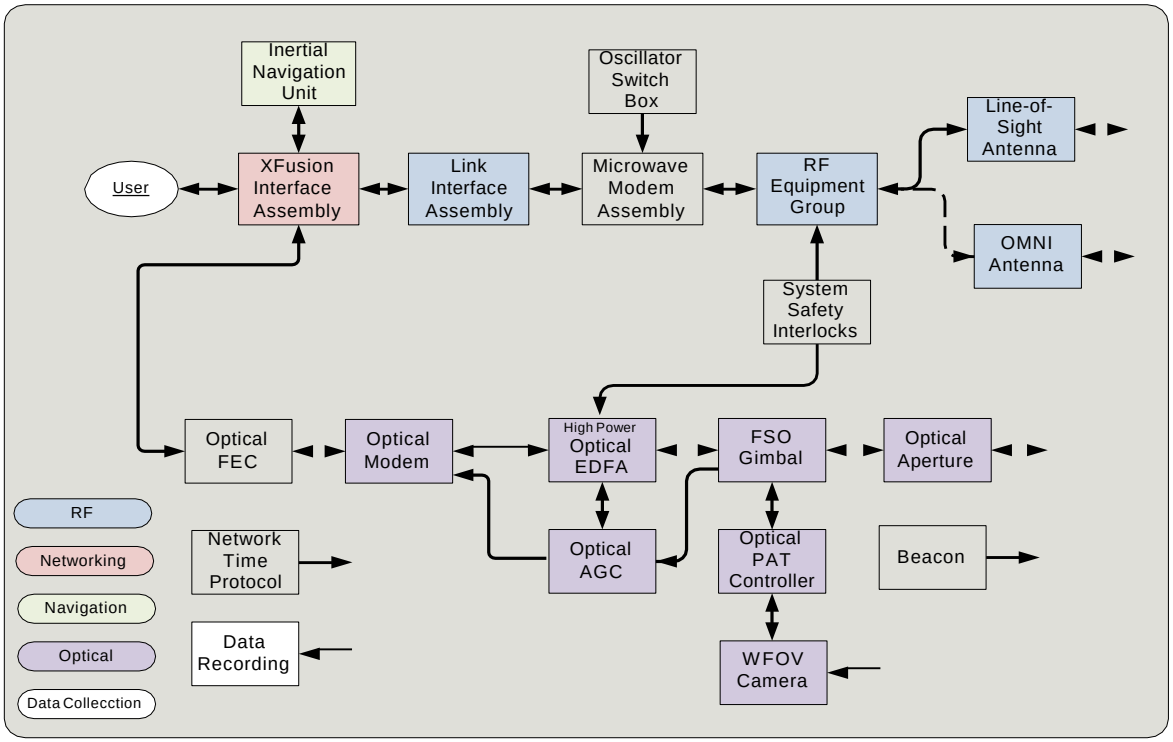
XIA to RF modem Interface adapter

RF Modem

Oscillator Switch Box (OSB)



RF Electronics



RF Antenna

10 Gbps Optical Modem, Optical Automatic Gain Control System (OAGC), Forward Error Correction (FEC)

Free Space Optical (FSO) Terminal

ORCA/FOENEX Network Stack Capabilities

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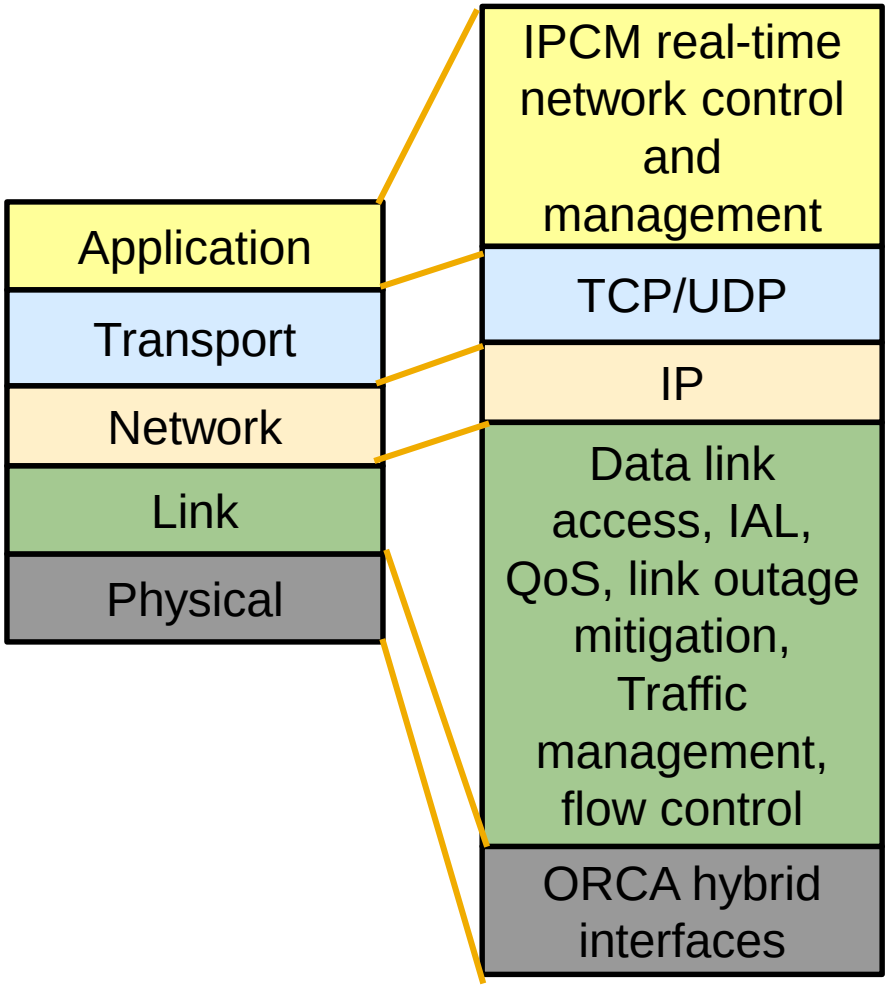
- **Capabilities of the FOENEX Network stack**
  - **Network discovery, formation/reformation through real-time network control (discovery subsystem and Inter-Platform Communications Manager (IPCM))**
  - **Hybrid link management and control**
  - **Link outage mitigation through predictive link outage, Layer 2 re-transmission for handling scintillation effects, deeper queues for 2-3 second cloud blockages and replay of data for 5 second outages**
  - **Mobility management to dampen the effects of mobility on standard Internet protocols (IPCM Adaptation Layer (IAL))**
  - **Integrated Diffserv QoS for priority and internal and external ORCA network users, traffic management and flow control**



Focus of initial experiments was link layer retransmission performance

Example Experimental Results [183 km/ 5xHV5/7 (85%)]

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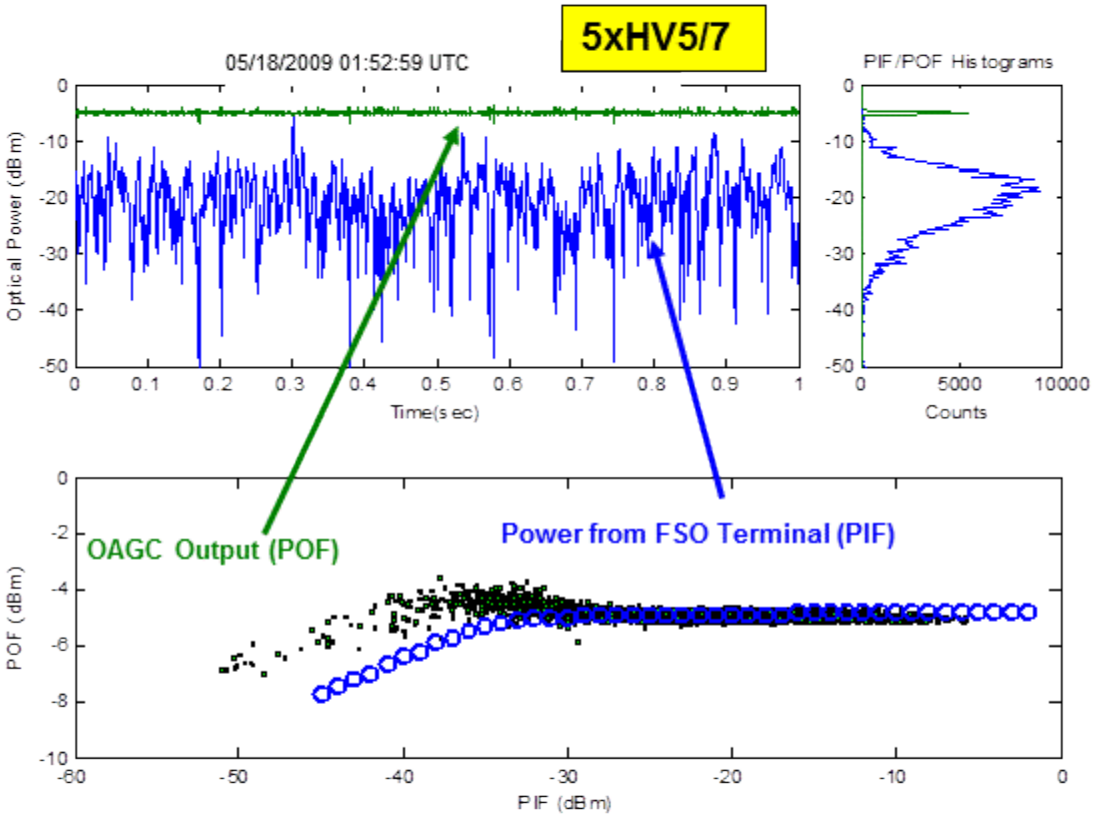

ORCA Field Test POF vs PIF - 18 May 2009, 01:52:29 UTC

Lab Measured POF vs PIF – 23 Jan 2009

- Field-measured OAGC response – OAGC output (POF) vs power from FSO terminal (PIF), OTM system
- 18 May 2009, 01:52 UTC, aircraft range ~ 183 km
- Fielded system had 2 dB higher gain at low PIF than the system measured in the lab -caused by minor system upgrade prior to field test

Example FOENX Experimental Results at ~20xHV5/7

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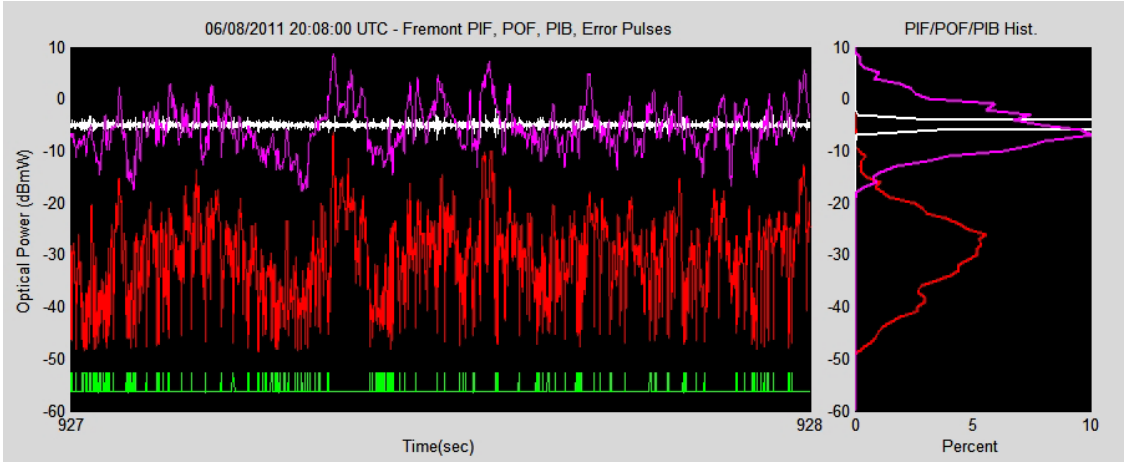
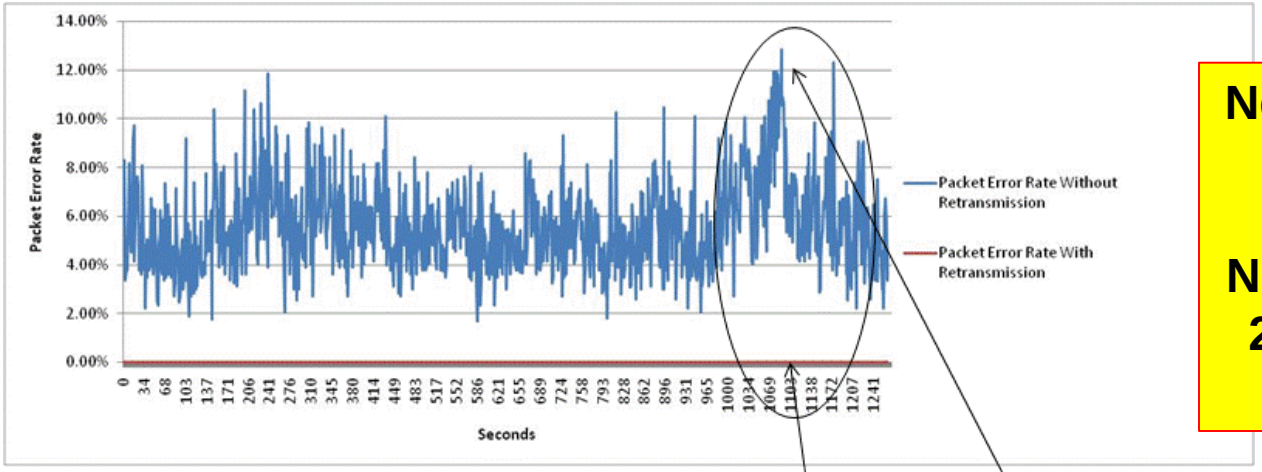
Fremont Peak at 1 PM local time, 8 June 2011





Network Rerouting and Retransmission Needed to Mitigate 20xHV5/7 (>99%) Turbulence