Through the Looking Glass: The Pacific Littoral ISR Experiment (PLIX)

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Presentation Outline

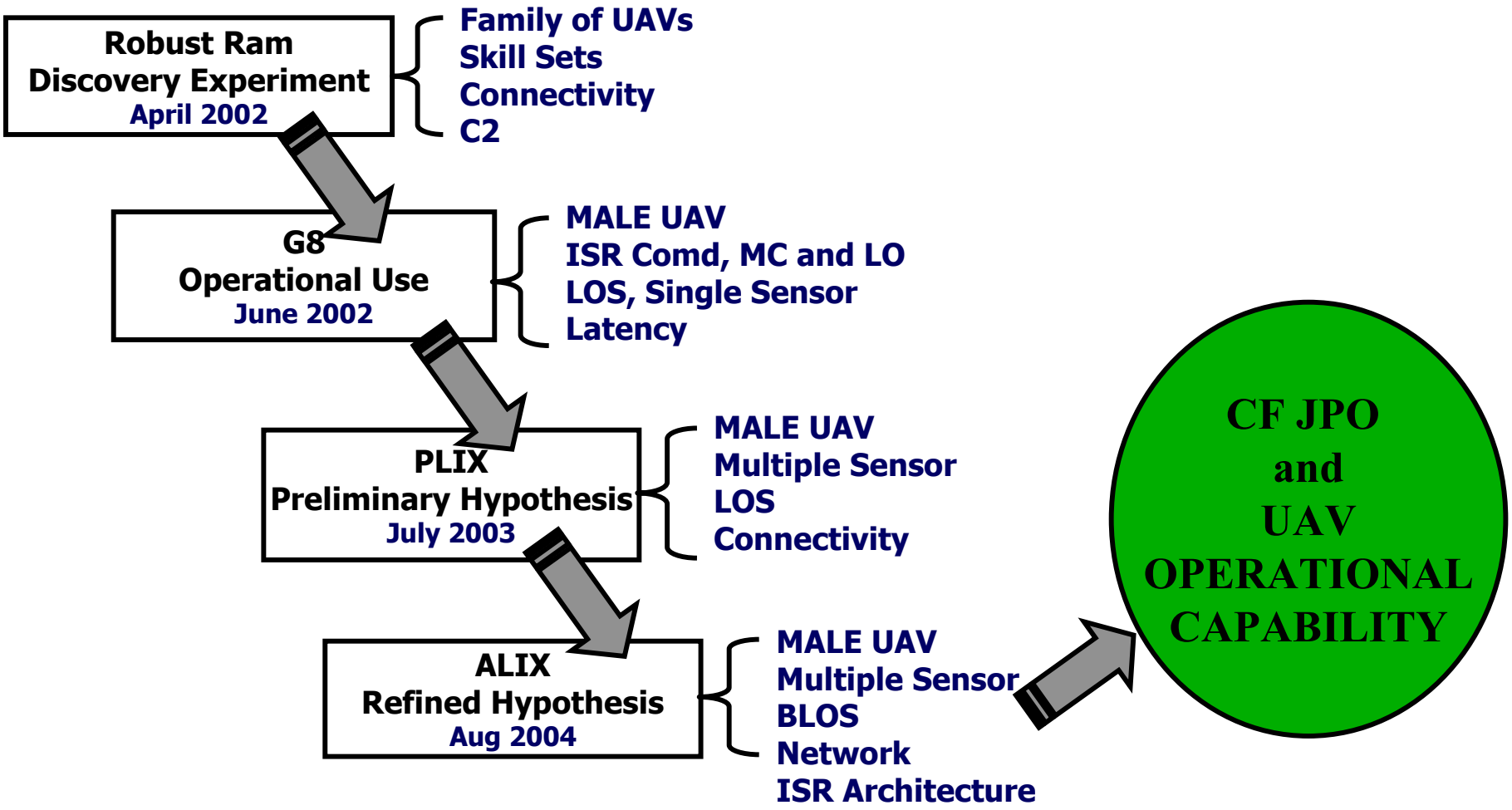
- Joint CD&E in Canada
- Objectives and Experiment Design
- Experimental Setup
- Findings and Way Ahead
- Questions

CFEC CD&E Areas – PLAN PEGASUS '02-'04

	INTEGRATING CONCEPT	FUNCTIONAL CONCEPT	EMPLOYMENT CONCEPT
CAPSTONE CONCEPT STRAT 2020	COMMAND & CONTROL	***EFFECTS BASED OPS***	POL-MIL
			COLLABORATIVE PLNG
			JOINT TARGETTING
		COLLABROATIVE INFORMATION ENVIRONMENT	***COP 21***
			FUTURE CFCS
			COMBAT ID
	INFO & INTEL	***INTEGRATED ISR ARCHITECTURE***	***UAVs***
			TPPU
			C2 ISR SYSTEMS
		EFFECTS BASED ASSESSMENT	RED TEAM
			GLOBAL INFO GRID
			KNOWLEDGE MGMT
	SUSTAIN	LOGISTICS INFO FUSION	***COMMON LOGISTICS PICTURE***
			LOGISTICS DECISION SUPPORT
			LOGISTICS PLANNING AND EXECUTION
		JOINT AND COMBINED LOGISTICS INTER-OPERABILITY	ALLIANCE/COALITION LOGISTICS
			INTEROPERABILITY WITH OGDS/NGOS/ CONTRACTORS
			CF JOINT LOGISTICS

PLIX '03
ALIX '04

UAV/ISR CD&E Progression

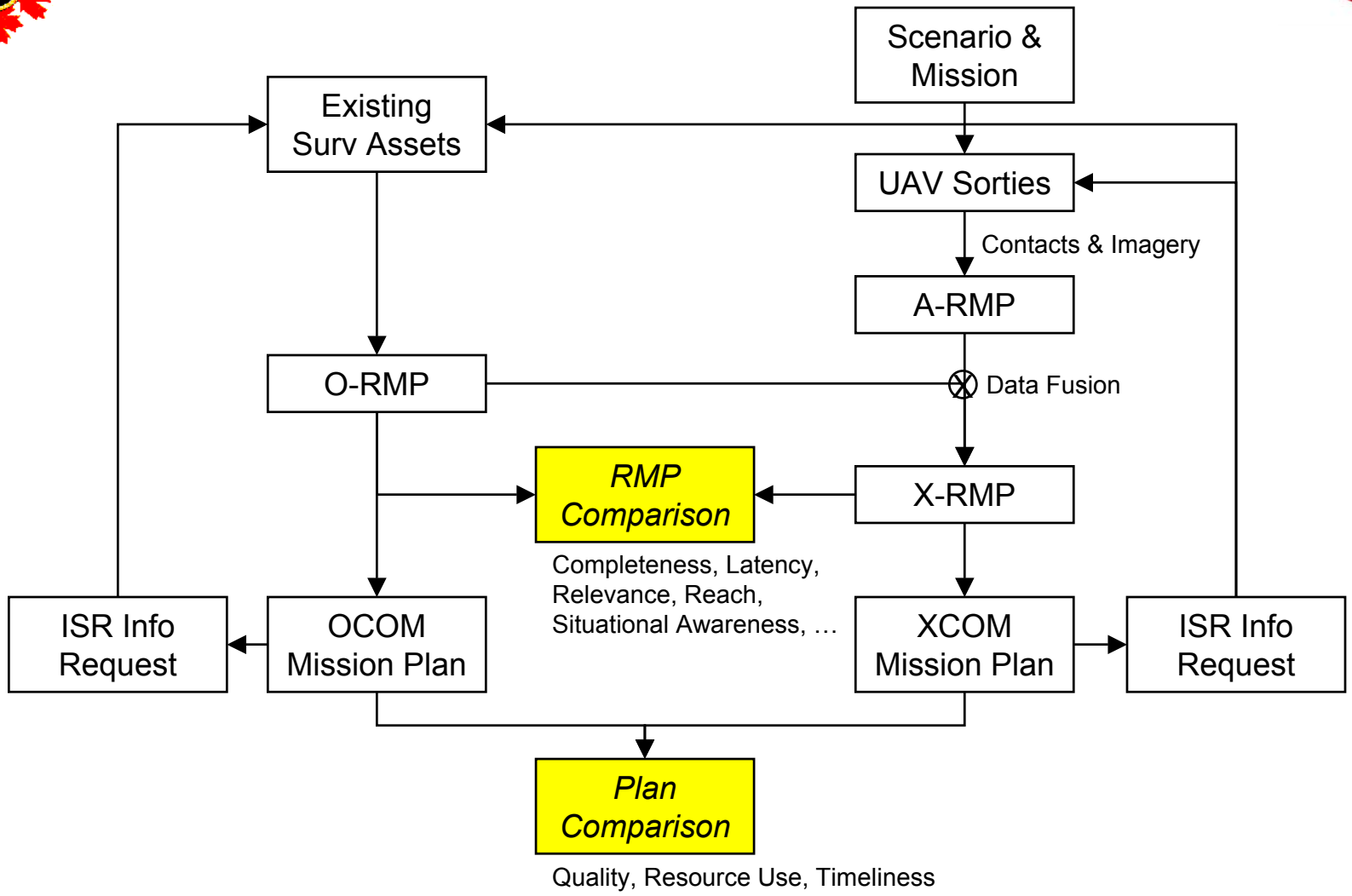


PLIX Objective and Hypothesis

- Assess the utility of the PLIX UAV to support the construction of a RMP within a specific littoral operations area.

- If PLIX UAV patrols a designated littoral operations area, then all surface contacts are detected, continuously tracked, and positively identified in the Experimental RMP (XRMP) of the operations area before the end of the patrol.

PLIX Experiment Design



PLIX Experimental Design

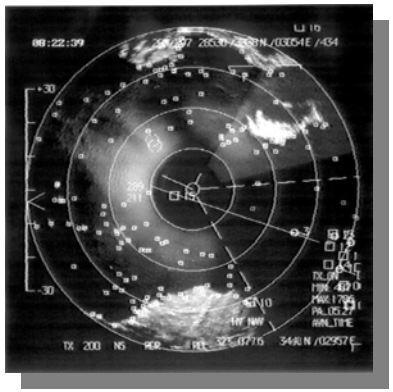
Scenario Vignettes and UAV Flights

- Mission 1 Area Surveillance
- Mission 2 Search and Rescue for Overdue Ship
- Mission 3 Locate and track Vessel with Illegal Immigrants
- Mission 4 Locate, track, and provide targeting for Vessel of Interest with WMD

DATE	TYPE	TAKE OFF	LANDING	FLYING TIME	REMARKS
3 Jul	Functional Test	1630 L	1702 L	0.53 hrs	Without Payloads
4 Jul	Systems Test	Cancelled – Radar unserviceable			
6 Jul	Systems Test	Cancelled – Weather			
7 Jul	Systems Test	1310 L	1520 L	2.17 hrs	With Payloads
8 Jul	Flight 1	1201 L	1613 L	4.20 hrs	
9 Jul	Flight 2	1252 L	1858 L	6.10 hrs	Suspect Pollution Violator detected
10 Jul	Flight 3	1058 L	1658 L	6.00 hrs	
11 Jul	Flight 4	1200 L	1508 L	3.13 hrs	
13 Jul	Experiment	Cancelled – Weather			ENDEX
TOTAL				2.7 / 19.43 hrs*	

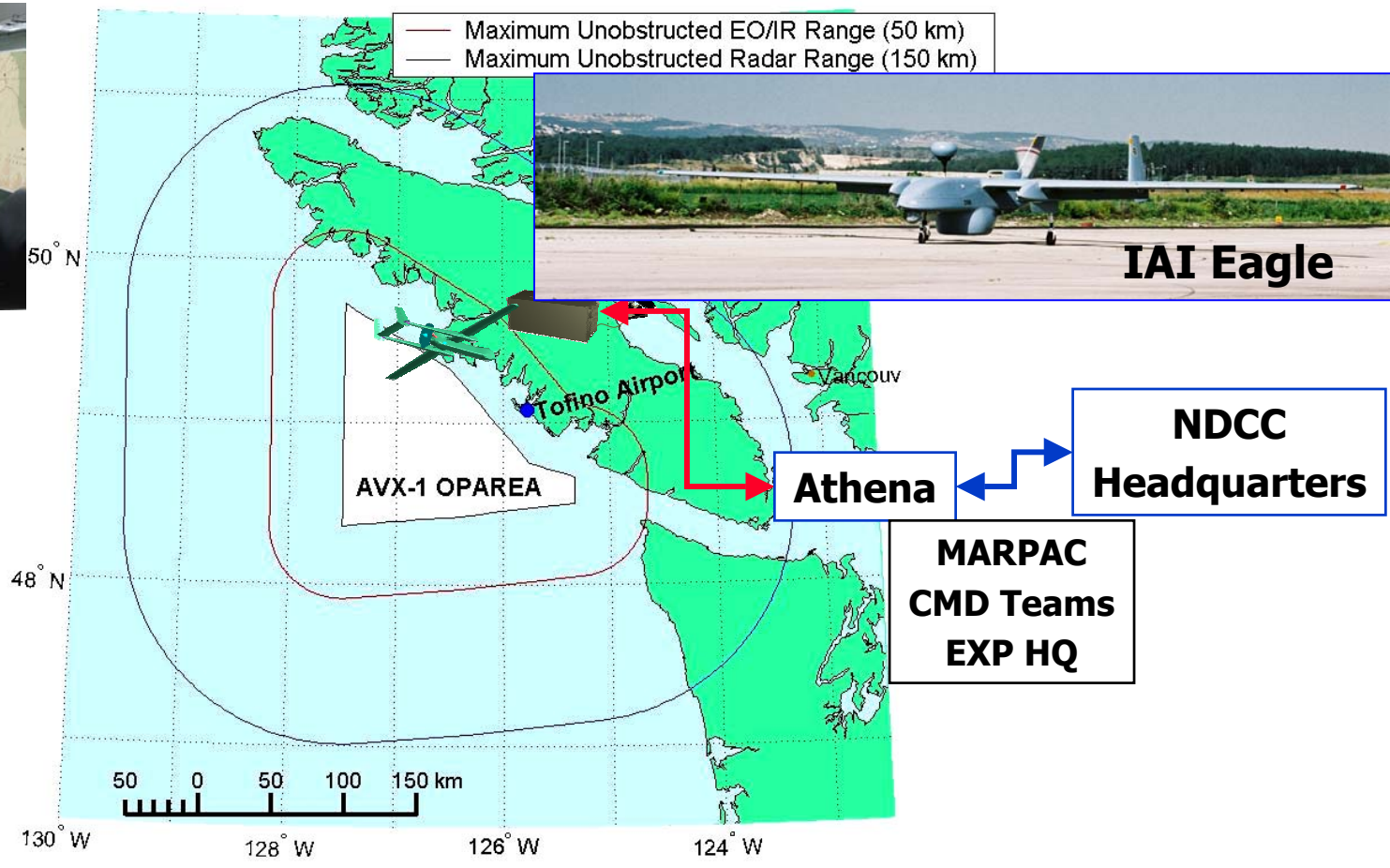
MALE UAV

Sensor Performance and OPAREA



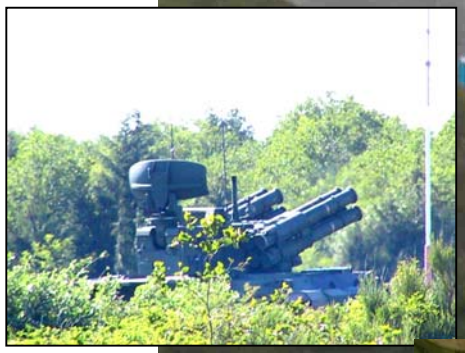
Manufacturer's Typical Detection Ranges

Dinghy 22nm
Fast Patrol Boat 55nm
Tanker/Corvette 130nm



Operational Sponsor: CMS

Tofino Air Operations Layout



Participating Naval Units

CCGS BARTLETT

CCGS GORDON REID

CCGS SIR WILFRID LAURIER

CCGS TANU

Position recording every 6 minutes during experiment period.

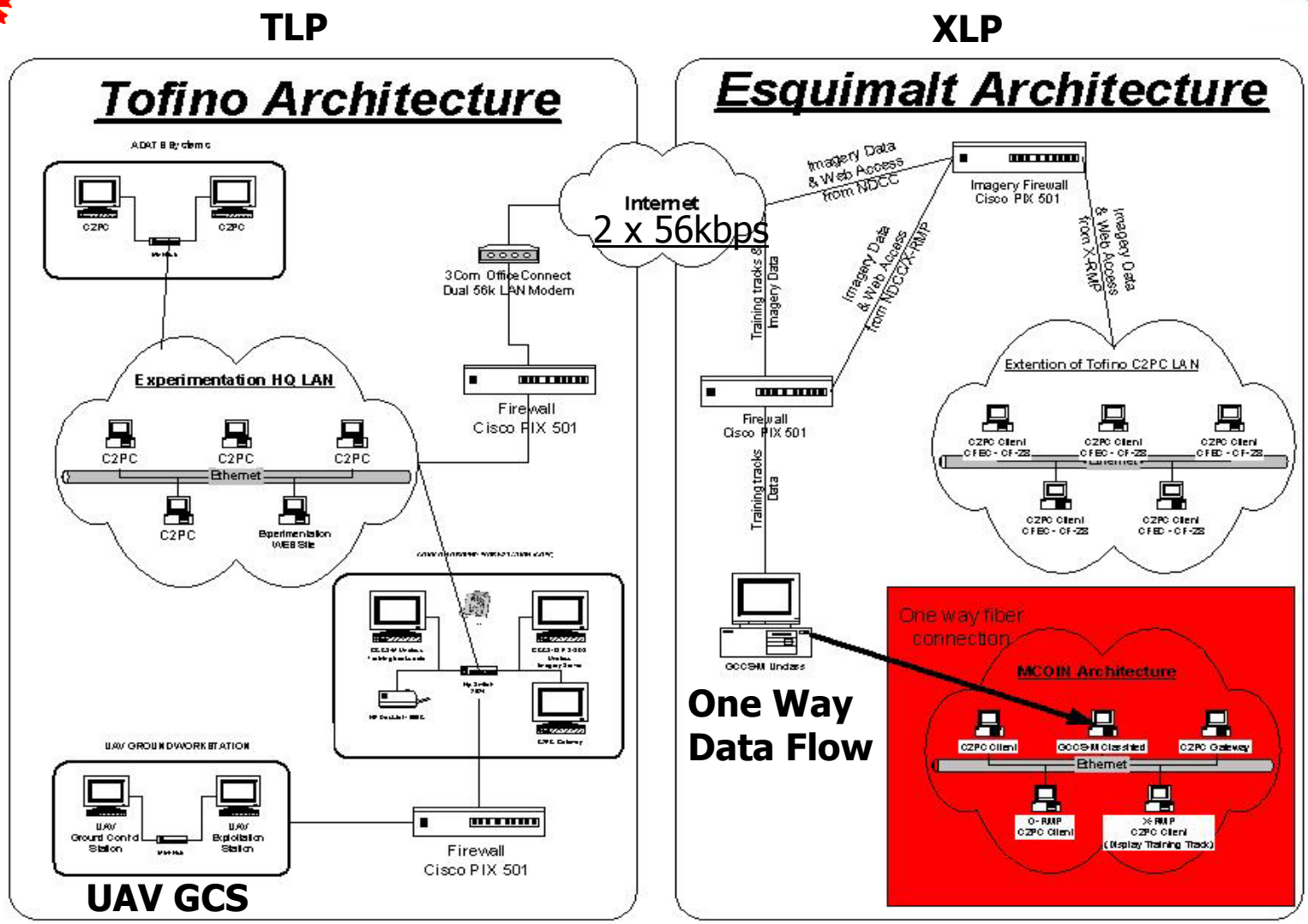
Raytheon NMIS

YARD PATROL CRAFT AGATE PASSAGE YP 697

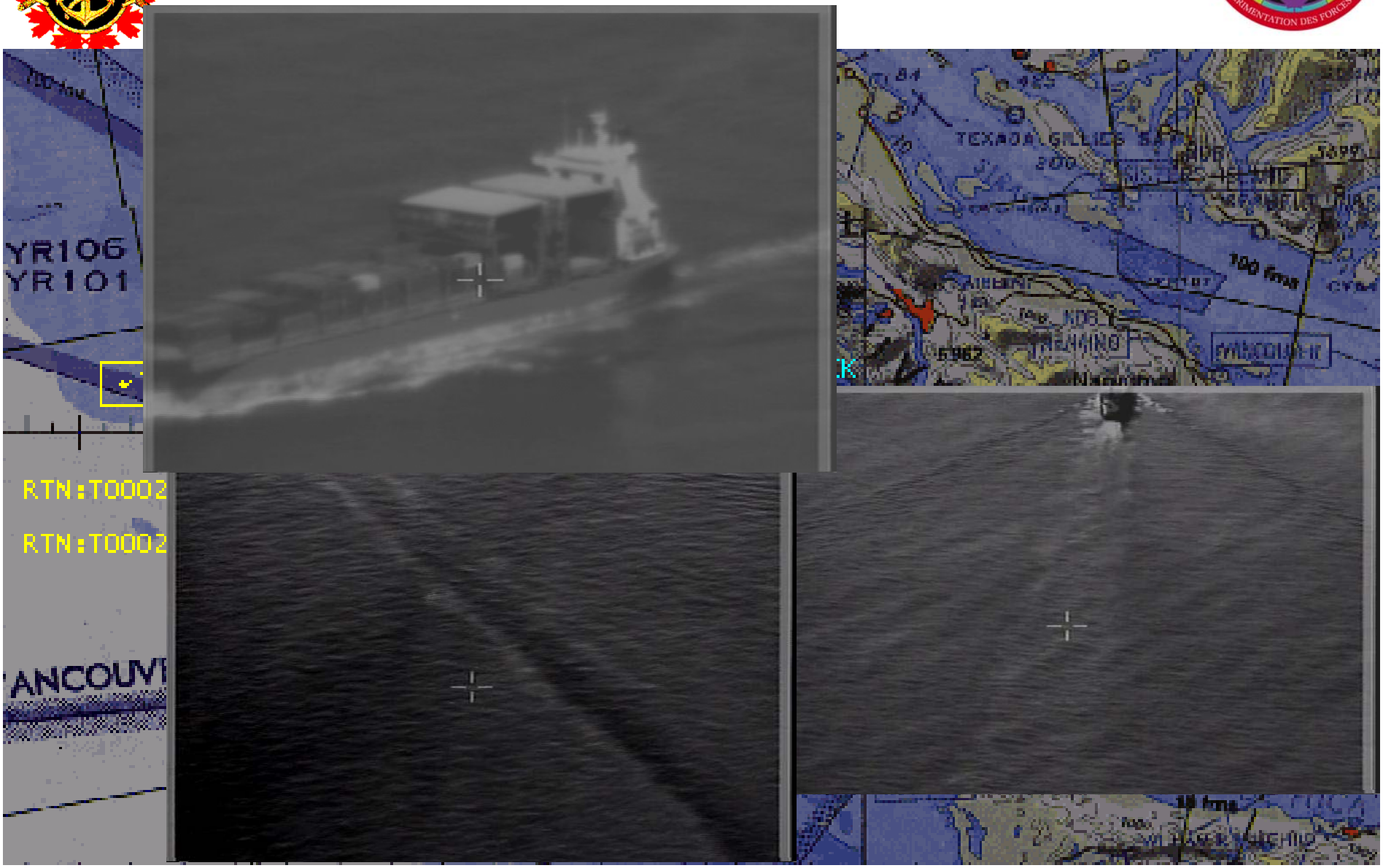
Position recording every 6 minutes Following scripted event profiles.

<u>YP 697 Agate Passage</u>
Coastal Oiler
Ship in Distress
Immigrant Smuggler
Terrorist Vessel

PLIX Network Architecture

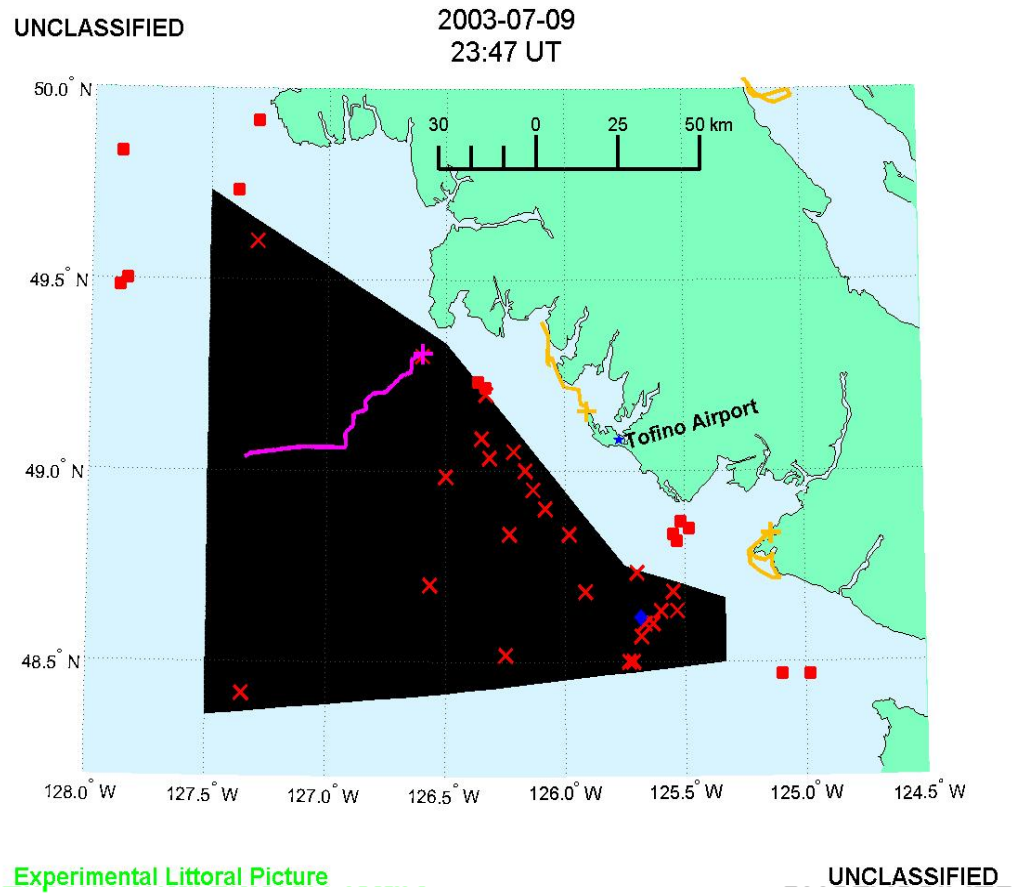


Pacific Littoral ISR Experiment



Experiment Reconstruction

XLP 9 July 2003 (MPG)

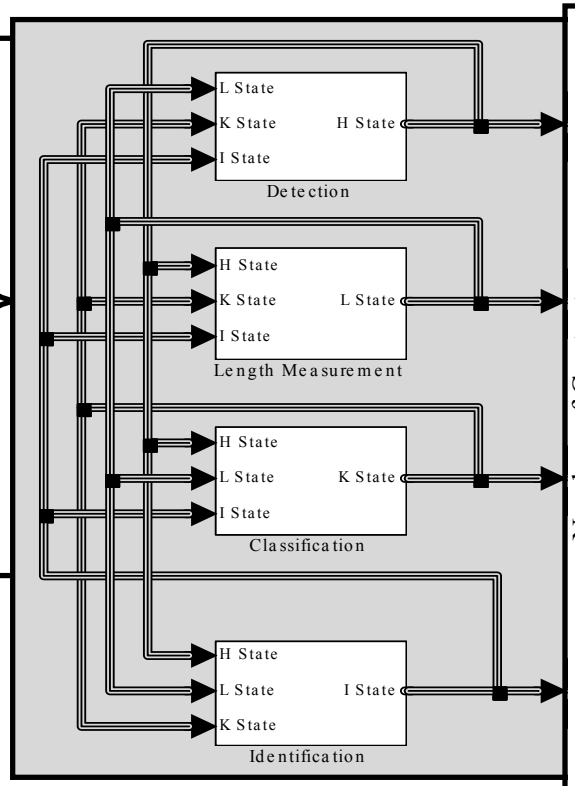


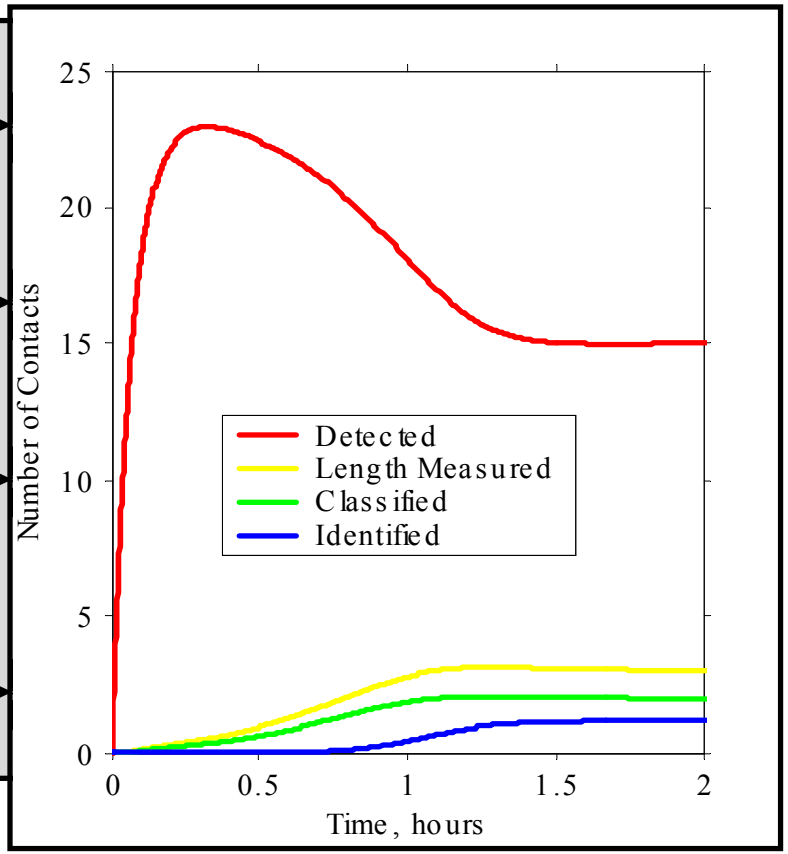
LEGEND

- **X** UAV Contact inside OPAREA
- ■ UAV Contact outside OPAREA
- + Vessel of Interest
- + Coast Guard Vessel
- ♦ UAV Position

Dynamic IISRA Model (DIISRAM)

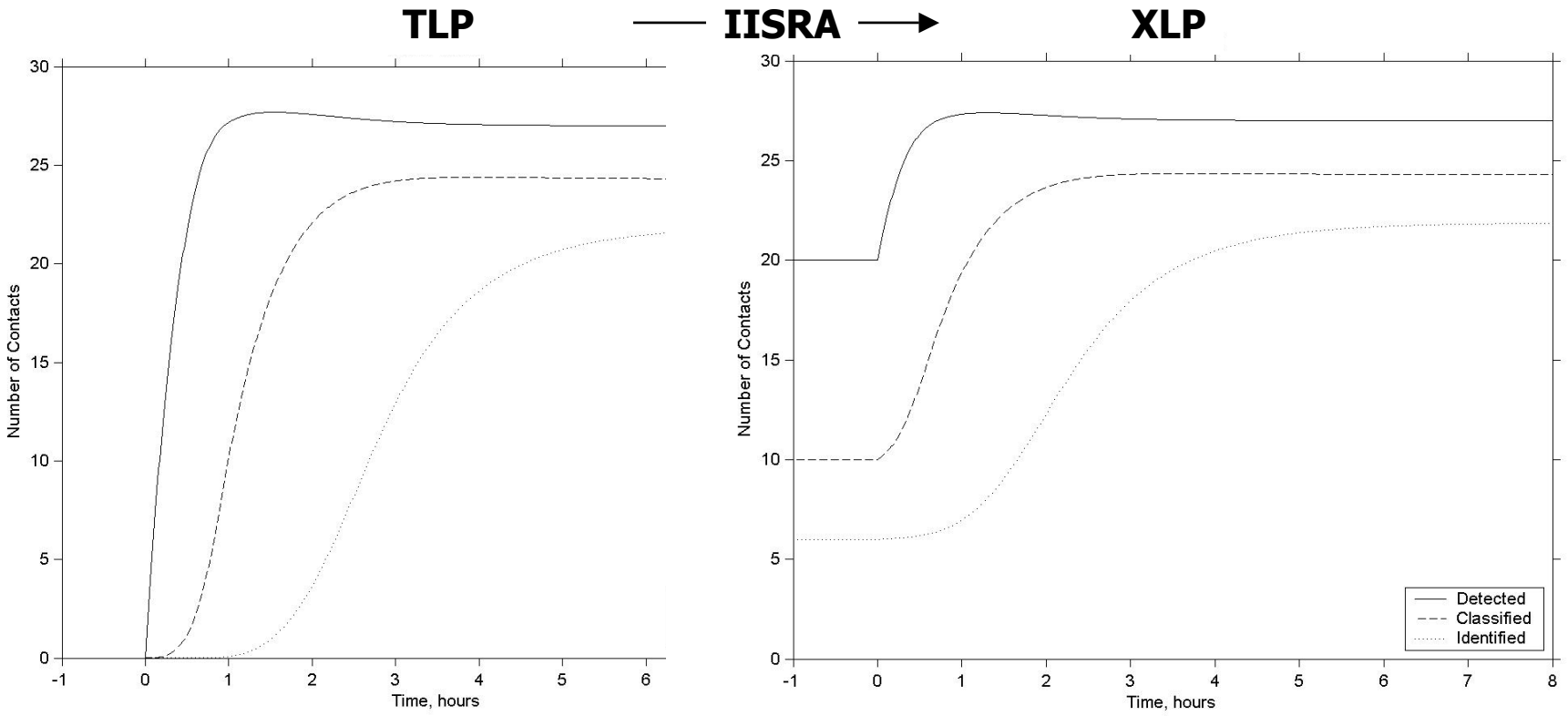
$$\frac{dH}{dt} = f_H(H,L,K,I)$$
$$\frac{dL}{dt} = f_L(H,L,K,I)$$
$$\frac{dK}{dt} = f_K(H,L,K,I)$$
$$\frac{dI}{dt} = f_I(H,L,K,I)$$





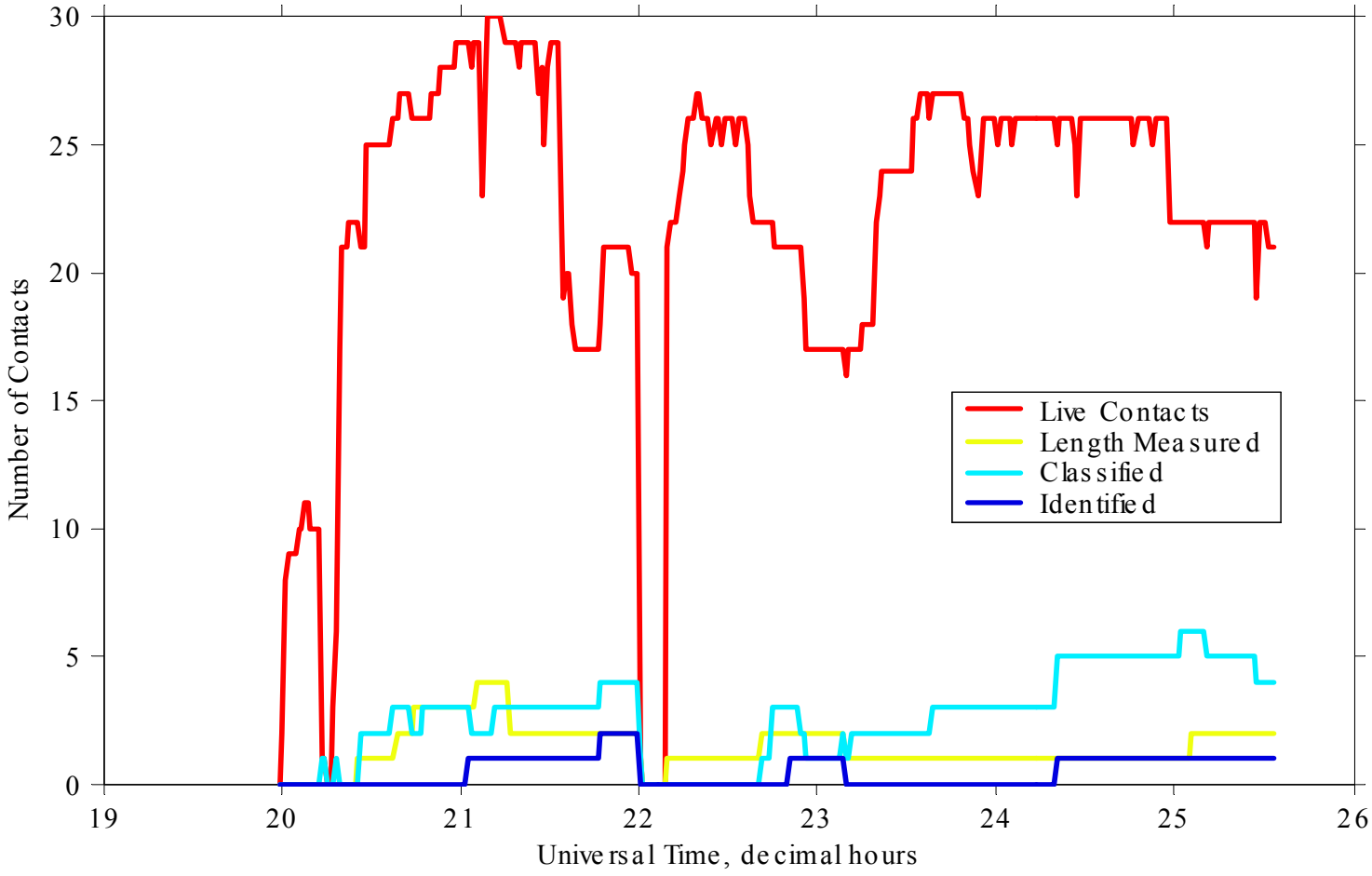
Dynamic ISR Model
Measure of Effectiveness (MOE)

- The number of detected, categorised, and identified contacts in XLP (Experimental) relative to TLP (Tofino Littoral picture)



UAV Contacts

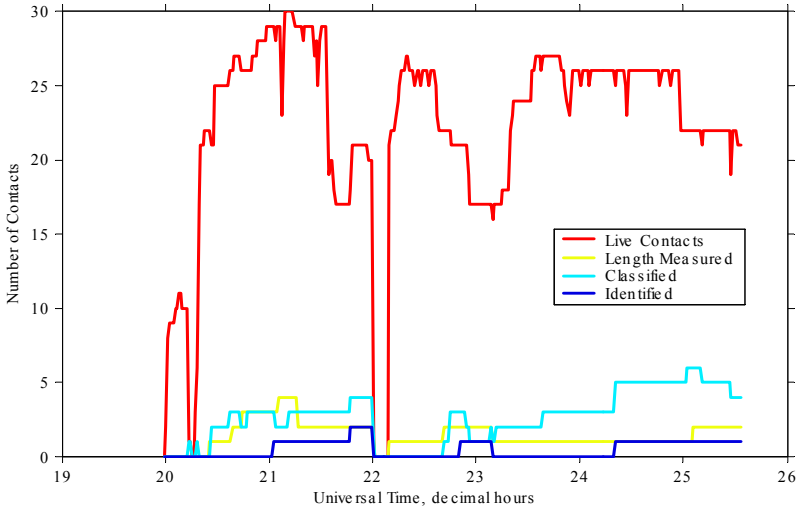
Tofino Littoral Picture, July 9

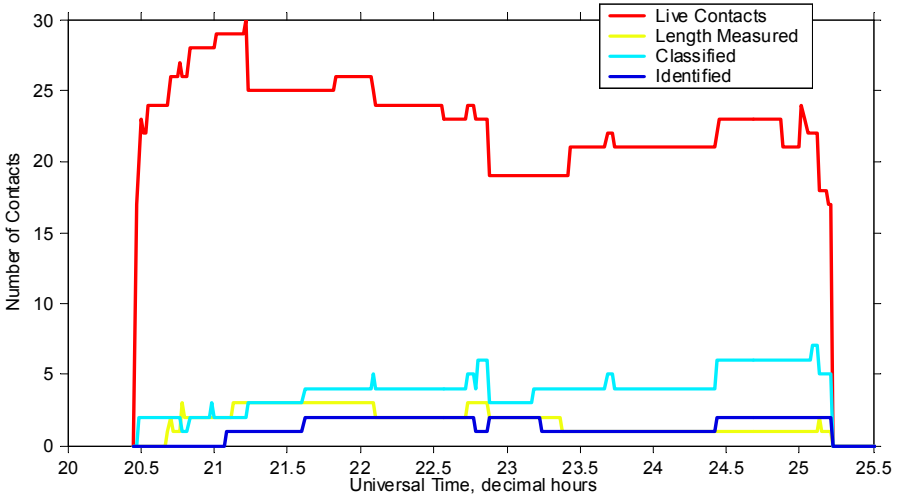


UAV Contacts

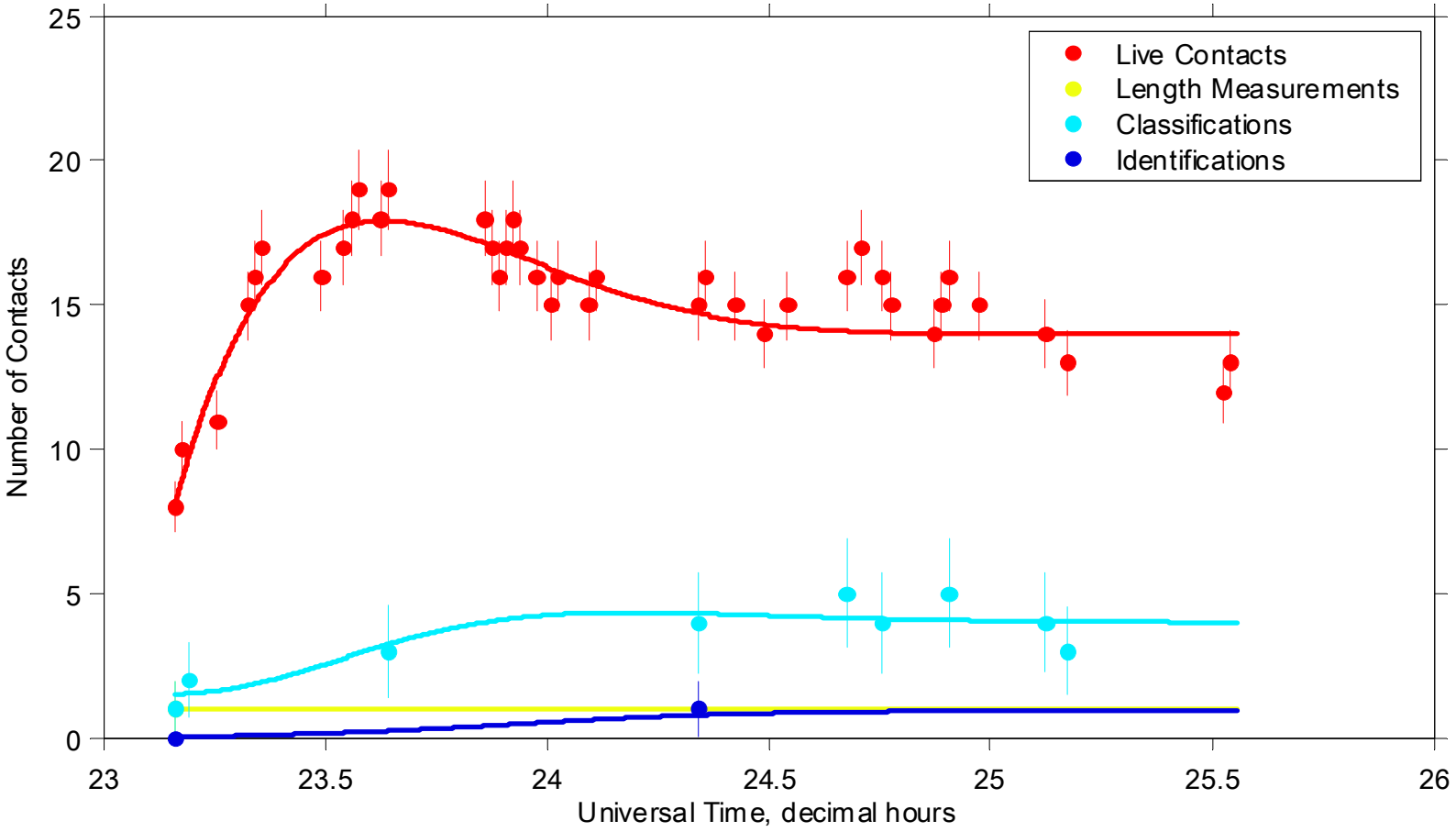
July 9

TLP — **IISRA** → **XLP**





Provisional Fit: July 9, Event 3

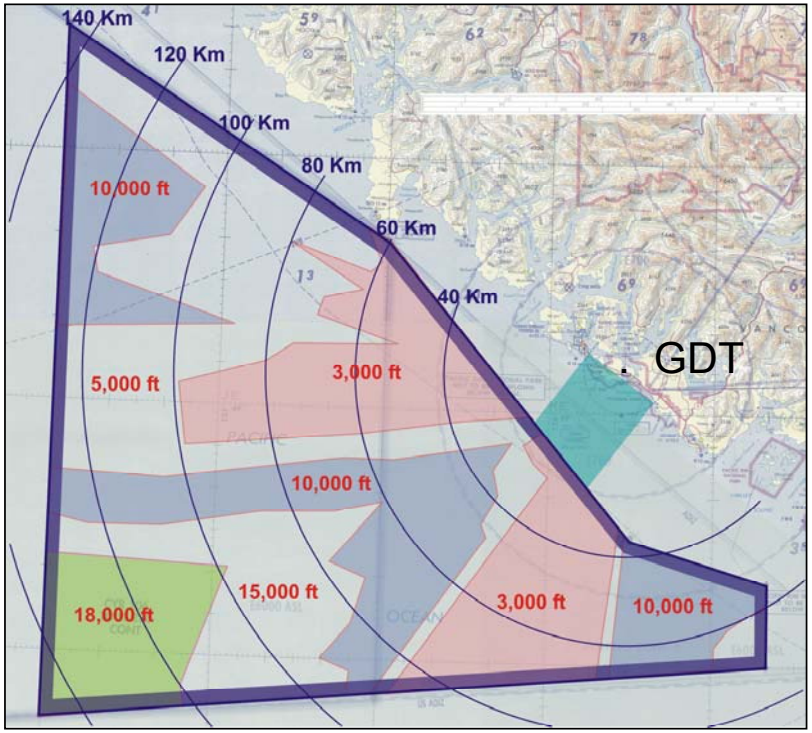


Contact Count Error Analysis

Day of July	Sample Size (Steady State)	P_{Det}	*N Tgts*	σ	*%CL (KS test)*
8	16	86%	17	1.4	51%
9	21	90%	17	1.2	30%
10	31	75%	18	1.8	78%
11	11	97%	25	0.9	41%

UAV-GDT Line of Sight

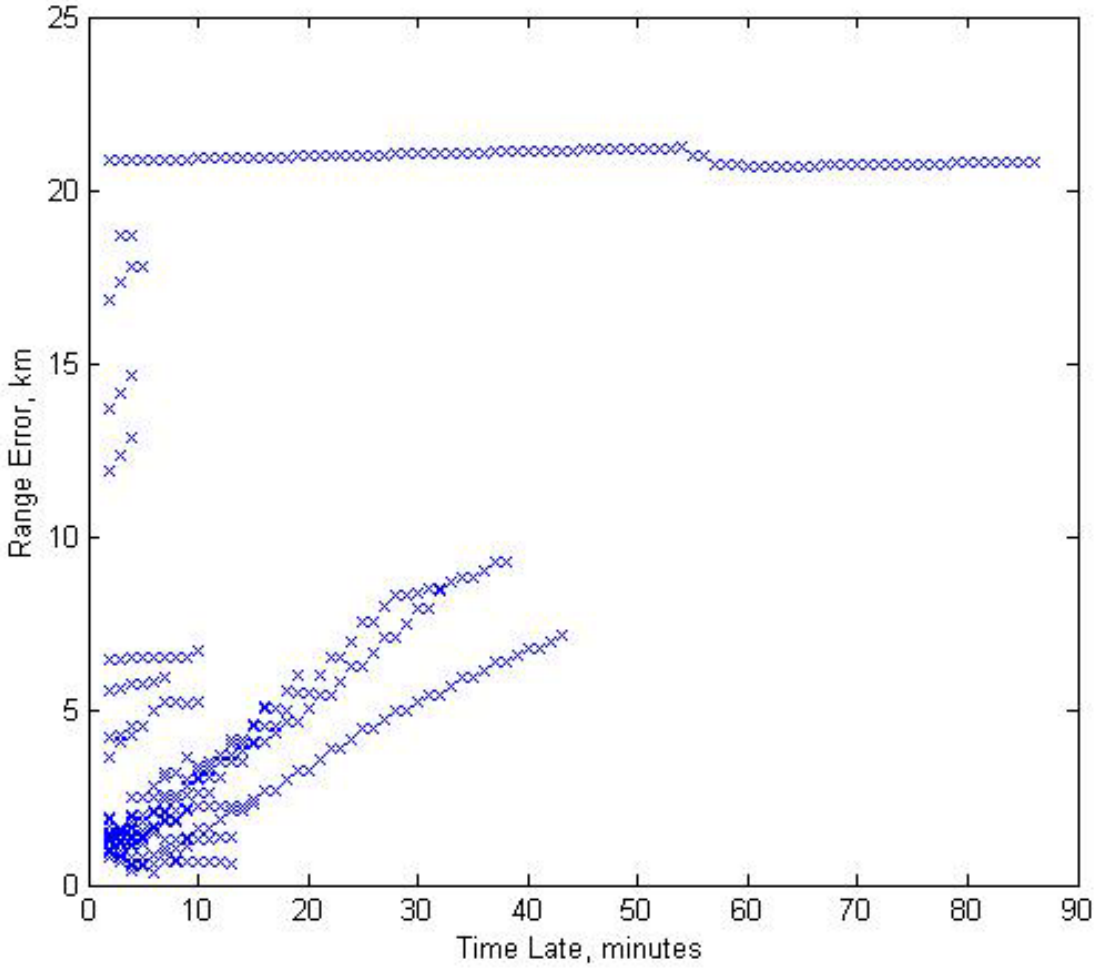
- MALE UAV operations limited by line of sight datalink impacting on contact classification and identification



Minimum UAV LOS Operating Altitude (feet)

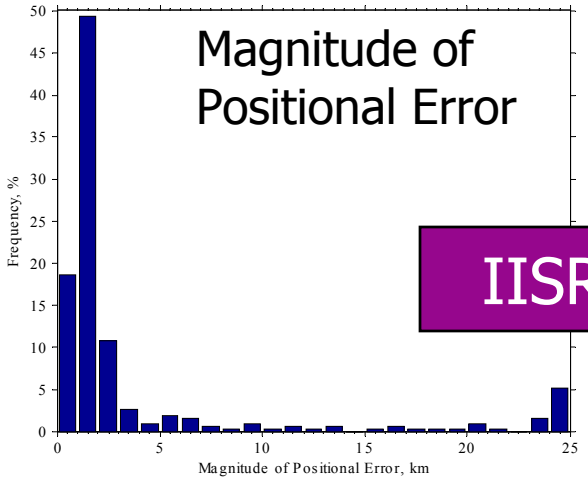
UAV/ISRA Tracking Performance

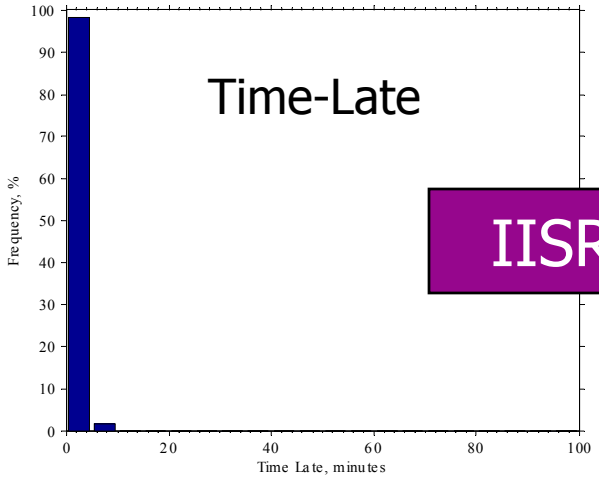
USN Agate Passage – 09JUL03



Tracking Performance, July 9

TLP

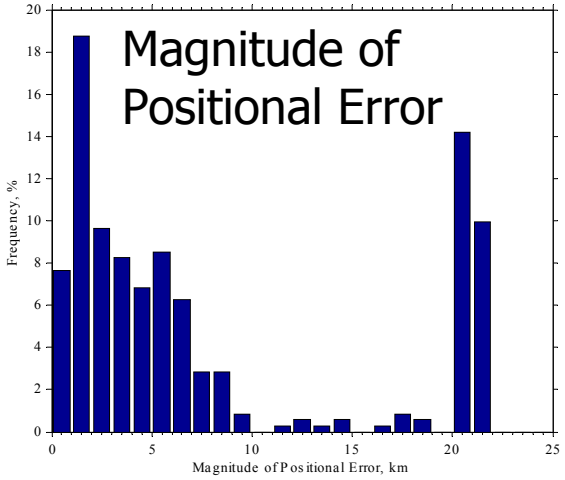


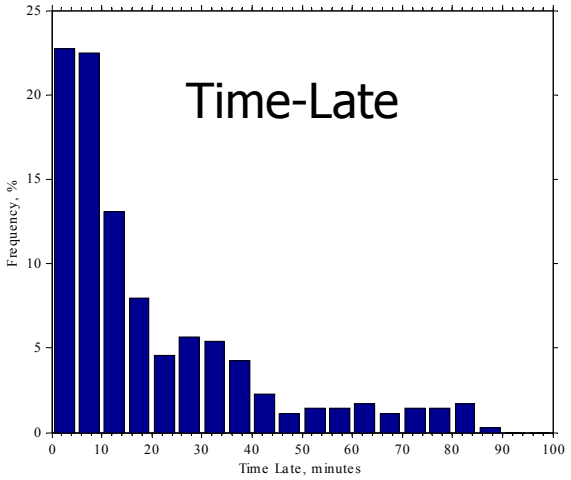


IISRA

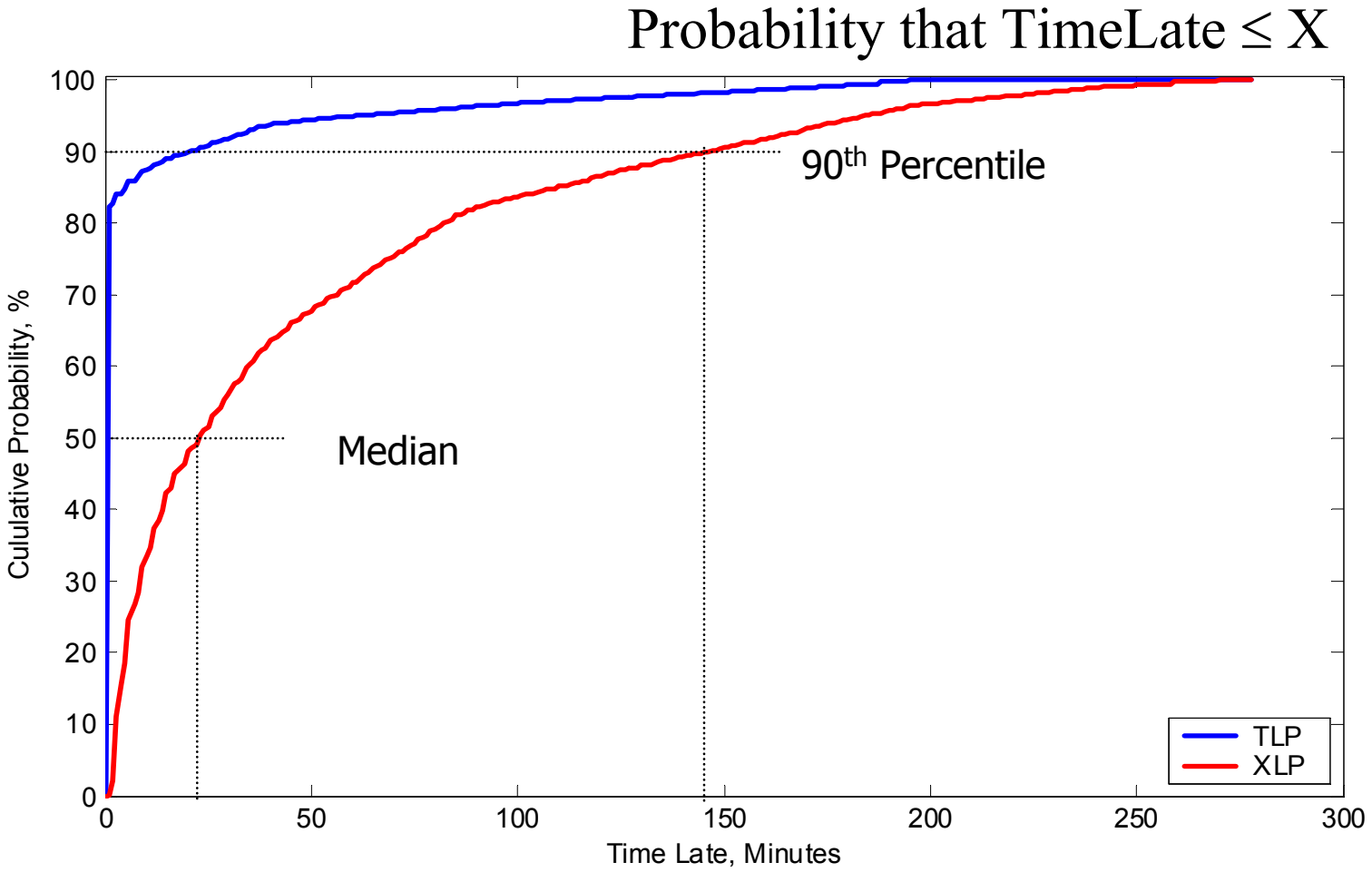
IISRA

XLP

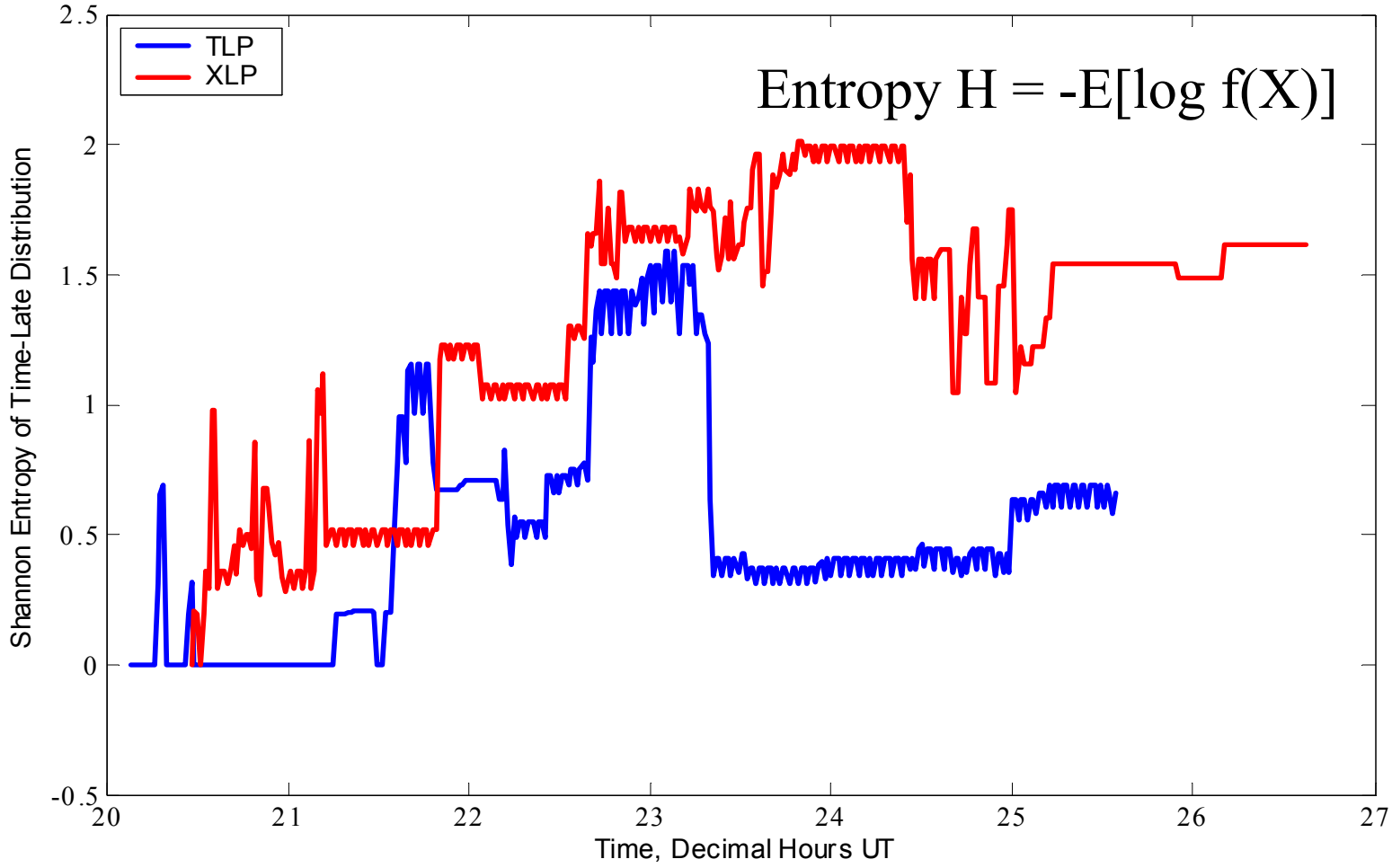




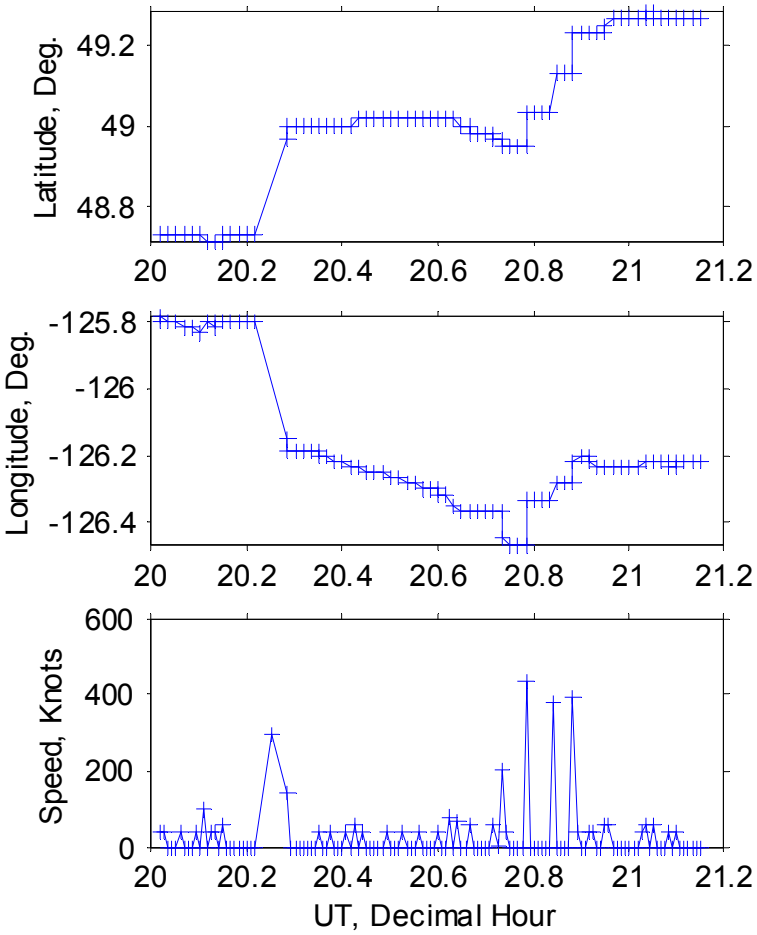
Time-Late Cumulative Dist'n July 9

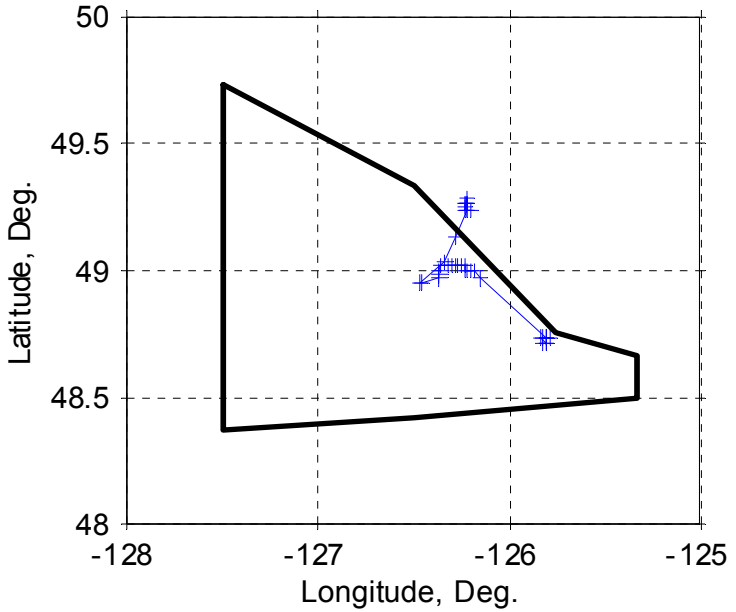


Entropy of Time-Late Distribution, July 9

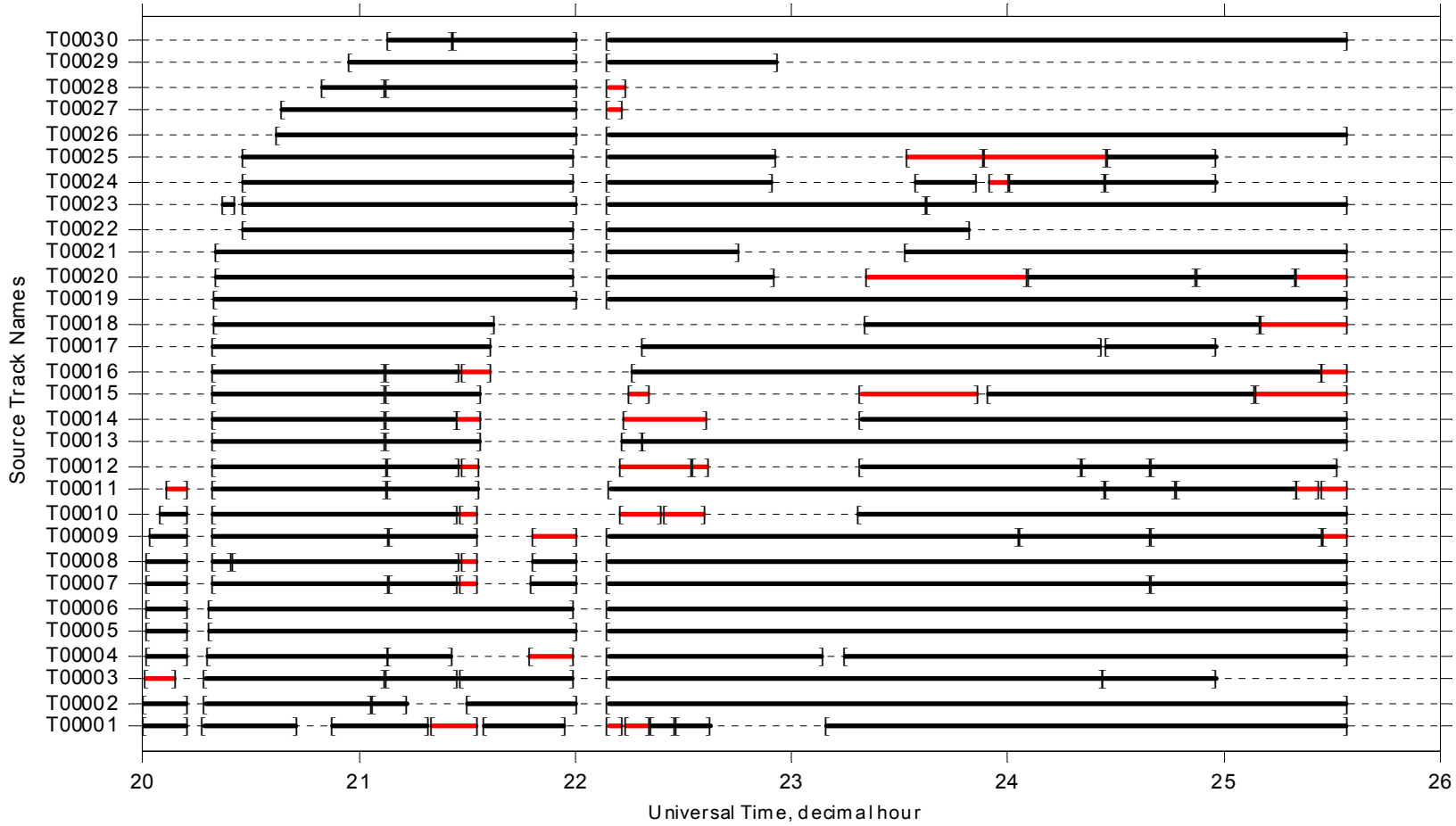


UAV Contact Track T00001
July 9

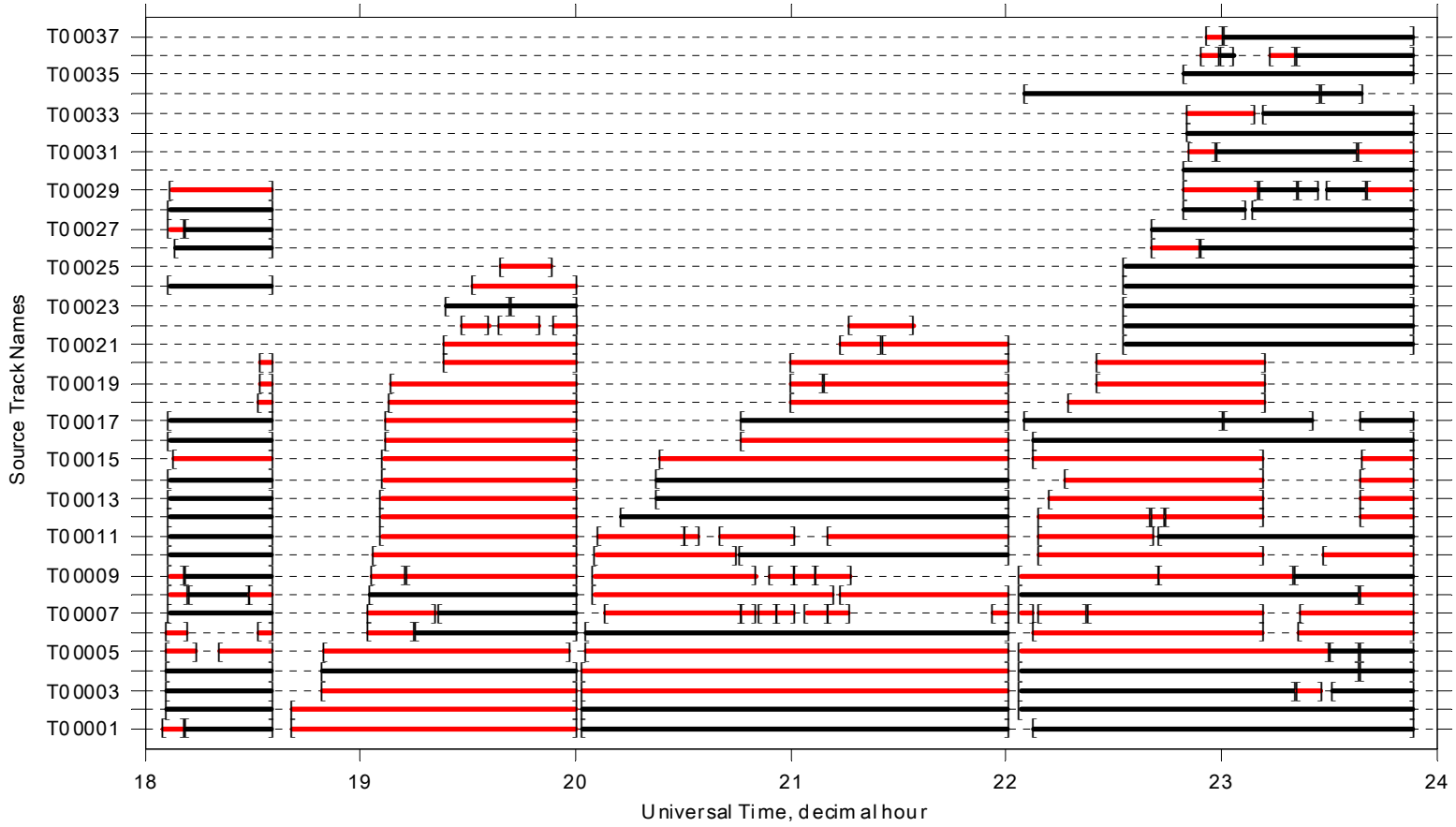




UAV Track Fragmentation
TLP to XLP Links, July 9

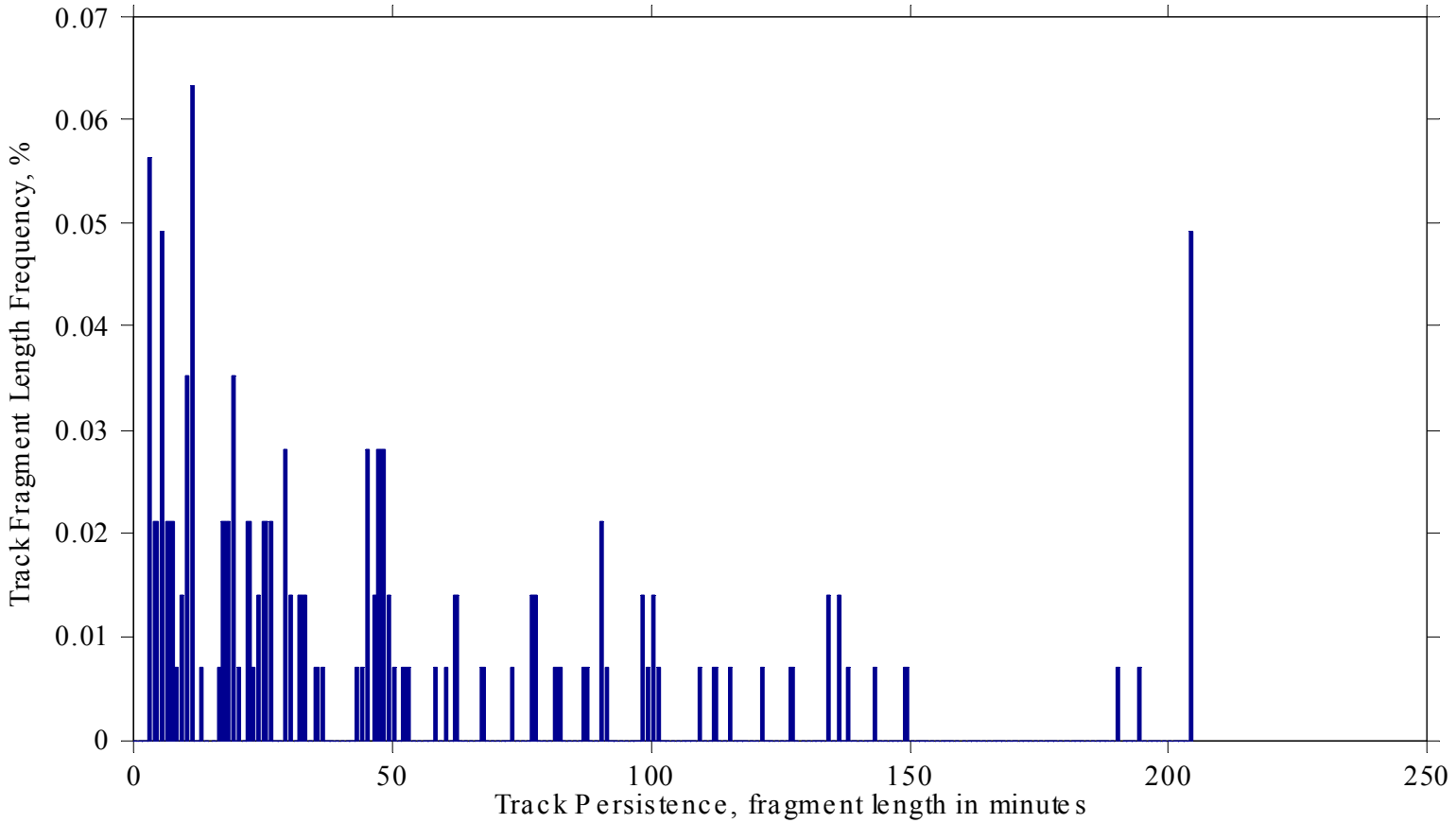


UAV Track Fragmentation
TLP to XLP Links, July 10

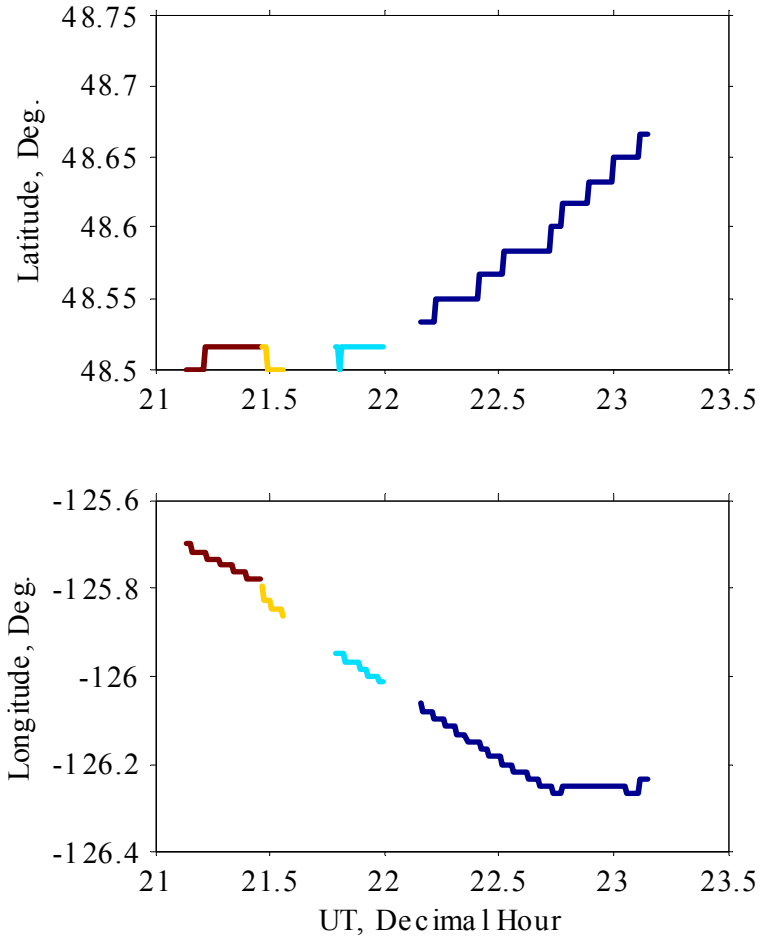


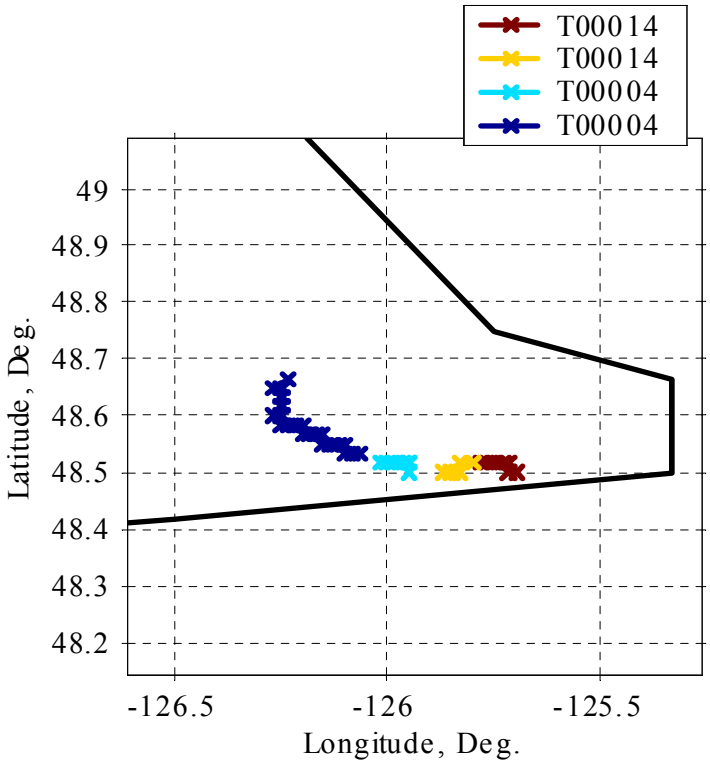
UAV Track Persistence Dist'n

Tofino 9 July

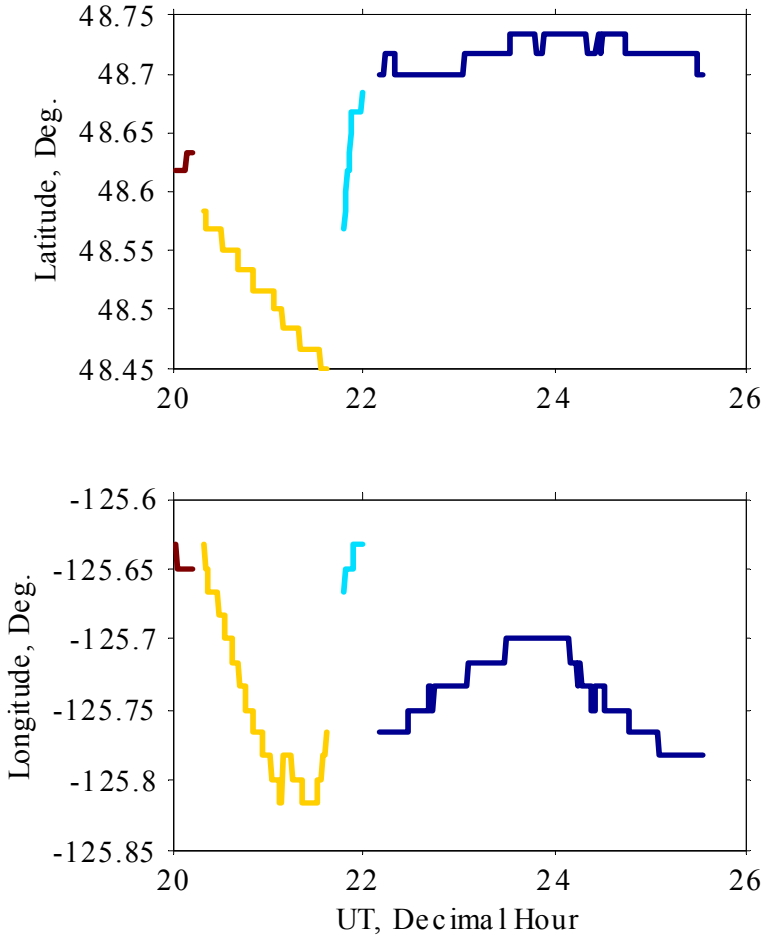


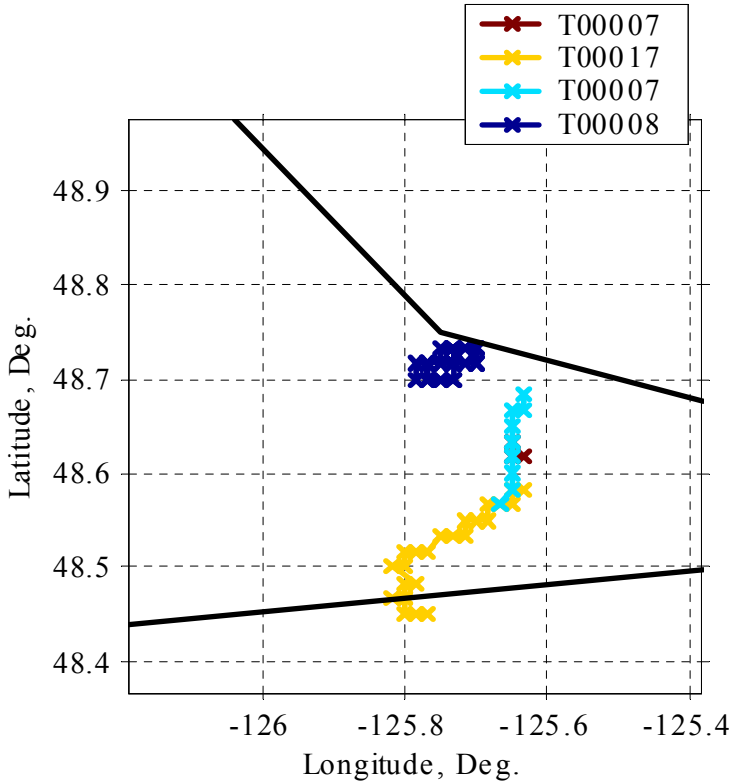
Composite Track TLP114, July 9
(The Good)





Composite Track TLP007, July 9
(The Ugly)





Mission Analysis Observations

- Incomplete Situational Awareness resulted in sub-optimal UAV use for target search
- Information latency and loss observed between nodes
- Understanding of sensor capabilities, location and limitations affected mission outcomes
- GCCS Operator Proficiency affected picture quality
- Resource allocations varied by Command team and level of confidence

PLIX Lessons Learned

- **P**ersonnel
  - Variability in GCCS operators to exploit info
- **R**esearch and Development / OR
  - Req't for all Wx sensors, BLOS UAV capability
  - Track Mgmt, Bandwidth Mgmt, Multiplex
- **I**nfrastructure and organization
  - LOS GDT drives layout, 3D air sense req'd
- **C**oncepts, doctrine and collective training
  - UAV potential as persistent/reactive ISR asset
- **I**nformation management
  - Maximize Info sharing, Standards, Minimize Info loss
  - Need Multi-sensor Data fusion to enhance exploitation
- **E**quipment, supplies and services
  - UAV airspace integration

Conduct of Experiment Lessons Learned

- Experiment objectives must be well communicated
- Effective Exp Control requires high level of SA thru regular coordination and systems access
- Sufficient training req'd to reduce confounding of learning curve effects from concepts
- Sufficient lead time required for "systems" design, integration, and testing
- Need for "robust" data collection strategy; Maximize electronic data capture
- Develop contingency plans (Master Events List)
- Complete bulk of analysis post-experiment

Conclusions

- PLIX Hypothesis was falsified but ..
  UAV ISR requirements better understood
- UAV Radar provided input track data for the IISRA; mixed success detecting and tracking VOI
- IISRA significantly affected Time-Late (Latency)
- Provide timely & high quality data at source
- Priorities for R&D include:
  - BLOS, all weather capability
  - Improved sensor integration and track management
  - Multi-source, multi-sensor data fusion
  - Network-enabled CONOPS thru simulation and LIVEX

Way Ahead for ALIX '04

- Relax IISRA constraints: UAV LOS, single classified RP, network bandwidth, sensor integration
- Conduct Concept Development seminars and Mission Rehearsal
- Formalize Net Enabled CONOPS and Tactics
- Enhance lead-up training
- Engage Other Gov't Depts (OGD)
- Quantify baseline
- Enhance ground truth

Questions

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