# Requirements Development for a Modernized Loran / LEMS / LICOS

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#### **Overall Project Review**

- System Development Life Cycle (SDLC) compatibility
- Requirements Development and Requirements Management using Telelogic's DOORS Requirements Management software
- Concise, unambiguous requirements that are traceable, testable, configuration managed and quality controlled
- Baseline of existing Loran requirements; Modernized Loran/ LEMS/ LICOS requirements; leading to a baseline of requirements for the future Loran system







#### C4&IT SDLC

#### C4&IT System Development Life Cycle Documents and Products

	Conceptual Planning	Planning & Requirements	Design	Development & Testing	Implementation	Operations & Maintenance	Disposition
	Business Case						
Management Documents (Updated throughout SDLC Process)	Project Manageme	nt Plan					
	Funding Plan						
	Enterprise	Architecture Docume	ntation				
		Information Assur	rance Plan				
System Documents (SDLC Phase Specific)		Develo	pment & Support Pla	n			
			Implementati	on Plan			
						Dis	position Plan
				System D	ocumentation		
SDLC Products (Competency & Capability)		Functional Requirements	Detailed Design	Approved & Tested System	Implemented Syste	m	Archived System & Data
					System F	erformance Reports	
				Training Pl	an		
					Trained Personnel		

#### C4&IT SDLC



#### **Overall Project Review** Lessons Learned

- Past designs implemented following weak or no requirements
- Requirements not documented and managed in a selfcontained manner
- Capabilities added with little or no determination as to effectiveness
- No (Minimal) "why's" can be answered
- No (Minimal) centralization of information
- Testability occurs "after the fact"
- Requirements / Design changes follow no managed configuration and could be made "on-the-fly" (Scope Creep)

#### HOW DO WE SOLVE THESE CHALLENGES??







### THE ANSWER: TELELOGIC DOORS

- Requirements Management Software
- > Answers "Lessons Learned" challenges by:
  - Managing a centralized requirements database
  - Hierarchically structuring information (top-down)
  - Provides requirements traceability to stakeholders and assists in collaboration
  - Saves historical information and important attributes
  - Provides for scalability, testability, configuration management, life-cycle requirements tracking...















#### LEMS Project Review Goal

Define the Mission & Business, Operational and Functional Requirements for a new operational Loran receiver and monitoring system to complement the Loran Command & Control (C4&IT) System architecture.







### LICOS Project Review -Purpose

- To determine functionality of a new Command and Control (C4&IT) architecture for a Modernized Loran.
  - ✓ Man-machine interfaces for Command & Control
    - Data Storage and Information Retrieval
  - ✓ Network architecture for information flow
  - Assist in the objective to provide for autonomous Loran Station operation (Remotely controlled, secured, etc.)







#### LICOS Project Review Goal

- Define the Mission & Business, Operational and Functional Requirements for a modernized Command & Control (C4&IT) infrastructure
- The ultimate goal is to develop a system optimized for the modernized Loran system
  - User-friendly
  - Secure
  - Reliable
  - Available
  - Scalable
  - Economical







#### LICOS Project Review -Description

- The C4&IT Loran Information, Control, and Operations (LICOS) project will enhance the ability to monitor, control, and maintain the Loran infrastructure. LICOS will provide for the enhancement of the Loran Network Architecture to support a Modernized Loran. The development of new equipment and procedures will result in significantly increased Loran signal availability. Remote maintenance, security, and the automated sharing of information for all Loran equipment will occur in an integrated environment using modern technologies. The LICOS project will provide the infrastructure to support and further automate current Loran equipment and will support a Modernized Loran. LICOS will automate processes in the Loran infrastructure, assisting in the future objective to fully automate Loran Stations.
- The LICOS project is dependent on all current Loran Technologies being researched, as the modernized design shall significantly affect the Command and Control architecture of the Loran System as a whole.







#### eLoran









Homeland

### **Project Approach Existing Requirements Determination**

# **Retrieved from**

- System Descriptions
- Operator's Manuals
- Specifications
- Policies / Procedures











#### Project Approach Future Requirements Determination

# High-level requirements for a Modernized Loran System retrieved from:

- Capability to Mitigate the Impact of a GPS Outage on GPS Position, Navigation, and Time Applications prepared for the Federal Aviation Administration, Vice President for Technical Operations, Navigation Services Directorate, dated March 2004
- Coordinate requirements development effort with work that has already been accomplished, and with work that is currently ongoing









## **Project Approach Future Requirements Determination**

# Study of a Modernized Loran <u>Architecture</u>

- Time of Transmission Implementation
- GPS Independence
- Differential Loran, Loran Data Channel & Differential Loran Monitoring Theory of Operation
- Evaluation as to LEMS/ LICOS dependencies







#### **LEMS Envisioned Future Requirements (Orange)**



#### LICOS Envisioned Future Requirements (Orange)



	Project Approach Future Requirements Determination					
$\triangleright$	R	equirements Development & Management				
		Baseline Requirements (Existing) + Added Functionality (Future) = Future Baseline of a modernized Loran system				
		End product will be a self-contained managed requirements system				
		Note: Traceability for existing requirements shall be provided to the maximum <u>practical</u> extent. Due to essentially non-centralized and unmanaged documentation, many existing requirements may not be traceable.				
		Make least risk assumptions from project conception				
		Depending on the approval of future requirements:				
		Tree structure (Binary switch)				
		Turn requirements on/off from tree structure				







# **Project Accomplishments**

- Draft documents that have been created (SDLC)
  - Project Management Plan
  - Microsoft Project Tasks / Timeline Plan
  - Requirements Management Plan
  - QC/QA Plan
  - Risk Management Plan
    - Note: Documents are viewed as living documents as the project progresses and continues through its lifecycle.







# Project Accomplishments (cont'd)

- Microsoft SharePoint site set up and populated for project information sharing
- Site visit to NavCenDet, Lorsta Middletown, and Pt. Pinos
  - User/ Operational/ Mission requirements were discussed for the familiarization of existing requirements and to further assist in determining requirements for a Modernized Loran/ LEMS/ LICOS







#### **Project Continuation SDLC Phase II: Planning & Requirements**

- Researching future System Level functional changes required
- **Concerned with:**
- Generation and management of clear, concise, unambiguous requirements
- → Traceability (What is the reason for the effort?)
- Testability (Did we meet the requirement?)
- Configuration Management (How is change formally documented and controlled?)
- Quality Control (How are the requirements validated and verified?)
- Standard Operating Procedure for managing the self-contained DOORS requirements management system at the end of SDLC Phase II (Planning & Requirements)







#### **Project Continuation SDLC Phase II: Planning & Requirements**

#### **Requirements Quality Control**

Correct

Feasible

Validation ----

Necessary Prioritized

Complete Consistent --- Verification

Unambiguous

Traceable

Concise

Non-redundant

Organized Conformant to

standards Verifiable







#### **Project Continuation SDLC Phase II: Planning & Requirements**

- "Validation is more an issue of communicating requirements, as constructed by the analysts, back to the stakeholders whose goals those requirements are supposed to meet, and to all those other stakeholders, with whose goals those requirements may conflict."
- "there is an obvious need for an information flow about requirements being constructed from the analysts to the stakeholders. Maintaining this information flow is the core of the requirements validation activity, the same way as maintaining the flow from the stakeholders to the analysts is the core of the elicitation activity. The goal is to give the stakeholders a chance to check early whether the solution proposed will really solve their problem."
- Ref: Artem Katasonov / Markku Sakkinen; Requirements quality control: a unifying framework; Requirements Eng (2006) 11: 42–57; DOI 10.1007/s00766-005-0018-1







## **Project Continuation**

 Mission & Business/ Operational/ Functional Requirements for a Modernized Loran System
 Determine SDLC approval authorities

Functional Requirements for TOT, Differential Loran, Loran Data Channel and UTC Sync must be determined (Dependencies to LEMS)

Functional Requirements must be validated/ verified/ approved before SDLC Phase III (Design) begins {Fiscal Year 2007}







### **Project Continuation**

Date	Task				
30 Sept '07	Requirements Development				
31 July '07	Submit Requirements to be approved				
30 Sept '07	Modernized Loran/ LEMS/ LICOS Mission & Business, Operational, and Functional Requirements Approval				
	U.S. COAST GUARD W Homeland ILA-35 10/25/2006				

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