FOS Engineering Activities

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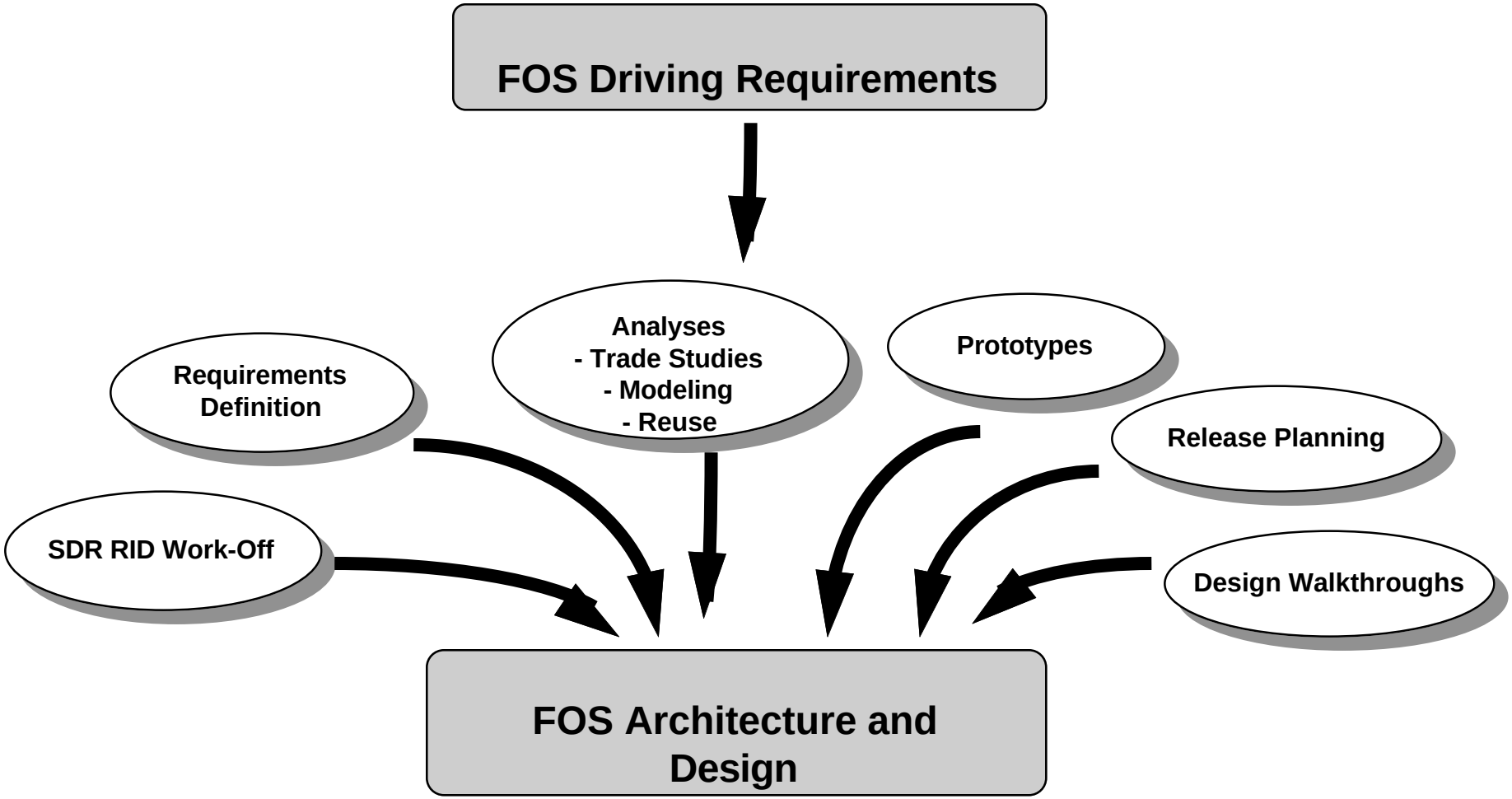
FOS Segment Engineering



FOS SDR RID Work-Off

42 FOS RIDS Defined at SDR

42 FOS RIDS Closed
- 36 issue RIDS
- 6 comment RIDS

2 Super RIDs
- IST Capabilities Document
- Reuse Analysis

FOS Requirements Definition

FOS Requirements Sources

FOS Requirements Input

- AM-1 Project
- Martin Marietta
- Instrument Ops Teams
- NASA FOS Team
- ECS M&O
- ECS SI&P
- ECS QA

Decompose Level 3 Requirements

Analyze Heritage Control Center Requirements

AM-1 Ground System Workshops

Review Draft Requirements

FOS Level 4 Requirements
- General Requirements
- AM-1 Mission-Specific

FOS Requirements Traceability

Requirements

Level 4 Requirements

Volume 1: General FOS Requirements
Volume 2: AM-1 Mission Specific

Baseline January 1995
Volume 2 under ESDIS CCB Control

Traceability

Requirements

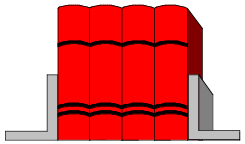
Level 3 -> Level 4
Level 4 -> Level 3
IRD to Level 3
IRD to Level 4

Design Spec

Level 3 -> Object
Level 4 -> Object

FOS Analyses

Trades and Studies



Architectural Trades → **Distributed vs. Centralized Distribution of Telemetry Processing**

Network Trades → **EOC LAN Topology**
Hub vs. Ring Connectivity

Other Studies and Analyses → **ECS Command Language**
I&T Procedure Transition

FOS Analyses (cont.)

Modeling

FOS User Profile Definition

Define nominal and worst-case scenarios used to model the FOS
- FOT Users
- IST Users

FOS Modeling

Objective: Determine size of computers, networks, and disks

Model network data flows, disk sizing, processing drivers

Source of modeling data: Heritage performance data, prototype performance data, and Level 4 requirements

FOS Analyses (cont.)

Reuse

Reuse Categories

- Operations Concepts
- Requirements
- Architecture
- Design
- Software
- Test and Documentation

Reuse Candidates

GSFC Projects
- TPOCC
- Hubble Space Telescope
- UPS
- FORMATS

FOS Heritage Systems
- NOAA GIMTACS
- NOAA PACS

Other Control Centers
- AM-1 I&T/ OASIS
- IntelSat
- N-STAR

ECS Project
- SPDS
- CSMS

FOS Prototypes

End-to-End Prototype Threads

Subsystems:

Planning and Scheduling
Command Management
User Interface
Telemetry
Decision Support

Objectives and Results:

- **Early feedback from FOT and user community**
- **Early benchmark data**
- **Early integration of components**
- **Proof-of-concept**
- **Develop experience with OO/C++**

FOS Prototypes

Joint FOS/CSMS Prototypes & Studies

Prototypes and Studies:

- Multicast Study
- Security Study
- Interprocess Communication Prototype
- Management Prototype

Objectives and Results:

- Proof-of-concept for infrastructure components
- Early benchmark data
- Early integration of components

FOS Release Planning

Build/Thread Approach

Define Segment-level scenarios

Segment-level scenarios are comprised of a sequence of threads that transcend individual subsystems.

Develop, integrate, and test FOS in sequence as defined build/thread

Release Definition

Define general objective for each Release

Define infrastructure components

Define development dependencies
- predecessor/successor relationships

Partition threads according to Releases and internal builds

FOS Release Planning Drivers

Release A

- Establish infrastructure early that is required for development
- Establish basic connectivity internally and with external interfaces
- Demonstrate basic telemetry and command processing
- Support early interface testing and Spacecraft Tests (e.g., S/C Bus Comprehensive Performance Test, 11/96)

Release B

- Expand system based on building blocks established in Release A
- Support Spacecraft Training, Simulations
- Support AM-1 launch

FOS Release A Capabilities

Scheduling

TDRS Scheduling
Ground Script Generation
ATC Load Generation

Real-Time

Command Generation
Telemetry Processing
& Monitoring
String Management
External Interface Support

Analysis

Analysis Request Processing
Statistics
Report Generation

Support Services

Display
Events
Screen Management
Data Base Generation
Control Window Manipulation
Archive Services

Infrastructure

Message Passing
Management Services
Security
Event Services
Network Services
Time Services

FOS Release B Capabilities

Scheduling

Late Changes
Scheduling Uplink Loads
Maintain Load Catalogs
Flight Software Loads
Microprocessor Loads

Real-Time

Prerequisite State Checking
Telemetry Verification
Clock Correlation
S/C State Checking
Memory Dump Processing
Derived, Context-Dependent Parameters

Analysis

User-specified Statistics Data
Standing Orders Processing
Triggers Processing
Database Crossovers

Support Services

Customized User Tools
System Failure Recovery
Long-Term Data Archive
E-Mail, Help
Advanced Displays

Infrastructure

Release A Capabilities
Additional Management and Communication Services

FOS Release Allocation

Release Allocation

Requirements:

Level 3:	**317**
Level 4:	**1330**
FOS	81
Hardware	88
Planning & Scheduling	125
Command Mgt	166
Telemetry	177
Command	73
Resource Mgt	63
Analysis	103
User Interface	392
Data Management	62

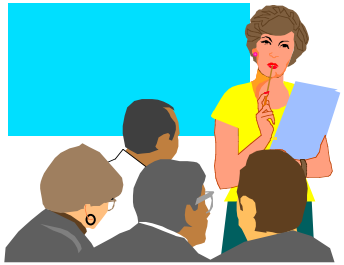
Builds:
- Release A 3
- Release B 2

Lines-of-Code: 298K

Release A: 55%
Release B: 45%

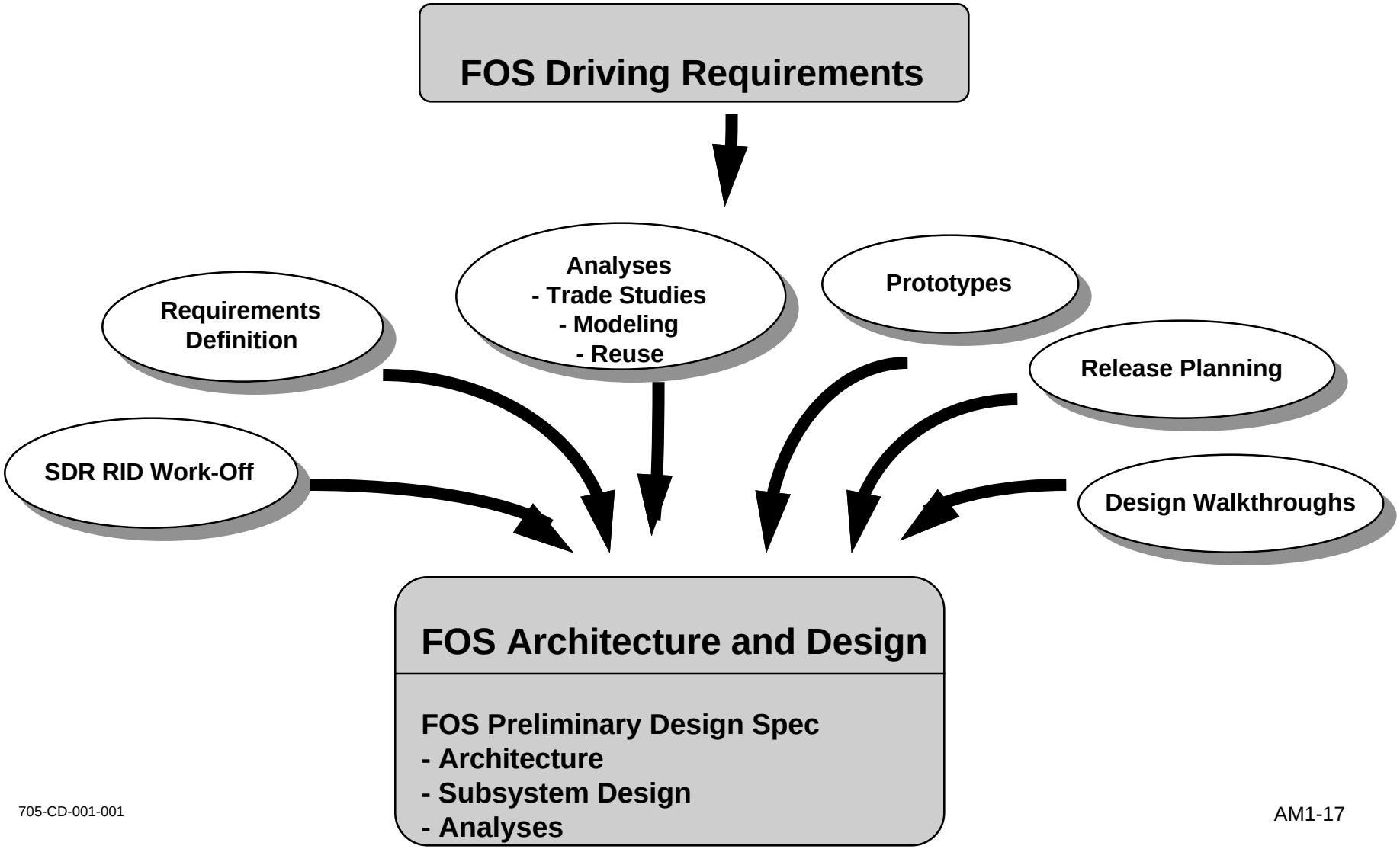
FOS Design Walkthroughs

Subsystem Design
- Context Diagrams
- Object Models
- Dynamic Models
- Data Dictionary

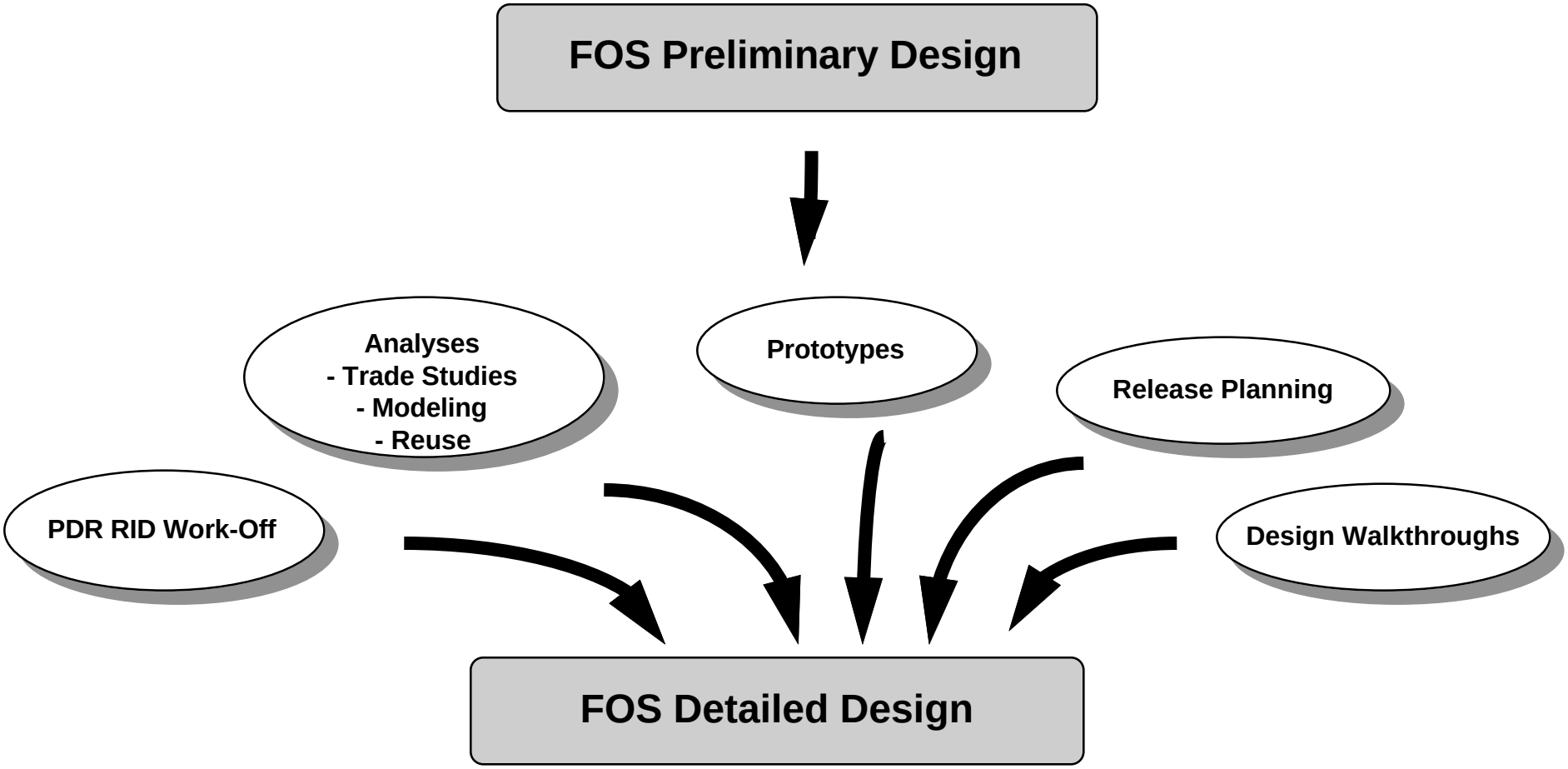


Subsystem Design Walkthroughs
- NASA FOS Team
- ECS M&O
- ECS SI&P
- ECS QA

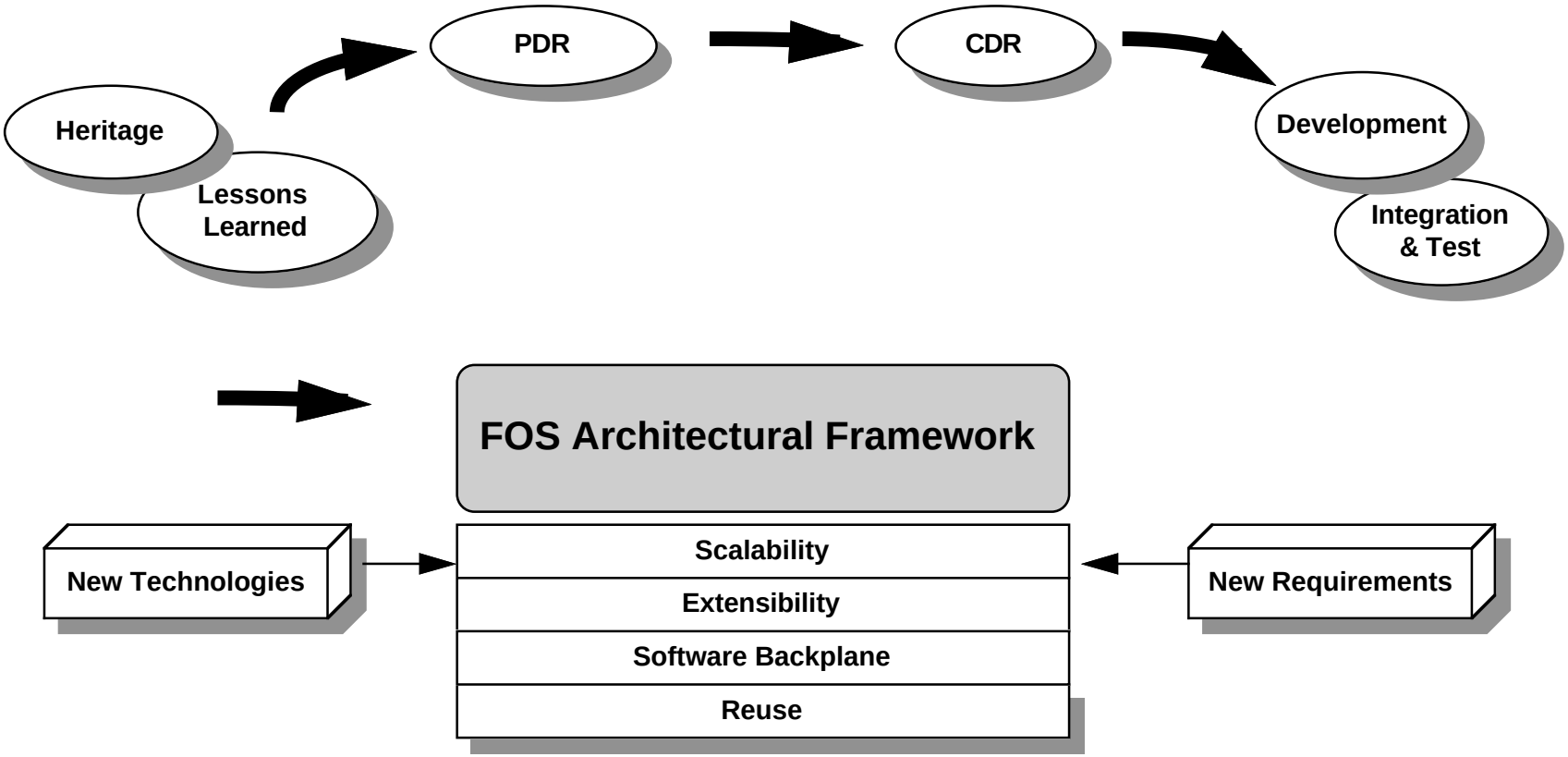
FOS Segment Engineering



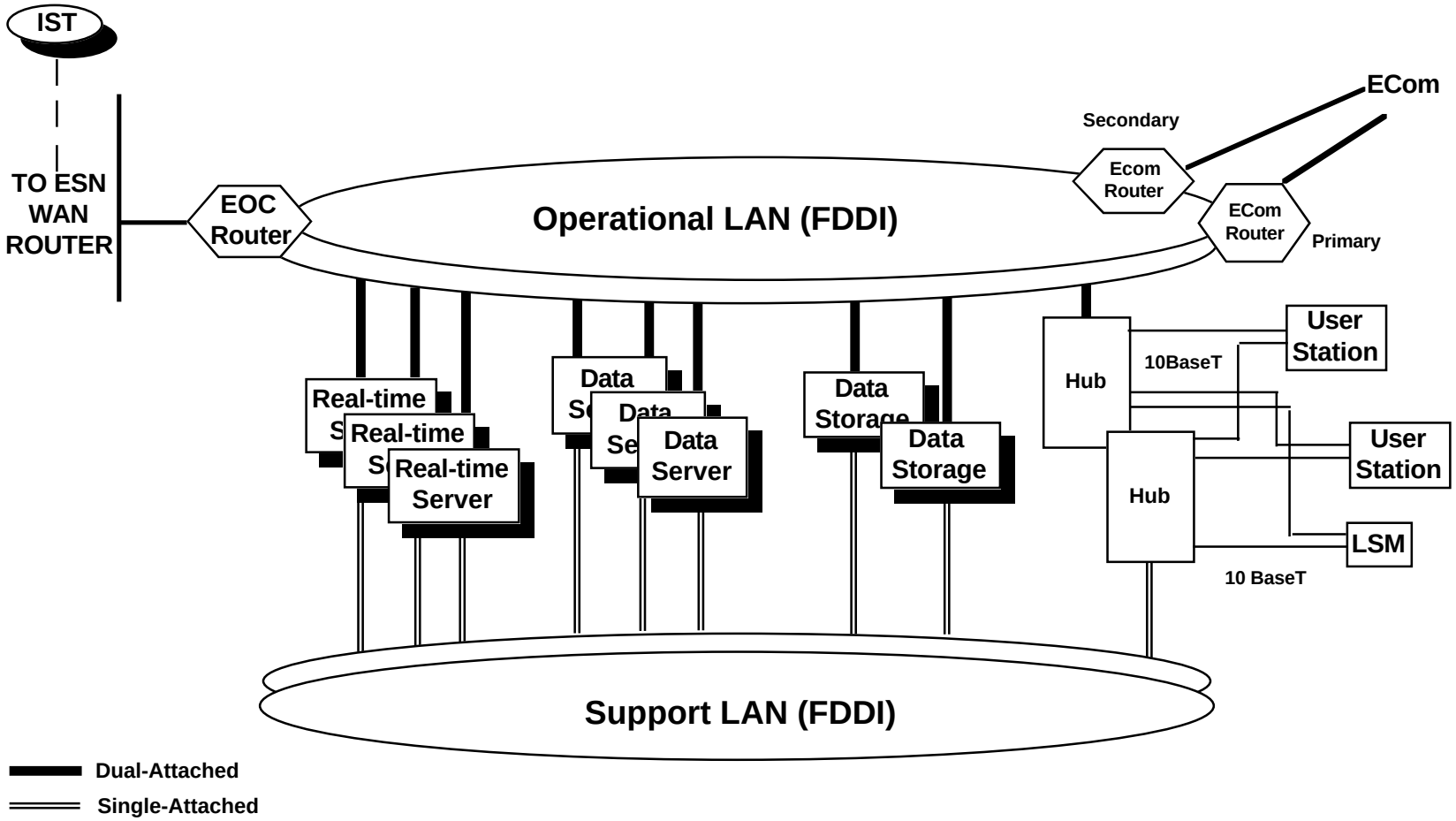
FOS CDR Engineering



FOS Architectural Goals



FOS Block Diagram



FOS Architecture Overview

EOC Network

- **Dual FDDI rings**
  - **Operational LAN**
  - **Support LAN**

Computers

- **Real-Time Server**
  - **Performs real-time processing of telemetry and command in support of a spacecraft contact**
  - **Distributes telemetry packets to the User Stations**
- **Data Server**
  - **Services requests for historical data and database information**
- **User Stations**
  - **Provides user capability to access all FOS services**

Candidate Configurations

Data Server	Real Time Server	User Station
DEC 1000 4/200	DEC 1000 4/200	DEC 3000/600
DEC 2100 4/275	DEC 2100 4/275	HP 715/80
HP9000/800-H53	HP9000/751	IBM RS6000/41T
SGI Challenge S	SGI Challenge S	SGI 4600SC
		SUN SPARC 20 /61

SAMPLE CONFIGURATIONS ONLY

FOS Architectural Features

Results of Analysis

Early Flight Ops Team (FOT) and Instrument Ops Team (IOT) involvement in FOS development.

Provide integrated spacecraft and instrument operations.

Provide global visibility into the FOS data.

FOS Features and Benefits

FOT and IOT providing influence into the FOS design process.
- Definition of Solid State Recorder tool
- Allow IST to operate in stand-alone mode
- Provide ‘carry-out’ capability for telemetry data

FOT and IOT provided access to authorized FOS capabilities
- IOT access Scheduling, Real-Time and Analysis tools through the IST
- FOT and IOT can use the same displays simultaneously

FOS provides:
- Concurrent scheduling access to multiple users via partitioning, which enables both IOT and FOT personnel to work on different portions of a schedule simultaneously.

FOS Architectural Features (cont.)

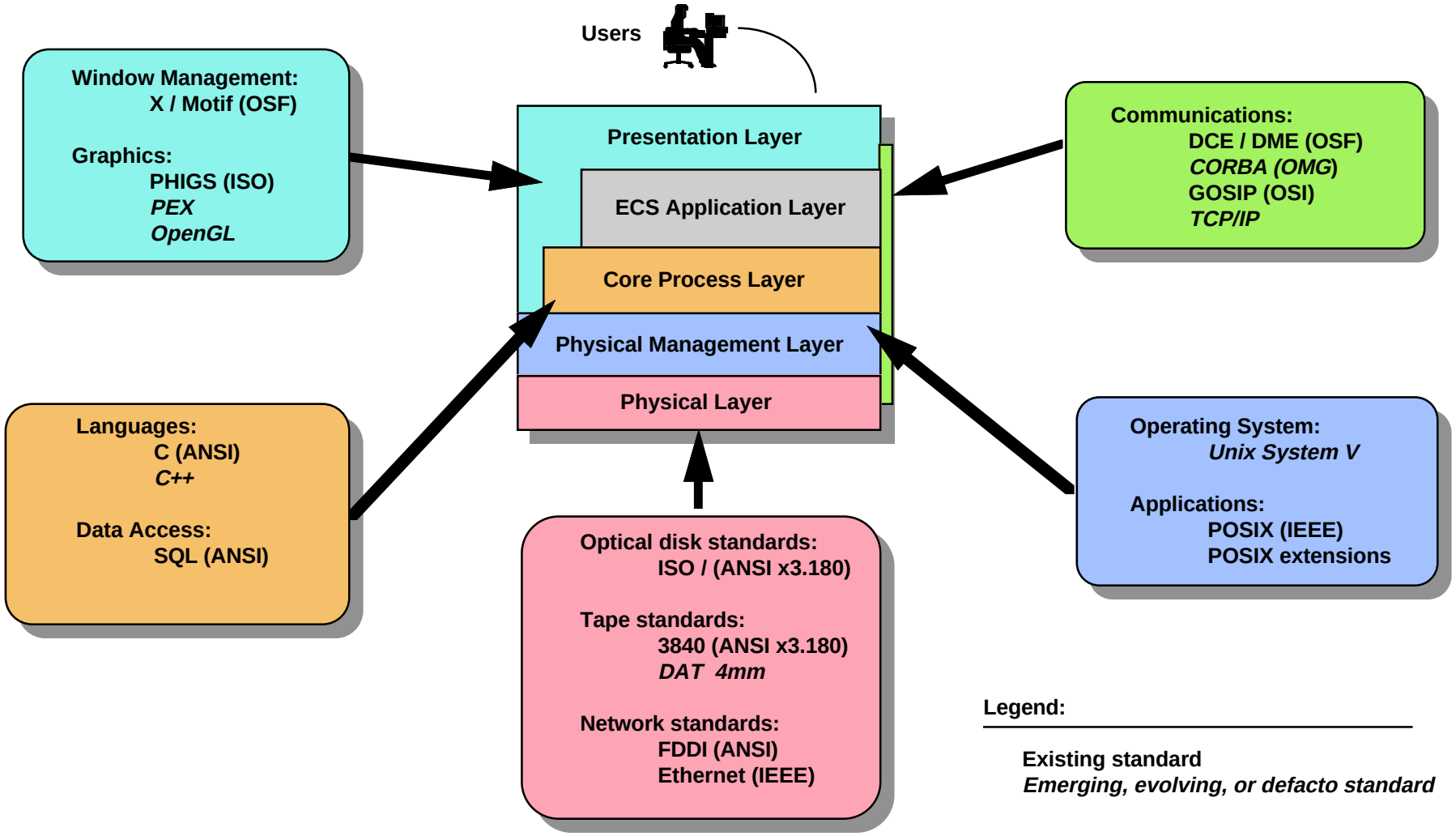
Results of Analysis

Vendor-specific solutions reduce options for growth and evolvability.

FOS Features and Benefits

FOS will be developed using standards:
- **POSIX, Motif**
- **TCP/IP, DCE**
- **IEEE, ANSI**

Candidate FOS Standards



Legend:

Existing standard
Emerging, evolving, or defacto standard