Ares I Engineering Support Function

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Present Shuttle Support

♦ **For the Shuttle Program we presently provide support for (**including IT Security, maintenance, networking, and configuration management):

- Data Reduction
- Data Display and Distribution
- Shuttle Engineering Support Center and Shuttle Action Center
  - Includes console stations for the propulsion elements: Space Shuttle Main Engine, External Tank, Safety & Mission Assurance (S&MA), Hazardous Gas, Solid Rocket Boosters, and Solid Rocket Motors
  - There are "certified" and "non-certified" consoles, depending on requirements
  - PCGoal2 is software used to display data for engineers and element managers
- Meteorological Interactive Data Display System (MIDDS)
  - Accepts weather data from JSC and KSC
  - Helps develop Day of Launch software loads to launch vehicle

- Work Year Equivalents: 28 (contractor and civil service)

Remote Operations:
Enabling and Protecting Distributed Data and Resources
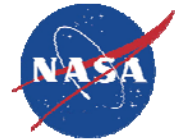
- ◆ **The current ISS/Shuttle facility actively maintains a NPR 2810 compliant security program with layered defense in depth to protect assets thereby freeing customers to focus on their mission**
- ◆ **The network is a combination of NASA NISN and local high speed / high reliability firewalls, routers, and network switches**
- ◆ **Presently support (approximately) 158 remote Shuttle users from 10 distinct locations and app. 200 remote users for ISS. Many more can be supported, if necessary**
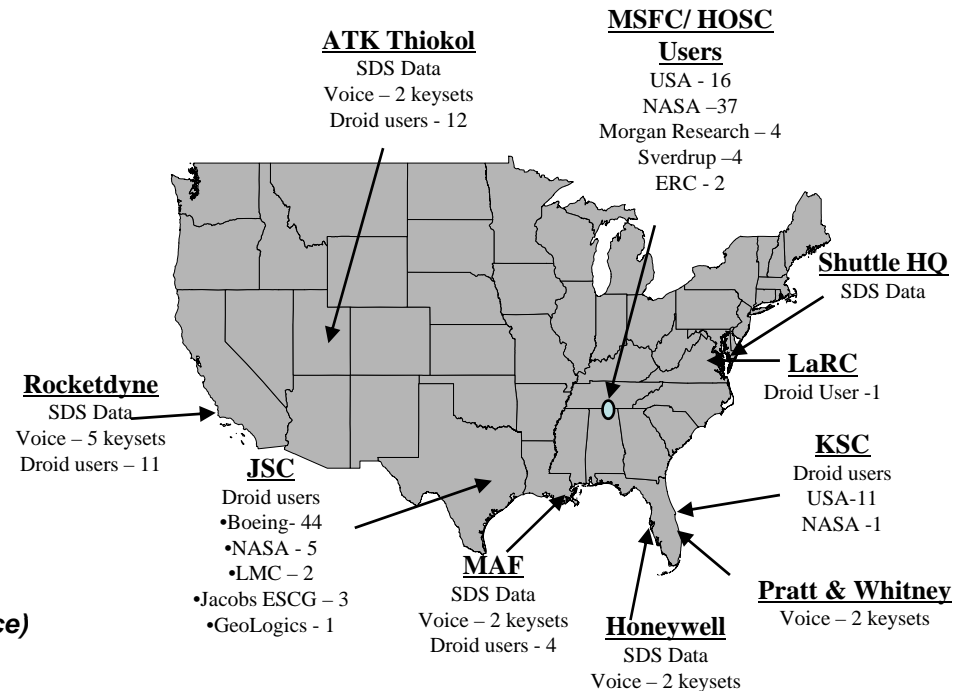
◆ Remote ISS Users

JSC (TCIV)
GRC (TCIV)
KSC (TCIV)
JPL (IV)
GSFC (IV)

MIT (V)
Cal Tech (V)
Wyle Labs, Houston (TCIV)

ESA Columbus Control Center (TI)
ESA Belgium (TCIV)
JAXA (TCI)

(T=TLM, C=CMD, I-Info Mgmt Sys (PIMS, etc.), V=Voice)
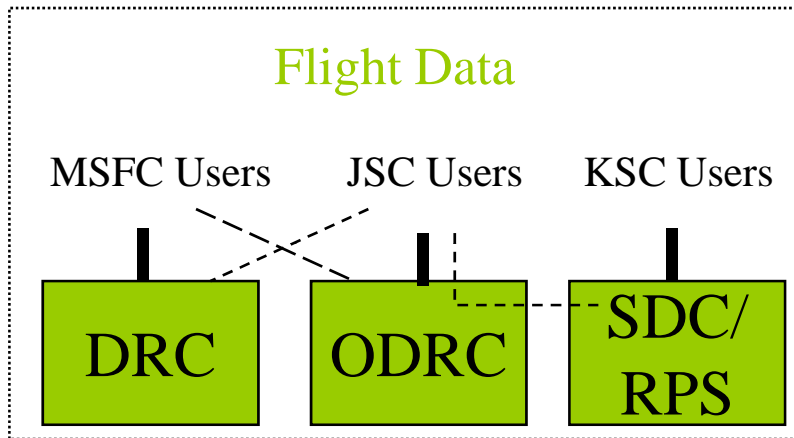
Present Remote Shuttle Users

ATK Thiokol
SDS Data
Voice – 2 keysets
Droid users - 12

MSFC/ HOSC Users
USA - 16
NASA –37
Morgan Research – 4
Sverdrup –4
ERC - 2

Shuttle HQ
SDS Data

LaRC
Droid User -1

Rocketdyne
SDS Data
Voice – 5 keysets
Droid users – 11

JSC
Droid users
• Boeing- 44
• NASA - 5
• LMC – 2
• Jacobs ESCG – 3
• GeoLogics - 1

MAF
SDS Data
Voice – 2 keysets
Droid users - 4

Honeywell
SDS Data
Voice – 2 keysets

KSC
Droid users
USA-11
NASA -1

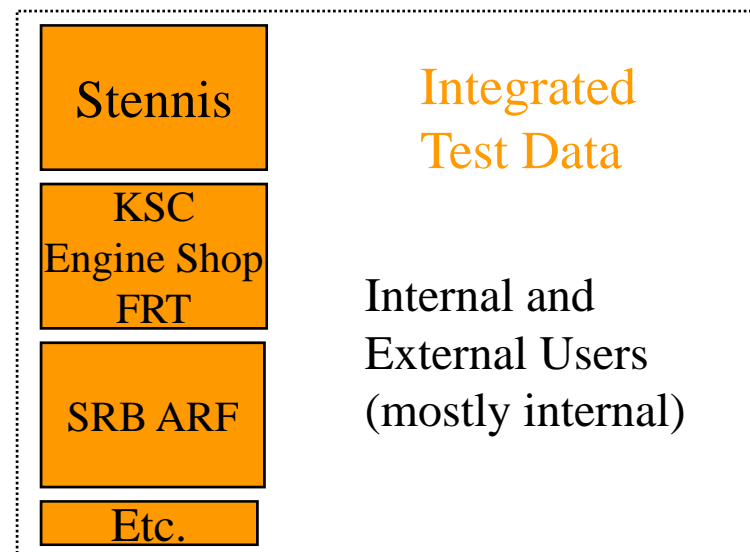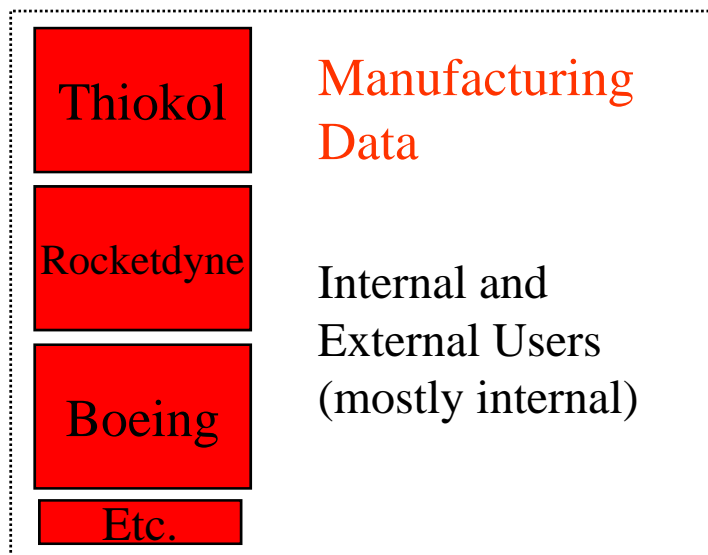**Pratt & Whitney**
Voice – 2 keysets

Decision making can be difficult with the current methodology

Providing access to decision making information is complicated. Historically, data is summarized at each level and presentation charts are used to brief next level

- Data/Information is not readily accessible
- Stored in disparate and sometimes in multiple locations
- Different data owners
- Stored in different formats
- Sometimes requires week(s) to obtain information/data
- Lacks catalog/index– hard to identify what's available
- Lack of search/browse across "ownership" boundaries

Flight Data

MSFC Users   JSC Users   KSC Users

DRC   ODRC   SDC/ RPS

Manufacturing Data

Thiokol

Rocketdyne

Boeing

Etc.

Internal and External Users (mostly internal)

Integrated Test Data

Stennis

KSC Engine Shop FRT

SRB ARF

Etc.

Internal and External Users (mostly internal)

Ares I Engineering Support and
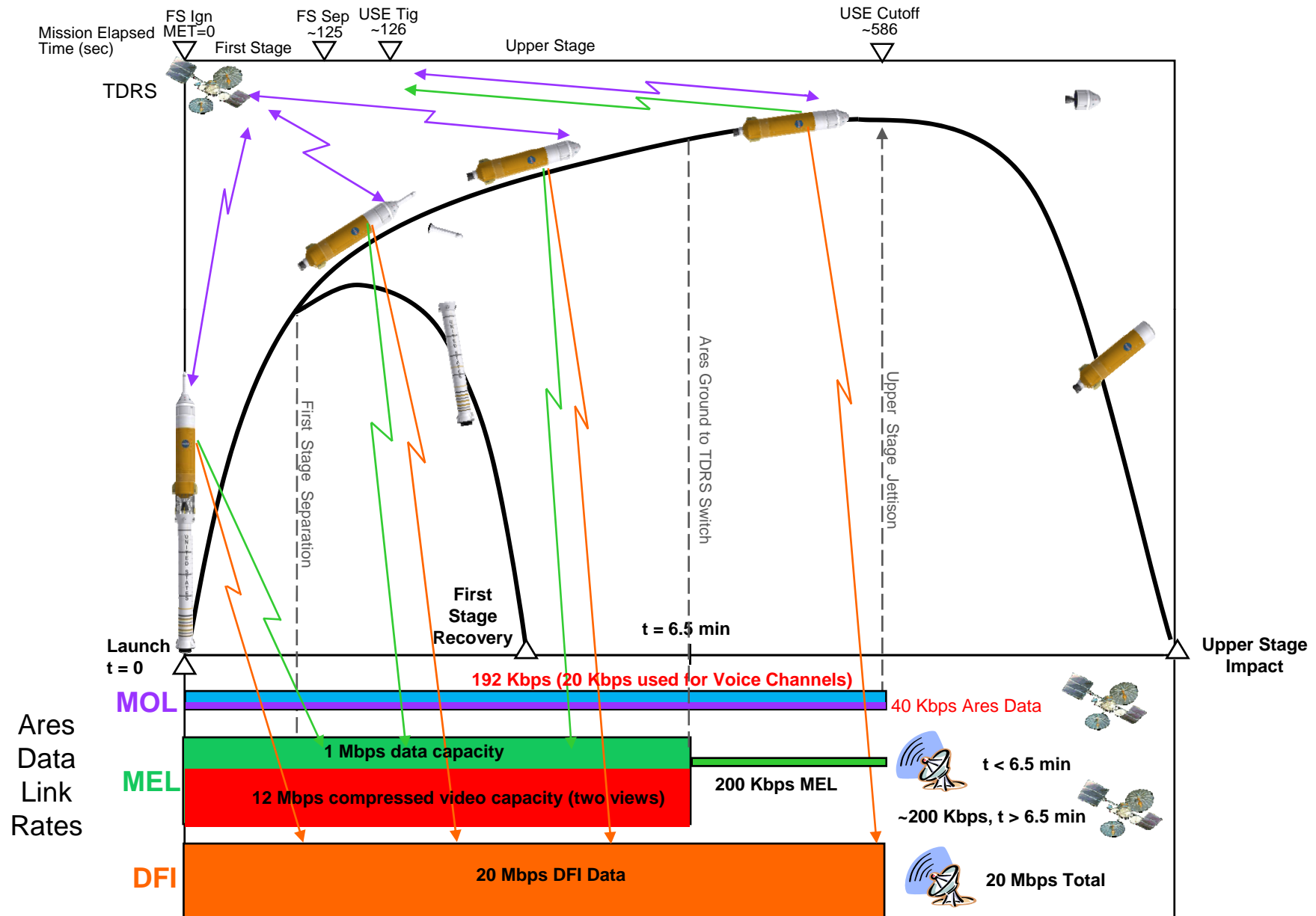# Integrated Vehicle Sustaining Engineering

♦ The Ares Project Office and MSFC Engineering will be responsible for providing **integrated engineering support** for the Ares launch vehicles over the life of the project. Although much of the operational support for Ares I will become the responsibility of the Constellation Space Transportation Flight Planning Office at KSC, the Ares I integrated vehicle will be the responsibility of the VI office at MSFC, which is different than the Shuttle today.

♦ Ares integrated engineering support will include:
- Vehicle Design, Development, Test and Evaluation (DDT&E) phase
- Integrated testing and analysis
- Launch countdown and flight thru Upper Stage disposal
- Flight Evaluation (FE) Activity
  - Identify issues and anomalies before next flight
  - Identify long-term trends that are "creeping up" that can effect performance
  - Document results of each flight (flight evaluation reports -own process and end item document)
  - Capture system learning (evolution of knowledge – why certain components react or work in a certain matter) to take forward for future analysis
  - Coordinate FE products from elements to support next launch
- Vehicle Performance Reconstruction (loads, trajectory, acoustic, etc.)
- Provide support for design modifications/changes affecting OML, mass distribution, etc. which could change aero-loading, thrust oscillation sensitivities, and overall vehicle performance
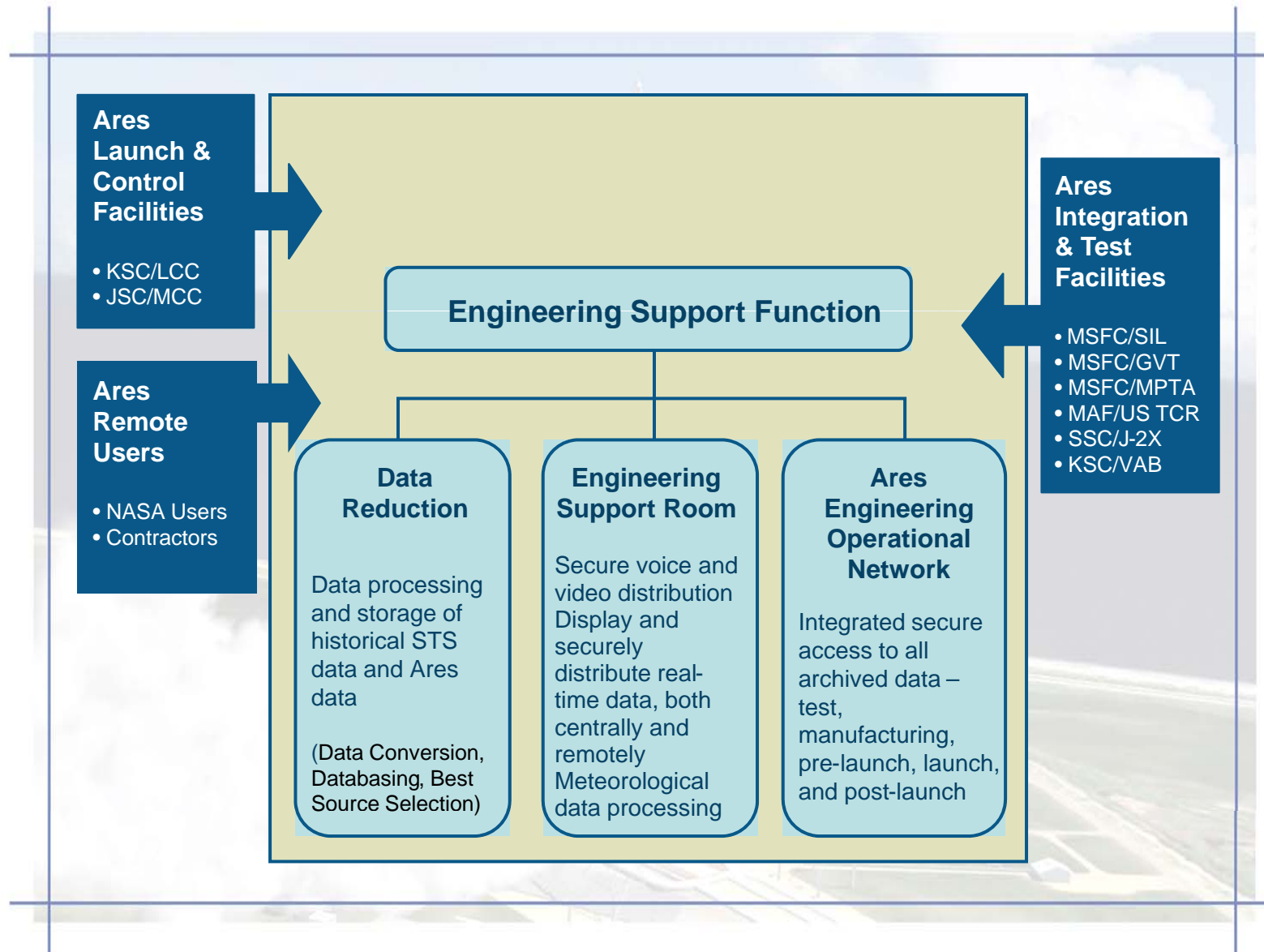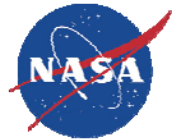- Manage and/or provide support for major design modifications/changes

Baseline (CR-130A): Ares I / Orion Telemetry Architecture

Engineering Support Function

Ares Launch & Control Facilities

- KSC/LCC
- JSC/MCC

Ares Remote Users

- NASA Users
- Contractors

Ares Integration & Test Facilities

- MSFC/SIL
- MSFC/GVT
- MSFC/MPTA
- MAF/US TCR
- SSC/J-2X
- KSC/VAB

Engineering Support Function

Data Reduction

Data processing and storage of historical STS data and Ares data

(Data Conversion, Databasing, Best Source Selection)

Engineering Support Room

Secure voice and video distribution Display and securely distribute real-time data, both centrally and remotely Meteorological data processing

Ares Engineering Operational Network

Integrated secure access to all archived data – test, manufacturing, pre-launch, launch, and post-launch

Integrated Engineering Support
For <u>All</u> Project Phases

Limited capability currently exists in Windchill but could be improved in the future

Vehicle Design & Manufacturing | AEON
- Provide a <u>central point of access to the Cx Program</u> for Ares design data
- ECR reviews and CM archive
- Requirements, drawings, trajectories, performance, logistics and test plans

Integrated Testing and Analysis
- Provide a <u>central point of access to the Cx Program</u> for Ares engineering test data | AEON
- Provide common data reduction interface for all tests/data types
- Provide secure remote access to archived test data to remote users (CxP, Orion, KSC..)
- Provide secure remote access to test sites (SIL, GVT, MPTA, MAF, etc) so test data, video and audio can be monitored and archived.
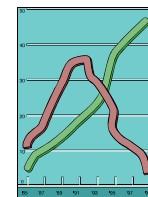- Distribute live or archived test data to remote sites to reduce travel

Vehicle Processing and Assembly at the Launch Site
- Provide engineering support to KSC during vehicle processing and assembly | AEON
- Provide ELO easy access to scheduling and resource inputs
- Remote support/analysis of complex ops (i.e. TCDT) | DR
- Allow easy access to OMSRD evaluation and processing flow improvements
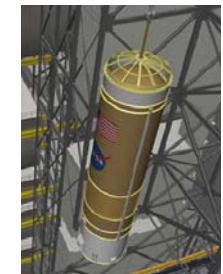
Launch Countdown and Flight Support Thru Upper Stage Disposal
- Provide a <u>central point of access to the Cx Program</u> for Ares I flight data | ESR
- Provide centralized data archiving, data reduction as well as audio and video | DR
- Allow engineers to support simulations, countdown and flight phases
- Provide consoles for weather assessment team | AEON
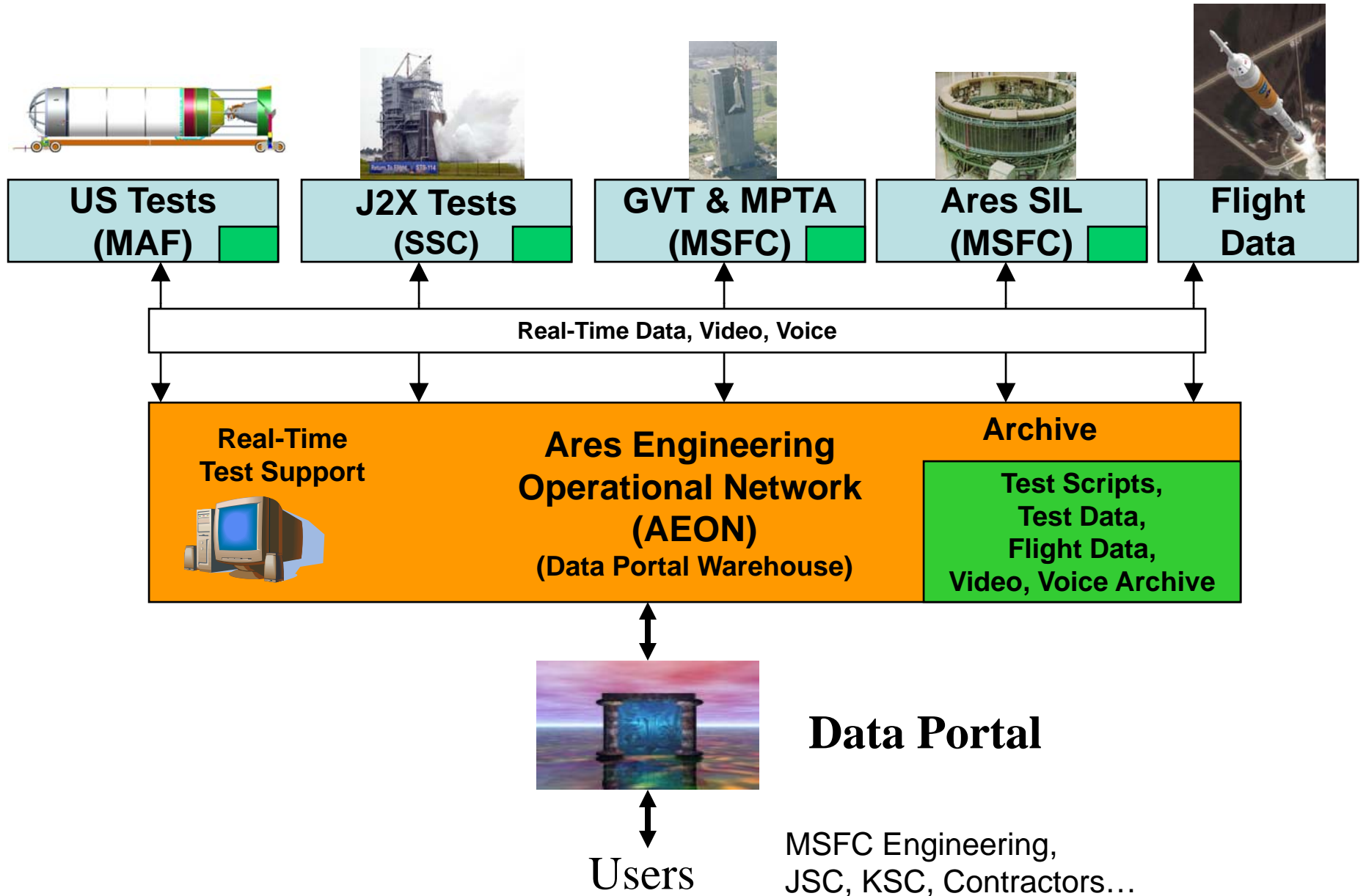- Archive and provide secure remote distribution of real-time data, audio and video.

Post Flight Performance Analysis
- Provide a <u>central point of access to the Cx Program</u> for Ares post flight data and analysis | DR
- Provide capability for engineers to assess vehicle performance and provide post flight products.
- Provide ability for ELO to quickly provide flash reports to Cx and NASA upper management
- Provide capability for engineers to analyze anomaly and provide timely resolution. | AEON

Ares Data Access Point for all of CxP

Ares Integrated Engineering
Data Portal Concept

| US Tests (MAF) | J2X Tests (SSC) | GVT & MPTA (MSFC) | Ares SIL (MSFC) | Flight Data |

Real-Time Data, Video, Voice

Real-Time Test Support

Ares Engineering Operational Network (AEON)
(Data Portal Warehouse)

Archive

Test Scripts, Test Data, Flight Data, Video, Voice Archive

Data Portal

Users

MSFC Engineering, JSC, KSC, Contractors...

- ♦ **Projected Engineering Support Function staffing varies from year to year depending on development work for new products. The lowest is 3 and the lowest is 21 over the period from FY09 through FY15 with the peak coming in FY13 for development of software and processes for Data Reduction. After DDT&E, we have a sustaining level of approximately 14 work year equivalents (for both contractor and civil service).**

- ♦ **As you can see, we are cutting our support in half in terms of manpower for supporting the Ares launch vehicle.**

- ♦ **We are also planning our purchases of equipment for supporting the data archival to be in conjunction with other projects, such as International Space Station, (as Shuttle and ISS have already) to achieve savings in those areas, as well.**

- ♦ **Our data portal and the other software tools that will be available will be more user friendly, instead of a "push" environment, where the user asks for data by time, instrument id, etc., the user will now be able to use web-based tools to pull that data for themselves.**