Welcome
The SGSS Project highly values the customers it will serve. This TIM is an opportunity to share information, receive feedback and engage in candid conversation.

SGSS is committed to keeping the end user community informed about the SGSS progress, system capabilities, interfaces, test opportunities, and transition strategies.

This TIM has the following goals:

- Update selected information provided at the last TIM
- Inform customers of SGSS progress
- Convey high level details of the customer interfaces
- Convey approach and plans for transition

**Customer TIM Purposes**

- **Base System:** Structure, Behavior, Interfaces…
- **Customer Feedback:** Customer TIMs, Individual Missions Tag-Ups, Questionnaires…
- **Operable System:** Meeting operational and customer needs…
Customer TIM presentations and newsletters are available on the SGSS website:

http://esc.gsfc.nasa.gov/space-communications/sgss.html
<table>
<thead>
<tr>
<th><strong>Topic</strong></th>
<th><strong>Presenter</strong></th>
</tr>
</thead>
<tbody>
<tr>
<td>Management Overview</td>
<td>Tom Gitlin</td>
</tr>
<tr>
<td>Technical Overview</td>
<td>Vir Thanvi</td>
</tr>
<tr>
<td>Scheduling Interfaces</td>
<td>Jean-Pierre Chamoun</td>
</tr>
<tr>
<td>Data Transport Interfaces</td>
<td>Wes Eddy</td>
</tr>
<tr>
<td>Early Interface Testing</td>
<td>Dave Waters</td>
</tr>
<tr>
<td>Deployment and Transition</td>
<td>Richard Von Wolff</td>
</tr>
<tr>
<td>Wrap Up</td>
<td>Vir Thanvi</td>
</tr>
</tbody>
</table>
Management Overview

Tom Gitlin
• The SGSS Project will develop and deliver a new ground system that will enable the Space Network (SN) to continue safe, reliable, and cost efficient operations for the next several decades
  – The SN, a designated national resource, provides essential communications and tracking services to NASA human exploration & scientific missions and non-NASA missions
  – The current SN ground segment, developed in the mid 1990s, is based on obsolete technologies and is becoming increasingly difficult to operate safely and reliably
  – The SN space segment is being replenished with additional TDRS spacecraft. TDRS-L was launched on January 23, 2014 and TDRS-M launch is planned for Late 2017

• SGSS will allow the SN to support an evolving customer set by:
  – Providing all of the capabilities and capacities required by current SN customer missions
  – Expanding the capabilities and capacities of the SN to support new services for new customers in the near to mid term
  – Delivering an extensible and expandable system to easily allow future modifications to implement services not yet defined
  – Enabling reductions in operations and maintenance costs
Programmatic Status

- SGSS Schedule is being re-aligned to meet fiscal year funding profile guidance / constraints
  - Revised schedule forecast is being developed in close coordination with the SCaN Program’s Budget submission
  - Remote Ground Terminals (GT) in Guam and Blossom Point, MD, remain in scope, but have been deferred
  - Working closely with the Space Network (SN) on Transitional Architecture capabilities to meet near-term mission needs and smooth the transition from Legacy to SGSS
Significant Accomplishments

• Development of Increment A6 – the final development increment – is underway; focus includes:
  – Completing integration of User Services capabilities, including automated scheduling, legacy proxies and real-time execution
  – Multisite Services and transition support
  – Automation and Service Recovery / Failover modes

• Completed system-level integration of Increment A5 functionality at General Dynamics in Scottsdale, AZ. Cross-element testing / risk reduction is in process. Increment A5 includes:
  – Most User MOC Services, tracking services, and some Test Services
  – Integrated SN Operations Center functionality for management and control for the TDRS fleet and Ground resources
  – Most External Interfaces implemented

• Continued Early Interface Testing
  – Risk mitigation activity which external entities connect directly with the GD lab via the NASA Mission Network
  – Phase 1 testing complete; Phase 2 testing will follow the completion of A5 system-level I&T
Technical Overview
Vir Thanvi
SGSS Functional Architecture

**Maintenance & Training (MT)**
- Offline support for the SGSS
- System/SW maintenance, debug
- System-wide training access

The MT element is not part of the operational system.

**Digital Signal Processing (DSP)**
- Convert analog <> digital signal
- Modulates, demodulates, encodes, decodes traffic
- Ground-based beam-forming
- High-Speed IF signal distribution

**Enterprise Infrastructure (EI)**
- High-availability operating environment to host applications system-wide
- Catalog of common *services*
- Internal system networking resources
- Network/boundary protection
- CMD and TLM encryption/decryption

**Fleet & Ground Mgmt (FGM)**
- Control and manage the TDRS fleet
- Manage the ground resources
- Manage the entire SGSS enterprise

**Service Management (SM)**
- Plan, schedule, and execute user service sessions
- Monitor and report user service performance

**User Services Gateway (USG)**
- External interfaces for forward and return user traffic
- Data format, protocol translation
- Signal/baseband record and replay

**Space-Ground Link (SGL)**
- Forms the link between the antenna feed and the signal processing equipment
- Provide precise timing and frequency references

**Fleet & Ground Mgmt (FGM)**
- Control and manage the TDRS fleet
- Manage the ground resources
- Manage the entire SGSS enterprise

**Service Management (SM)**
- Plan, schedule, and execute user service sessions
- Monitor and report user service performance

**User Services Gateway (USG)**
- External interfaces for forward and return user traffic
- Data format, protocol translation
- Signal/baseband record and replay

**Enterprise Infrastructure (EI)**
- High-availability operating environment to host applications system-wide
- Catalog of common *services*
- Internal system networking resources
- Network/boundary protection
- CMD and TLM encryption/decryption
Incremental System Build-Up

- SGSS System is built up in increments.

- The approach is to build the system in a manner that a set of key system functionalities are demonstrated at the completion of each increment.

- Each new increment will build upon functionality demonstrated in prior increments.
## SGSS Incremental Integration Objectives

### Overall Theme
- Element integration on EI
- Selective Element Integration
- Core functionality integration

### Bearer Plane
- **Initial RF/IF Integration**
  - RF/IF Integration (all antenna exc. Ka & STTC)
  - Bitstream for User & Test
  - MACE
  - Ku Services
  - Recording

### Control Plane
- **Initial Gen 1 T&C Transport**
  - Tracking Data
  - Gen 1,2,3 T&C services w/o TDRS ant. control
  - Integrated Service Execution, MMA Signal, T&C and Ku User

### Management Plane
- **Fault Mgmt (FM) and Config Mgmt (CM) integration as test tools.**
  - FM, CM (SNOC/GT), Log Mgt deployment
  - FM, CM, Log integration with MEs.
  - Initial mgmt of Sched Resources

### External Interfaces
- **E02 physical thru transport layers only**
  - E04 MACE and 650 IF
  - E05 bitstreams
  - E18 GPS
  - Legacy to WSC

### A2 Foundation
- **Complete: 6/27/14**
  - Element integration on EI
  - Selective Element Integration
  - Core functionality integration

### A3 Bearer Network and Basic GT
- **Complete: 2/27/15**
  - Isolated GT with limited service execution
  - Core Bearer Integration
  - Limited Local Services

### A4 Functional GT and Basic SNOC
- **Complete: 9/4/15**
  - GT + SNOC, all local User data relay services execution exc. Dig IF
  - Additional Local Services

### A5 MOCs and Mature Networks
- **Complete: 7/1/16**
  - External Network Integration
  - SNOC Functional Completion
  - Most User MOC Services
  - Initial Test Services

### A6 Life Cycle Features
- **Overall Theme**
  - Element integration on EI
  - Selective Element Integration
  - Core functionality integration

- **Bearer Plane**
  - RF/IF Integration (all antenna exc. Ka & STTC)
  - Bitstream for User & Test
  - MACE
  - Ku Services
  - Recording

- **Control Plane**
  - Tracking Data
  - Gen 1,2,3 T&C services w/o TDRS ant. control
  - Integrated Service Execution, MMA Signal, T&C and Ku User

- **Management Plane**
  - FM, CM (SNOC/GT), Log Mgt deployment
  - FM, CM, Log integration with MEs.
  - Initial mgmt of Sched Resources

- **External Interfaces**
  - E02 physical thru transport layers only
  - E04 MACE and 650 IF
  - E05 bitstreams
  - E18 GPS
  - Legacy to WSC

- **A2 Foundation**
  - **Complete: 6/27/14**

- **A3 Bearer Network and Basic GT**
  - **Complete: 2/27/15**

- **A4 Functional GT and Basic SNOC**
  - **Complete: 9/4/15**

- **A5 MOCs and Mature Networks**
  - **Complete: 7/1/16**

- **A6 Life Cycle Features**
  - Multisite Services and Transition Support
  - Feature Completion
  - Automation
  - Final Test Services
## User Services in the SGSS Management, Control and Bearer Planes

### Management
- Service plan and schedule
- Situational Awareness
- Device (ME) Commissioning
- Ground fault mgmt/correlation
- Performance trending
- SW patch deployment

### Control
- Service initiation
- Service recovery
- Fleet commanding
- Fleet Telemetry processing
- Tracking message generation

### Bearer
- Signal ADC, DAC
- Signal tuning, filtering
- Signal frequency conversion
- Beam forming
- Modulation/demodulation
- Protocol translation
- Format conversion at edge

### Management
Describes the process of preparing the system to perform its mission, sustaining that preparedness, and measuring performance of mission execution. Management data includes configuration, performance, and historical information used to improve and evolve the system. All non-inert SGSS components are managed. Management data flows on the conceptual “management plane.”

### Control
Describes the process of operating the system in the performance of its mission, and monitoring that operation. This includes information used to setup, modify, status, and teardown a provided service. A small subset of SGSS components are controlled. Control data flows on the conceptual “control plane.”

### Bearer
Describes information “product” that is transported through the system. This includes traffic between user platform and user ground systems (MOC or ULE), and any traffic which might be played-back from system internal buffer/storage. Bearer information flows on the conceptual “bearer plane.”
The SGSS design is mature and the system is proceeding through implementation

- Increment A2 has been completed
  - Completed initial bearer RF/IF integration
  - Initial TDRS Gen 1 Telemetry & Control capability
  - Fault management and configuration management integration as test tools

- Increment A3 has been completed
  - Initial user service set-up and provision
  - Narrowband Modem Factory Acceptance Test completed
  - Demonstrated full bearer loop / A3 baseline

- Increment A4 has been completed
  - Production Equipment for STGT integrated in the lab
  - Wideband Modem Factory Acceptance Test Completed
  - Demonstrated Gen 3 TDRS Station-keeping Maneuver Planning and Execution with User Service Execution

- Increment A5 is in final stages…
  - Building upon A4 functionalities
  - Completes SNOC functions and introduces MOC services

- Increment A6 Development is underway
  - Adding on multi-site services, finishing up Service Management, and MTF
  - System performance tuning; security compliance; operational and interface needs focus
Notable Items

- Completed Phase 1 Early Testing
- Completed survey of TCP MOCs (legacy PTP) to understand data transports. Thank You!!
- Completed initial development of SGSS Service Management Human-Machine Interface (HMI)
  - Used for service scheduling and GCMRs
- Steady progress in development of Mission ICDs
- Addition of active-active redundant return services support option
  - Utilization managed by the SN policies
- Commenced WSC Facility Preparations
- Moved development of Service Management Legacy Adapter outside the boundary of SGSS
  - Transparent to the customers
- Deferred deployment and installation at Blossom Point Ground Terminal and Guam Remote Ground Terminal
- Deferred implementation of SGSS Machine-to-Machine Interface
• **Service Scheduling (Service Management Element)**
  - Ingest user requests from legacy SN scheduling systems and new SGSS HMI
  - Validate requests against approved mission and service profiles
  - Develop de-conflicted schedule for use of SN space and ground resources
  - Issue directives to set-up and provision services, including bearer data processing (where applicable) and ground data transport
  - Process allowable, in-service configuration changes

• **Data Transport (User Services Gateway Element)**
  - Provide network for distribution of bearer data
  - Protocol and data formats (legacy and new)
  - Record and Buffer Service

---

### Customer Interfaces

#### Service Scheduling

- Ingest user requests from legacy SN scheduling systems and new SGSS HMI
- Validate requests against approved mission and service profiles
- Develop de-conflicted schedule for use of SN space and ground resources
- Issue directives to set-up and provision services, including bearer data processing (where applicable) and ground data transport
- Process allowable, in-service configuration changes

#### Data Transport

- Provide network for distribution of bearer data
- Protocol and data formats (legacy and new)
- Record and Buffer Service

---

### Scheduling of Data Interfaces

<table>
<thead>
<tr>
<th>Interface Type</th>
<th>SNAS/EPS</th>
<th>SN/CSM</th>
<th>SGSS HMI</th>
<th>SGSS MMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>SN Service</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>RTN</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E-04.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E-04.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E-04.3</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E-04.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E-05.1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E-05.2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>E-06.4</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

### Customer Interfaces Diagram

[Diagram showing customer interfaces and data transport services]
• **Purpose of SGSS-Mission ICD for Each Customer**
  - Define and describe all external interfaces between SN with SGSS and customer platform/spacecraft and ground facilities
    - Ensure that SGSS design includes supporting all current mission-unique services, any mission-unique operational needs, and all mission-unique expected behaviors on the interfaces for each customer

• **Scope of Each ICD**
  - For each customer, detail all SN/SGSS external RF and ground interfaces
    - Include scheduling, status, real-time control, vectors, baseband data, tracking, time-correlation, timing signals, and RF interfaces
  - Use typical NASA ICD format
  - Define any notable changes for customers in ICD when applicable
    - Any changes to legacy customer interfaces or operations will be finalized via full dialog and agreement with customer

*Don’t see your mission name….😢*

*Don’t Panic 😁*

*We are aware of additional missions and the interface documentation for those will be planned in the most effective and efficient way. 👍*
Scheduling Interfaces

J.P. Chamoun
• Progress and changes since last customer meetings
• Summary of Schedule and Service Execution Interfaces
• Customers per interface type
• New SMLA configuration for transition
• Service Agreements and Service Profiles
• Legacy SSC vs SGSS Service Profiles
Where we are since the last customer forum

• Completed version E of the User MOC E-06 ICD.

• Continued working on User Mission ICD Addendum, including the mapping of legacy service configuration (SSC) and service status (UPD) parameters to SGSS database.

• Completed initial development of HMI for scheduling (PSS) and service execution (SE). Started tuning HMI’s to access SGSS database efficiently.

• Completed partial development of SN/CSM proxy.

• The development of the SM Legacy Adapter (SMLA) has been moved to the Space Network. SGSS is working with the SN to coordinate completion, testing and integration between the SMLA-R and SGSS.
• SGSS continues to support existing interfaces for existing customers
  – SN/CSM
  – MOC can continue to use their SNAS and EPS Clients

• SGSS implements new scheduling interfaces and protocols providing the customer additional flexibility for managing and controlling services and the new SGSS service features.
  – SGSS Web Portal HMI
  – SGSS MMI

• SGSS Service Management & Control interfaces provides the following functionality to the customer:
  – User and TDRS Vector
  – Service Management
  – Service Control and Monitor
  – Service Accounting
Existing Customer Interface Support

- SGSS HMI and MMI will be documented in the E-06 User MOC ICD
Scheduling Interfaces: Access to scheduling functionality

- The following tables map which scheduling functions are available from each of the scheduling interfaces.

<table>
<thead>
<tr>
<th>Mission</th>
<th>Interface Type</th>
<th>SNAS/EPS SN/CSM</th>
<th>SGSS HMI</th>
<th>SGSS MMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Service Agreement</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mission Profile</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Service Profiles</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Legacy Service Specification Codes (SSC)</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Vector</th>
<th>Interface Type</th>
<th>SNAS/EPS SN/CSM</th>
<th>SGSS HMI</th>
<th>SGSS MMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>State Vectors</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Schedule Request</th>
<th>Interface Type</th>
<th>SNAS/EPS SN/CSM</th>
<th>SGSS HMI</th>
<th>SGSS MMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Schedule Add Replace Delete</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Request DAS Services*</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Request Specific Start Time Constraint</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Service Resource Constraint (e.g. TDRS, ULE)</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Service Start Time Constraint (lead and lag tolerances, minimum duration)</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Service Start Time Coupled or Bound to other services</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Service Start Time relative to other requests</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Service Time Window Constraints (e.g. TSW)</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Request Results</th>
<th>Interface Type</th>
<th>SNAS/EPS SN/CSM</th>
<th>SGSS HMI</th>
<th>SGSS MMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Active Schedule Events</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>TUT</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Reports</th>
<th>Interface Type</th>
<th>SNAS/EPS SN/CSM</th>
<th>SGSS HMI</th>
<th>SGSS MMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground Source / Mutual RFI</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Service Accounting Reports</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Service Status (e.g. UPDs)</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Service Change (e.g. GCMRs)</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Alerts</td>
<td>X</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Note:
SNAS will support DAS services through transition only (i.e. through FAR). Post transition DAS customers will schedule DAS events via the SGSS HMI or MMI

Thanks to DAS customers for effective collaboration!!
The following tables maps which Data Interfaces can be scheduled from each of the scheduling interfaces.

<table>
<thead>
<tr>
<th>Scheduling of Data Interfaces</th>
<th>Interface Type</th>
<th>SNAS/EPS SN/CSM</th>
<th>SGSS HMI</th>
<th>SGSS MMI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Analog Non-Digitized</td>
<td>X X X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>MACE Digital VRT Pkt.</td>
<td>N/A N/A N/A</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Analog Tuned IF</td>
<td>X X X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pkt. VRT Digital IF</td>
<td>X X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Serial BB</td>
<td>X X X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pky. VRT BB</td>
<td>X X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Legacy UDP BB</td>
<td>X X X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Legacy TCP BB</td>
<td>X X X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>CCSDS SLE</td>
<td>X X X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>New CCSDS SLE</td>
<td>X X</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IP BB</td>
<td>X X</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note:
- MACE interface is multicast to subscribers

Note:
- New services and new data interfaces available only from SGSS scheduling interfaces
## Customers by Scheduling Interface Types

<table>
<thead>
<tr>
<th>Interface Type</th>
<th>Planned Customers - Scheduling</th>
<th>Planned Customers – Control &amp; Monitor</th>
</tr>
</thead>
<tbody>
<tr>
<td>SN/CSM SNAS HMI (XDR TCP/P only)</td>
<td>HST, SPTR-2, SCaN Testbed, NPP, JPSS-1, MTRS, ELV, HTV, Dragon, Cygnus, LDCM, Landsat-7, GPM, SORCE, AIM, Swift, RBSP, NEOWISE, NUSTAR, THEMIS, TIMED, MMS, OCO-2, SMAP, LDBP</td>
<td>SPTR-2, SCaN Testbed, NPP, JPSS-1, MTRS, ELV, HTV, Dragon, Cygnus, LDCM, Landsat-7, GPM, SORCE, AIM, Swift, RBSP, NEOWISE, NUSTAR, THEMIS, TIMED, MMS, OCO-2, SMAP, LDBP</td>
</tr>
<tr>
<td>SN/CSM SNAS EPS (XDR TCP/P only)</td>
<td>ISS</td>
<td>ISS</td>
</tr>
<tr>
<td>SN/CSM Direct Connect</td>
<td></td>
<td></td>
</tr>
<tr>
<td>XDR, TCP/IP</td>
<td>Aqua, Aura, Terra</td>
<td>Aqua, Aura, Terra</td>
</tr>
<tr>
<td>4800BB, UDP</td>
<td>None</td>
<td>HST</td>
</tr>
<tr>
<td>SGSS HMI</td>
<td>Fermi, Swift</td>
<td>Fermi, Swift</td>
</tr>
<tr>
<td>SGSS MMI</td>
<td>None</td>
<td>None</td>
</tr>
</tbody>
</table>
What is SGSS “Transition”: the period of time starting when the first operational TDRS is being controlled by SGSS and concluding when no Operational TDRS are being controlled by the legacy system.

Scheduling Features impacted during Transition

- Alternate Schedule Add Request (ASAR)
  - ASAR request may be declined
    - Workaround is to resubmit ASARs without referencing a TDRS assigned to the other system (SGSS, SN Legacy)

- TDRS Sets (ANY, TES, TW7, TWE, etc.)
  - Discovered very limited use
  - Schedule requests using cross-system TDRS Sets will be processed but may result in increased declines
  - Workaround is to resubmit declined requests using specific TDRS

- Replace Request (RR)
  - RR request may be declined if the replacement is for a TDRS on the other system
    - Workaround is to resubmit RR as a SAR (on other system) and SDR (on current)
      » Submit SAR first to assure acceptance before delete

Workarounds were expressed to be acceptable to customers
• Customers can continue using existing interfaces if no new SGSS functionality or services are requested.
• Customers can use the new SGSS MMI to replace EPS and connect direct interfaces.

![Diagram of SGSS configuration]

1. SNAS MOC Client
2. SNAS (DB of SSCs)
3. Legacy Proxy
   - SUPIDEN
   - SSC/UIFC
4. Requests for TDRS on legacy system go to NCCDS
5. DAS requests go directly to DASCON (no change)

SM DB

HMI

MMI

SGSS Portal
   - DB of Service Profiles
   - DB of Transfer Profiles

SGSS

NCCDS

DASCON
New Transition Configuration: SMLA-R

- Customers can continue using existing interfaces if no new SGSS functionality or services are requested.
- Customers can use the new SGSS MMI to replace EPS and connect direct interfaces
• Customers can continue using existing interfaces if no new SGSS functionality or services are requested.
• Customers can use the new SGSS MMI to replace EPS and connect direct interfaces.
Leading up to system transition to SGSS, the SGSS project will work with customers to migrate legacy mission information, and service definitions to the SGSS database.

SGSS HMI will be used to:

- Create customer platforms,
- Create Service Agreements
- Create Mission Profiles
- Create user data interfaces
- Create user LDAP entries: user MOC authentication, authorization, privileges, data access
- Migrate Service Profiles.

The Service Agreement implements parameters that support Space Network constraints, resources and service types.

The Service Agreement captures information defined in various NASA documents such as:

- **Project Service Level Agreement (PSLA)**: A formal agreement between NASA and the customer for services, at a specific cost, within a specific time frame.
- **Network Requirements Documents (NRD)**: customer's detailed SN requirements.
- **Radio Frequency (RF) Interface Control Document (ICD)**: Describes the specific radio frequency interface details. The RF ICD is a required document intended to be developed early in the design phase to drive the spacecraft RF telecommunications design.
The SGSS Service Agreement is designed to be machine readable, vs. “people” readable like the PSLA for example.
• The SGSS will work with customers and NIMO to create customer service profiles.

• Each SSC will map to two SGGS Service Profiles:
  – Space Link profile: configuration of the space RF link
  – Transfer profile: configuration of the data transfer interface

SGSS maps SSC identifiers to Service Profiles names in the SGSS database. A naming convention will be establish for easy reference between SSC and Service Profiles.
Sample SSC and SGSS HMI Snapshots
User Mission Definition Example

- Services provided to Hubble Space Telescope: SSAF, SSAR
- Minimum service to be provided: 20 hrs per week
- Hubble Space Telescope (987654321)
- Freeze Interval of 2 hours
- Default RHP (Polarization), LHCP allowed
- Default Encapsulation Type IPDU
- Default Either SA antenna, SA1 allowed
- Default QPSK with data on I and Q Channels
- Default Single Data Source, Alternating I/Q
- SSAR, TDRS 9 or TDRS 11, SA1
- 12-25 minutes in duration
- Start between 09:00:00Z and 09:30:00Z
- TDRS 9, SA1, 16 minutes in duration, Start 09:24:00
Creating Mission Service Agreements with the SGSS HMI

1. Create Platform
2. Create Service Agreement
3. Create Mission Profile
4. Define User Interface
5. Create User LDAP Entries
6. Create User Service Profile

Please reference back-up slides from Nov 2015 Customer TIM
Data Transport Interfaces

Wes Eddy
SGSS ICDs

- SGSS has generic ICDs that describe all interface options
  1. E-03 for User Platform
  2. E-04 for IF ULE
  3. E-05 for Baseband ULE
  4. E-06 for User MOC
- Includes both service management and data transport
- Additional ICDs are being developed per-customer to document specific configurations that are supporting each mission
# Mission ICDs Status

## Draft
- AIM
- LDBP
- MMS
- NEOWISE
- NuSTAR
- OCO-2
- SMAP
- THEMIS
- TIMED
- RBSP / VanAllen

## Internal SN/SGSS Review
- Fermi
- Swift
- GPM
- Landsat-7
- LDCM
- SORCE

## External Review w/ Mission
- ELVs (Atlas V, Delta IV)
- ISS
- Visiting Vehicles (Cygnus, Dragon, HTV)

## NGIN Review
- HST

## Signed
- Aqua
- Aura
- Terra

---

All other supported missions are planned to be in-work soon
• The current legacy SN has several different types of data interface that are also supported by SGSS:
  – ULE / LI interfaces:
    • Analog IF
    • Taps for TDSD will be retained
    • Serial bitstream (RS-422 and ECL)
  – MOC interfaces:
    • 4800 bit-block over UDP/RTP
    • Legacy TCP MOC encapsulations from WDISC
    • SLE from SN Gateway

• SGSS is also offering additional new data interfaces beyond those available in the legacy SN:
  – Digital IF (VRT-based)
  – MACE (VRT-based)
  – Packetized baseband (VRT-based)
  – SLE EF_CLTU Orange book, SLE ROCF, and SLE Command Echo
  – IP-over-CCSDS

• SN and SGSS are working with each mission individually on ICD documentation covering the details of their data transport interfaces
## Customers by Interface Types

<table>
<thead>
<tr>
<th>Interface Type</th>
<th>Planned Customers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serial Baseband ULE</td>
<td>ISS, Aqua, Aura, Terra, SPTR-2, SCaN Testbed, NPP, JPSS-1, MTRS, Fermi (high-rate)</td>
</tr>
<tr>
<td>MDM/4800BB MOC</td>
<td>HST, ELV, HTV, Dragon, Cygnus</td>
</tr>
<tr>
<td>TCP Baseband MOC</td>
<td>LDCM, Landsat-7, Fermi (WDISC/DAS), GPM, SORCE, AIM, Swift, RBSP, NEOWISE, NUSTAR, THEMIS, TIMED, MMS, OCO-2, SMAP, LDBP</td>
</tr>
<tr>
<td>Packetized Baseband ULE</td>
<td>ISS Future High-Rate</td>
</tr>
</tbody>
</table>
## Customers by Interface Types

<table>
<thead>
<tr>
<th>Interface Type</th>
<th>Planned Customers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serial Baseband ULE</td>
<td>ISS, Aqua, Aura, Terra, SPTR-2, SCaN Testbed, NPP, JPSS-1, MTRS, Fermi (high-rate)</td>
</tr>
<tr>
<td>MDM/4800BB MOC</td>
<td>HST, ELV, HTV, Dragon, Cygnus</td>
</tr>
<tr>
<td>TCP Baseband MOC</td>
<td>LDCM, Landsat-7, Fermi (WDISC/DAS), GPM, Sorce, AIM, Swift, RBSP, NEOWISE, NUSTAR, THEMIS, TIMED, MMS, OCO-2, SMAP, LDBP</td>
</tr>
<tr>
<td>Packetized Baseband ULE</td>
<td>ISS Future High-Rate</td>
</tr>
</tbody>
</table>
Serial Baseband ULE

- RS-422 and ECL interfaces will continue to be supported
- Data Rate Ranges:

<table>
<thead>
<tr>
<th></th>
<th>Legacy SN</th>
<th>SGSS</th>
</tr>
</thead>
<tbody>
<tr>
<td>RS-422</td>
<td>Minimum Data Rate</td>
<td>100 bps</td>
</tr>
<tr>
<td></td>
<td>Maximum Data Rate</td>
<td>12 Mbps</td>
</tr>
<tr>
<td>ECL</td>
<td>Minimum Data Rate</td>
<td>100 kbps (HRDS)</td>
</tr>
<tr>
<td></td>
<td>7 Mbps (scheduling for forward services)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>Maximum Data Rate</td>
<td>300 Mbps</td>
</tr>
</tbody>
</table>

- Serial “splitter” device responsibilities transitioning to the missions
- Port counts in the SGSS design are based on existing allocations
  - SGSS is building adapter cards, rather than using serial switches
To support transition, SGSS LI adapter cards will be connected in-line between the customer ULE connections and the legacy LRDS and HRDS switches.

When SGSS services are not scheduled, the cards pass-through clock and data signals to/from the ULE and legacy switches.

- Minor difference between RS-422 and ECL in how this pass-through is performed.
# Customers by Interface Types

<table>
<thead>
<tr>
<th>Interface Type</th>
<th>Planned Customers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serial Baseband ULE</td>
<td>ISS, Aqua, Aura, Terra, SPTR-2, SCaN Testbed, NPP, JPSS-1, MTRS, Fermi (high-rate)</td>
</tr>
<tr>
<td>MDM/4800BB MOC</td>
<td>HST, ELV, HTV, Dragon, Cygnus</td>
</tr>
<tr>
<td>TCP Baseband MOC</td>
<td>LDCM, Landsat-7, Fermi (WDISC/DAS), GPM, SORCE, AIM, Swift, RBSP, NEOWISE, NUSTAR, THEMIS, TIMED, MMS, OCO-2, SMAP, LDBP</td>
</tr>
<tr>
<td>Packetized Baseband ULE</td>
<td>ISS Future High-Rate</td>
</tr>
</tbody>
</table>
• SGSS will continue to support 4800BB customers on the Closed IONet

• From a customer perspective, the interface will be mostly unchanged:
  – For source/destination fields in the 4800BB, 0x16 will be used, rather than legacy values of both 0x15 (WSGT) and 0x16 (STGT)
  – Line Outage Recording (LOR) functionality is separately scheduled (see later slide)
  – SGSS will not have machines on Closed IONet, but will utilize CSO/NISN-provided conversion devices (MUDs) to bridge between MDM customers on the Closed IONet and SGSS
## Customers by Interface Types

<table>
<thead>
<tr>
<th>Interface Type</th>
<th>Planned Customers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serial Baseband ULE</td>
<td>ISS, Aqua, Aura, Terra, SPTR-2, SCaN Testbed, NPP, JPSS-1, MTRS, Fermi (high-rate)</td>
</tr>
<tr>
<td>MDM/4800BB MOC</td>
<td>HST, ELV, HTV, Dragon, Cygnus</td>
</tr>
<tr>
<td>TCP Baseband MOC</td>
<td>LDCM, Landsat-7, Fermi (WDISC/DAS), GPM, SORCE, AIM, Swift, RBSP, NEOWISE, NUSTAR, THEMIS, TIMED, MMS, OCO-2, SMAP, LDBP</td>
</tr>
<tr>
<td>Packetized Baseband ULE</td>
<td>ISS Future High-Rate</td>
</tr>
</tbody>
</table>
TCP Baseband MOCs

• **Encapsulations:**
  – IPDU, LEO-T, and raw TCP encapsulations continue to be supported
  – IPDU and LEO-T header destination field values will not be filtered by SGSS

• **Connections**
  – Outgoing connections to the MOCs will come from a pool of SGSS IP addresses at the ground terminal the service is being provided at
  – Incoming connections from the MOCs will go to IP addresses specific to the ground terminal the service is being provided at

• **Connection Timing:**
  – Connections should be initiated slightly prior to the scheduled event time
    • Precise timing is configurable within SGSS
  – Return data is not buffered prior to a successful TCP connection with the MOC
    • Maintains consistency with the legacy SN PTPs and ensures timely data delivery
TCP Baseband MOCs

• **Return Data Connections:**
  - SGSS is designed to meet availability requirements with a single string of equipment selected from pools, but can also initiate or accept two TCP connections for a service
    - Either with 2 different IP addresses or 2 different ports to the same IP
    - Missions can choose to either make/accept both connections nominally, or only use the second for failover
  - User data will be provided on each connection established

• **Forward Failover Capabilities:**
  - SGSS supports multiple forward failover mechanisms, based on legacy capabilities:
    1. Latest TCP connection
    2. Latest SLE BIND
    3. Separate TCP control ports w/ control strings
      - SGSS is planning to support the new 7-byte control strings
      - We anticipate customers currently using 5-byte control strings will transition to 7-byte in conjunction with other SN updates prior to SGSS deployment

Received significant customer feedback on configurations; Thank you!
## SLE Services

<table>
<thead>
<tr>
<th>Service</th>
<th>CCSDS Book Number</th>
<th>Book Revision</th>
<th>BIND “version-number”</th>
<th>SGSS Supported</th>
</tr>
</thead>
<tbody>
<tr>
<td>RAF</td>
<td>911.1-B</td>
<td>2</td>
<td>2</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>4</td>
<td>No</td>
</tr>
<tr>
<td>RCF</td>
<td>911.2-B</td>
<td>1</td>
<td>2</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>4</td>
<td>No</td>
</tr>
<tr>
<td>ROCF</td>
<td>911.5-B</td>
<td>1</td>
<td>1</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>2</td>
<td>4</td>
<td>No</td>
</tr>
<tr>
<td>F_CLTU</td>
<td>912.1-B</td>
<td>2</td>
<td>2</td>
<td>Yes</td>
</tr>
<tr>
<td></td>
<td></td>
<td>3</td>
<td>4</td>
<td>No</td>
</tr>
<tr>
<td>EF_CLTU</td>
<td>912.11-O</td>
<td>1</td>
<td>101</td>
<td>Yes</td>
</tr>
<tr>
<td>Command Echo using RAF</td>
<td>N/A</td>
<td>N/A</td>
<td>2</td>
<td>Yes</td>
</tr>
</tbody>
</table>

**Note:** SGSS does not support version auto-negotiation

Prior connection information for TCP baseband MOCs is applicable for SLE
### Customers by Interface Types

<table>
<thead>
<tr>
<th>Interface Type</th>
<th>Planned Customers</th>
</tr>
</thead>
<tbody>
<tr>
<td>Serial Baseband ULE</td>
<td>ISS, Aqua, Aura, Terra, SPTR-2, SCaN Testbed, NPP, JPSS-1, MTRS, Fermi (high-rate)</td>
</tr>
<tr>
<td>MDM/4800BB MOC</td>
<td>HST, ELV, HTV, Dragon, Cygnus</td>
</tr>
<tr>
<td>TCP Baseband MOC</td>
<td>LDCM, Landsat-7, Fermi (WDISC/DAS), GPM, SORCE, AIM, Swift, RBSP, NEOWISE, NUSTAR, THEMIS, TIMED, MMS, OCO-2, SMAP, LDBP</td>
</tr>
<tr>
<td>Packetized Baseband ULE</td>
<td>ISS Future High-Rate</td>
</tr>
</tbody>
</table>
• VITA 49.0 Radio Transport (VRT) supported in addition to other MOC encapsulations
  – SGSS-tailored version of the VRT standard in order to packetize serial data
  – Important for future high-rate users
  – Intended primarily for local equipment, rather than remote MOCs
    – Sent over UDP/IP – no ability to correct for packet loss

Other useful service meta-data is included; full definition is in the E-05 ICD
• Very simple format
  – Possible for customers to implement processing efficiently in software or hardware / HDL
• Usable up to the maximum SGSS return data rate (1.2 Gbps)
Notable Relevant Features

- Recording and Playback
- In-Service Modifications / GCMRs
- Customer Access to Tracking Data
- Return Service Redundancy in SGSS
Recording and Playback

• SGSS has a unified recording and playback system for baseband customer return data
  – Intended to mitigate against outages in the WAN, MOC, or other networks

• Data recording is enabled in the user service agreement, and scheduled by the system, in conjunction with return services
  – Storage period defaults to 30 days, and is extended on request

• Recorded data is provided to the customer via a playback service
  – Scheduled using the SGSS HMI
    • Requested based on service ID, and other parameters that can be retrieved using the HMI
  – Playback is limited to MOC interfaces
• Exact timing for GCMRs to take effect may be different in SGSS than it is in the legacy SN
  – Total SGSS requirement is for reconfigurations to complete within 35 seconds of receipt, based on legacy SN requirements
  – Actual performance will often exceed this, but is not yet characterized
    • NISN path will also be different than in legacy

• SGSS will be consistent with the SNUG listing of GCMRs that can cause service interruptions
Customer Access to Tracking Data

- Customer and TDRS tracking data will continue to be provided to the FDF, as in the legacy SN
  - Using new CCSDS-based XML format for Tracking Data Messages (TDMs)

- New Capability with SGSS:
  - SGSS also supports sending XML TDMs directly to the customer MOCs
  - TDMs are posted to a MOC server via HTTPS
    - Mission specifies their IP address, TCP port number, and URL

- ICD and XML schema are currently available for reference
Return Service Redundancy

• SGSS architecture differs from legacy SN redundancy mechanisms
  – Legacy SN uses dual chains of equipment
  – SGSS composes services from pools of equipment
• Normally, SGSS only schedules one modem, and one UDC from the equipment pools

• SGSS is working to add an option to schedule 2 modems and UDCs / BBLIs
  – Two separate baseband data streams will be delivered (but are not necessarily carrying identical data)
  – Similar options are being worked for MOCs, packetized baseband, and serial ULE
Early Interface Testing

Dave Waters
To evaluate SGSS GD Lab interfaces with external entities prior to deployment to WSC, SGSS is undertaking an Early Test effort.

- **Goals**
  - Mitigate risk to Post System Acceptance Testing after deployment to White Sands, Blossom Point, and Guam.
  - Establish interfaces to facilitate early identification of mismatches on the structure and/or in processing of data
  - Increase confidence in success of migration from current SNGS to SGSS interfaces

- **Basics**
  - Incremental testing aligning with GD development activities starting October, 2015 and going through Fall 2017
    - Targeting 3 3-month intervals starting in October, 2015
    - A4/A5/A6
  - Connection into NASA’s Network facilitated by CSO
  - Customer User Local Equipment testing as available
Phase 1 Early Interface Testing Status

- Phase 1 test execution completed December 2015
  - Phase one testing attempted to interface with 5 endpoints:
    - IPSec Tunnel
    - DSN
    - NEN
    - FD
    - NOCA
  - 10 test objectives were planned:
    - 10 executed
      - 8 passed
      - 2 partially passed

<table>
<thead>
<tr>
<th>Endpoint</th>
<th>Objectives</th>
<th>STATUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPSec Tunnel</td>
<td>Verify IPSec tunnel transition from test configuration to the operational configuration for testing</td>
<td>Successfully completed</td>
</tr>
<tr>
<td>DSN</td>
<td>Successfully establish connectivity between the DSN endpoint (JPL Central) and the SGSS endpoint and for JPL to deliver a post-pass tracking data (Tracking Data Messages [TDMs]).</td>
<td>Successfully completed</td>
</tr>
<tr>
<td>NEN</td>
<td>Successfully establish connectivity to the JPL SPS analysis portal, upload a TDRS ephemeris, have DSN validate and create the view period files</td>
<td>Successfully completed</td>
</tr>
<tr>
<td>FD</td>
<td>SGSS to retrieve TDRS two line element and orbital element files via SFTP from FD (file transfer)</td>
<td>Successfully completed</td>
</tr>
<tr>
<td>FD</td>
<td>FD to SGSS HTTPS Post of TDRS and User IIFVs (message based)</td>
<td>Successfully completed</td>
</tr>
<tr>
<td>NOCA</td>
<td>SGSS to access the NASA Operational Certificate Authority (NOCA) to download the Certificate Revocation List (CRL) from the two sites identified in the ICD</td>
<td>Successfully completed</td>
</tr>
</tbody>
</table>
Phase 2 Early Interface Testing Status

• Phase 2 test execution planned for late July/Early August 2016
  • Test will occur post A5/L4
  • Testing will leverage L4 test execution

• Phase 2 testing will interface with 3 endpoints:
  • FDF
  • FERMI
  • DSN
  - 12 test objectives are planned

<table>
<thead>
<tr>
<th>Endpoint</th>
<th>Objectives</th>
<th>STATUS</th>
</tr>
</thead>
<tbody>
<tr>
<td>FD</td>
<td>SGSS sends BRTS TDM Data to FDF</td>
<td>On Plan</td>
</tr>
<tr>
<td></td>
<td>SGSS sends User TDM Data to FDF</td>
<td>On Plan</td>
</tr>
<tr>
<td></td>
<td>SGSS stores TDM Data in a locally mounted Network File System (NFS)</td>
<td>On Plan</td>
</tr>
<tr>
<td></td>
<td>The TDMs are encoded as an XML dataset. Both SGSS generated TDM types are</td>
<td></td>
</tr>
<tr>
<td></td>
<td>transferred over a secure link using the HTTPS ‘post’ operation.</td>
<td></td>
</tr>
<tr>
<td>FERMI</td>
<td>FERMI to send user data to SGSS</td>
<td>On Plan</td>
</tr>
<tr>
<td></td>
<td>SGSS to send user data and tracking data to FERMI</td>
<td>On Plan</td>
</tr>
<tr>
<td></td>
<td>SGSS performs Forward and Return Service Tests</td>
<td>On Plan</td>
</tr>
<tr>
<td>DSN</td>
<td>Demonstrate CMD Data (SGSS to DSN) - Forward CLTU Service Operations</td>
<td>On Plan</td>
</tr>
<tr>
<td></td>
<td>Demonstrate TLM Data (DSN to SGSS) - Return All Frames (RAF) Service</td>
<td>On Plan</td>
</tr>
<tr>
<td></td>
<td>Demonstrate “no authentication” on Forward CLTU and RAF Service</td>
<td>On Plan</td>
</tr>
<tr>
<td></td>
<td>Demonstrate ISP1 Forward CLTU and RAF Service Configuration Parameters</td>
<td>On Plan</td>
</tr>
<tr>
<td></td>
<td>Demonstrate transfer of CMD data over Forward CLTU Service</td>
<td>On Plan</td>
</tr>
<tr>
<td></td>
<td>Demonstrate transfer of TLM data over RAF Service</td>
<td>On Plan</td>
</tr>
</tbody>
</table>
Phase 2 Early Interface Testing Status

• Phase 2 Test Preparation Status
  • All test preparation is on plan
    • Completed
      • Identify Candidate Interfaces to be tested
      • Identify Functions to be tested
      • Define Lab Test Environment/Configuration
        • Install H/W and S/W in STGT environment
      • Identify services (per interface) to be tested
      • Identify data flow(s)
      • Identify data to be used

    • Identify Security specifics for accessing Endpoints

    • Identify Dataset for testing

    • Create Initial Test Procedures
Phase 3 Early Interface Testing Status

• General Dynamics Leading Test Planning Efforts

  – Phase 3 – Final Pre System Acceptance Test period
    • Status: planning starts ~ September 2016
    • Execution period: Post A6-L4
      • Leveraging selected functionality of L4 testing
EDOS ULE Testing

  - Testing objective was to flow valid EDOS supplied test data through the GD systems and capture and validate the data via the EDOS Hbox via digital IF.
    - Hbox successfully locked to the supplied TERRA data file through the SGSS bearer equipment
    - All data statistics matched the baseline statistics gathered by EDOS personnel at GSFC, and all objectives were met.

- Plan Forward
  - Tuned analog data transfer planned for September 2016
  - Initial planning efforts are underway

- Appreciate the active participation/collaboration !!
# POCs

<table>
<thead>
<tr>
<th>Role</th>
<th>Phone</th>
<th>Email</th>
</tr>
</thead>
<tbody>
<tr>
<td>Jim Clapsadle</td>
<td>301-286-5111</td>
<td><a href="mailto:James.E.Clapsadle@nasa.gov">James.E.Clapsadle@nasa.gov</a></td>
</tr>
<tr>
<td>Dave Waters</td>
<td>301-286-5428</td>
<td><a href="mailto:David.waters-1@nasa.gov">David.waters-1@nasa.gov</a></td>
</tr>
</tbody>
</table>
Deployment and Transition
Richard Von Wolff
The transition strategy considers all the activities that lead to full operational readiness and sustainment of the SGSS from deployment and transition to Final Acceptance:

- Equipment delivery and installation
  - Antenna Modifications
  - Pooled Equipment Installations
  - Legacy Adapters
- Level 5 and Level 6 Testing
- TDRS Shadow
- TDRS Control
- Customer Spacecraft Testing
The DTO IPT, Installation Working Group and the LOP Working group have been instituted and are held on a Weekly to Bi-Weekly basis.

Adding to DTO Staff – Transition Lead/Test Lead

SGSS DTO staff are engaged with the SN in several areas to prepare for when the GD DTO activities:

- HMI reviews and demos
- Facilities Prep for SGSS equipment installations
  - WSGT Antenna Structural – Deck Shelter Installations
  - WSGT Electrical
Harris Deck Shelter Efforts

Deck Shelter Arrival

[Two images showing the arrival and set-up of a deck shelter.]
Harris Deck Shelter Efforts

Paint Abatement Effort

Frame Weld Efforts
Harris Deck Shelter Efforts

Deck Shelter Installation
WSGT Facility Modifications

CDCN Conduit Install

CDCN Power Installations

Core Drill Efforts
WSGT Facility Modifications

STTC Antenna Power Installation

Antenna Waveguide Tunnel
MMA UPS Safety Switch and Essential Power Panel

Deck Shelters Power Install (Essential & UPS)
WSGT Facility Modifications

First Delivery of the PDUs to feed the SGSS Racks
• During the operational transition and test period, customers will be supported on both legacy SN and SGSS systems
  – There are some complexities during transition that result in some minor, temporary constraints with workarounds

• Deployment & Transition (D&T) team is cognizant of the unique aspects of each mission, such as:
  – User Data & Timing Interfaces
    • NISN interface Transition (4800BB, WDISC, SN Gateway, DAS, … )
    • LI port transition (ECL, TTL, IF, … )
  – Management & Control Services
    • Scheduling (SNAS, Direct Connect, … )
    • Real-time Control & Monitor (UPD, GCMR, … )
    • Time & Frequency (1 PPS, 10MHz, … )
    • Ephemeris & Tracking Data
  – RF Interfaces
    • Forward & Return Services
• D&T will coordinate and generate unique customer-specific appendices to the MO-01 Transition Plan.
  – Appendices will be derived in large part from existing documentation (PSLA, RFICD, etc) with emphasis on the USWG-generated SGSS ICD Mission Addendums
• Appendix contents will be coordinated and developed with the customer to baseline their transition steps and participation in the SGSS system testing. Contents include, but are not limited to:
  – User data interface transition details
  – NISN reconfiguration details (i.e. direct IP vs. DNS naming)
  – Coordinate participation during the SMLA/ANCC confidence testing
  – Specification of participation constraints (i.e. geographic, specific TDRS, or scheduling constraints)
  – Subset of Service Profiles to be executed during GD L5/L6 testing
• The MO-01 appendices will be organized around specific tasks to assist and guide each customer throughout the transition periods
• Significant NASA support required to coordinate and develop the appendices
3.3.5 System Testing

The overall test strategy, as stated in the V&V Plan, consists of six levels of test which correlate to the system definition and development processes to ensure that the system has been built per the requirements (verification) and performs in the manner intended to meet mission objectives (validation).

- Level 4 (L4): Complete end-to-end threads/sub-threads are tested to verify system functionality. A subset of Level 4 test will be performed during Post Ship regression testing.

- Level 5 (L5): CONOPS scenarios, derived from System ADD (CDRL SE-11) threads/sub-threads, are the focus of testing to validate higher level system functionality and operation.

- Level 6 (L6): End-to-end test scenarios using real TDRS satellites and User MOCs are performed to verify and validate full duplex operations.
MO-01 L5 Testing Flow

L5 K-Band TTC and User Test

TTC & User Service Verification/Validation

- TRR Complete
  - Level 5 TRR

- Select TDRS Type
  - (3-7, 8-10, 11-12)

TT&C S/C Functions
- Command to Simulator/Emulator
- Telemetry from Simulator/Emulator
- S/C SOH
- Trending & Analysis
- S/C Planning, Scheduling & Maintenance
- User Support Scheduling

TT&C Ground Functions
- Ground Equipment
  - Scheduling, Monitor, Maintenance, Performance & Analysis
  - Loop Tests
  - RZS
  - Failover
  - External Interfaces

Planning & Scheduling
- User Service
  - Maintenance

User Service Ground Functions
- Ground Equipment Monitor, Maintenance, Performance & Analysis
  - Loop Tests
  - RZS
  - Failover
  - Playback
  - External Interfaces

SGSS shadows legacy system’s monitor activities

No All TDRS types tested?
- Yes
  - Level 6 TRR

No
  - User Shadow

Yes
  - Next User
  - User Service Loading

Yes
  - Shadow Legacy EET
  - Next Service

No
  - SGSS EET
  - Next Service

Yes
  - Next Service

No
  - Shadow Legacy EET
  - Next Service

Yes
  - Next Service

No
  - User Shadow

Yes
  - Next User

No
  - User Service Loading
Suite User Services

This test suite will demonstrate On-orbit User services through normal and Engineering Test Events for SSA, KSA, MA and SMA services. Scheduling capabilities, reconfiguration of User Services, User MOC interfaces. User data playbacks will be performed and validated by the MOCs and the requirement will be verified. Tracking data messages (TDM) will be sent to FDF for validation of tracking services.

Objectives

The tests in the following table will verify requirements assigned or to validate system capabilities.
L6 K-Band TTC and User Service Testing

TTC & User Service Verification/Validation

- TRR Complete
- Level 6 TRR

Select TDRS Type
- (3-7, 8-10, 11-12)

TT&C Operations
- S/C SDH
- Planning, Scheduling, Maintenance
- S/K Acquisition
- Command/Telemetry/Ranging
- Situational Awareness
- Nav Acceptance
- H/K Manuever

User Service Ground Functions
- Ground Equipment
- Scheduling, Monitor, Maintenance, Performance & Analysis
- External Interfaces

Planning & Scheduling
- Loop Tests
- User Service
- Maintenance

SGSS EET
- Forward Services
- Return Services
- Tracking Services

User Target of Opportunity

TDRS Handover

User Service Testing

All TDRS types tested?

Conduct ORR

Yes

No

Next User

Yes

No

Next Service Type

Yes

No

TT&C Operations

User Service Testing

TDRS Handover

Yes

No

MO-01 L6 User Services Testing Flow
This test suite will demonstrate On-orbit User services through normal and Engineering Test Events for SSA, KSA, MA and SMA services. Scheduling capabilities, reconfiguration of User Services, User MOC interfaces, and a User service loading test will be demonstrated. User data playbacks will be performed and validated by the MOCs and the requirement will be verified. Tracking data messages (TDM) will be sent to FDF for validation of tracking services.

A User Services loading test will demonstrate resource allocation in the Operational environment. The criteria for the success of the loading test will be defined by the Stakeholders’ and the User MOCs’ expectations and through the demonstration of the ability of the SGSS to deliver high quality services to the SN community.
Next Steps

- GD is starting the population of the Customer Addendums beginning this summer.
- The D&T Team will be adding a resource person to serve as the liaison between Customer and GD for this development.
- Early installation of cables will start in the September 2016 time frame.
- Engineering Changes that adhere to current SN CM procedures are being developed and execution will follow the current SN Scheduling guidelines.

All Customer Testing will be coordinated with the Customer Community To Maximize the use of Customer Services for L6 and Post L6 Testing
Wrap-Up

Vir Thanvi
Wrap-Up

• Targeting 1st Quarter CY2017 for the next Customer TIM
• Please take a moment to provide feedback on this Customer TIM and complete our upcoming survey

<table>
<thead>
<tr>
<th>Discipline</th>
<th>Contact</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Customer Interfaces</td>
<td>Vir Thanvi – <a href="mailto:vir.thanvi@nasa.gov">vir.thanvi@nasa.gov</a></td>
<td>301-286-2164</td>
</tr>
<tr>
<td>Early Testing</td>
<td>Jim Clapsadle – <a href="mailto:james.e.clapsadle@nasa.gov">james.e.clapsadle@nasa.gov</a></td>
<td>301-286-5111</td>
</tr>
<tr>
<td>Deployment and Transition</td>
<td>Richard Von Wolff – <a href="mailto:richard.l.vonwolff@nasa.gov">richard.l.vonwolff@nasa.gov</a></td>
<td>575-527-7036</td>
</tr>
</tbody>
</table>

Thanks !!