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## Finalization

# OMG's Space Telecommunication Interface (STI) Submission Discussion

Finalization Task Force (FTF)

OMG Meeting: Dec 6-10, 2021

Presented by:

**Louis Handler and Janette Briones**  
**NASA Glenn Research Center**

**Supported by Jeff Smith – Multi-Agency Collaborative  
Environment (MACE Fusion Center)**

Based on document: mars/2020-12-01

This document: ptc/2021-11-30x





# Agenda

- Recap of the Space Telecommunication Interface (STI) RFP
- Overview of STI submission from NASA Glenn Research Center
- Changes since March/June OMG meeting

# Submission Team

<p>Janette C. Briones, PhD.          Louis M. Handler          NASA Glenn Research Center,          Cleveland, OH</p>	<p>William T. Dark          Vantage Partners, LLC,          Brook Park, OH</p>
<p>Jeffrey Smith, PhD.          Sierra Nevada Corporation,          Herndon, VA</p>	





## Space Telecommunication Interface RFP

- Published as OMG document mars/19-09-21
- The objective of this RFP is to expand the PIM and PSM for the Software Radio Components Specification to support space communications.
- Seeks to address areas where existing SWRadio specification does not address key communications and platform requirements imposed by the space domain sufficiently, for example, to simplify for spacecraft resource constraints, static deployment, specialized signal processing abstraction, reliability, and availability.



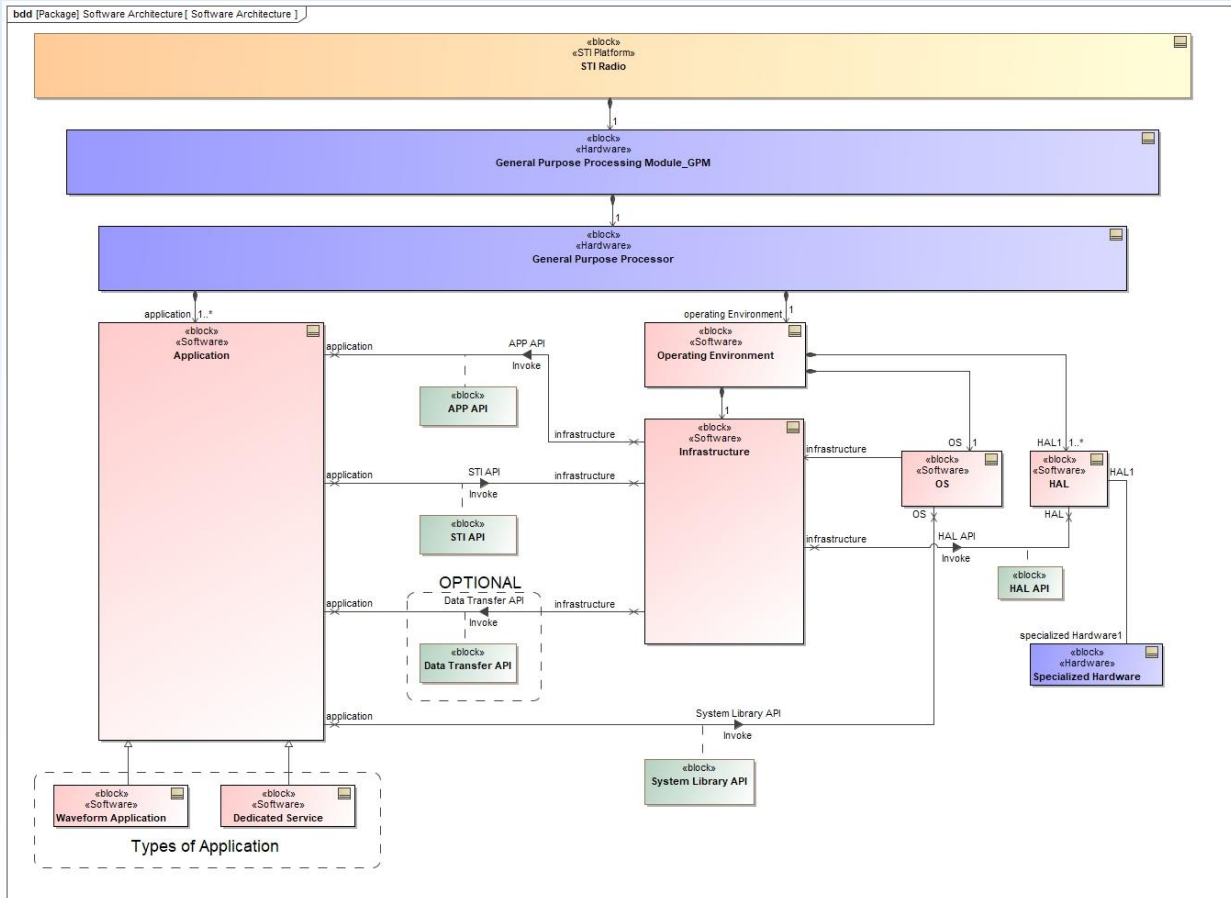
# Space Telecommunication Interface (STI) Proposal

## History

- A predecessor to this STI specification was developed by NASA as part of a technology demonstration of software-defined radio technology.
  - The predecessor was a “lightened” framework based on/inspired by SWRADIO (SDRP) and Software Communications Architecture Specification (SCA) and followed many of the same architectural patterns.
- NASA performed significant testing/validation on real space applications
  - Deployed and tested on the SCaN Testbed on the International Space Station (2012-2020)
  - Over a decade of testing and waveform development provided lessons learned for NASA-STD-4009A, on which this proposal is based.



# STI System Architecture Overview



- Hardware in blue
- Software in pink
- Interface blocks in green



## System Architecture

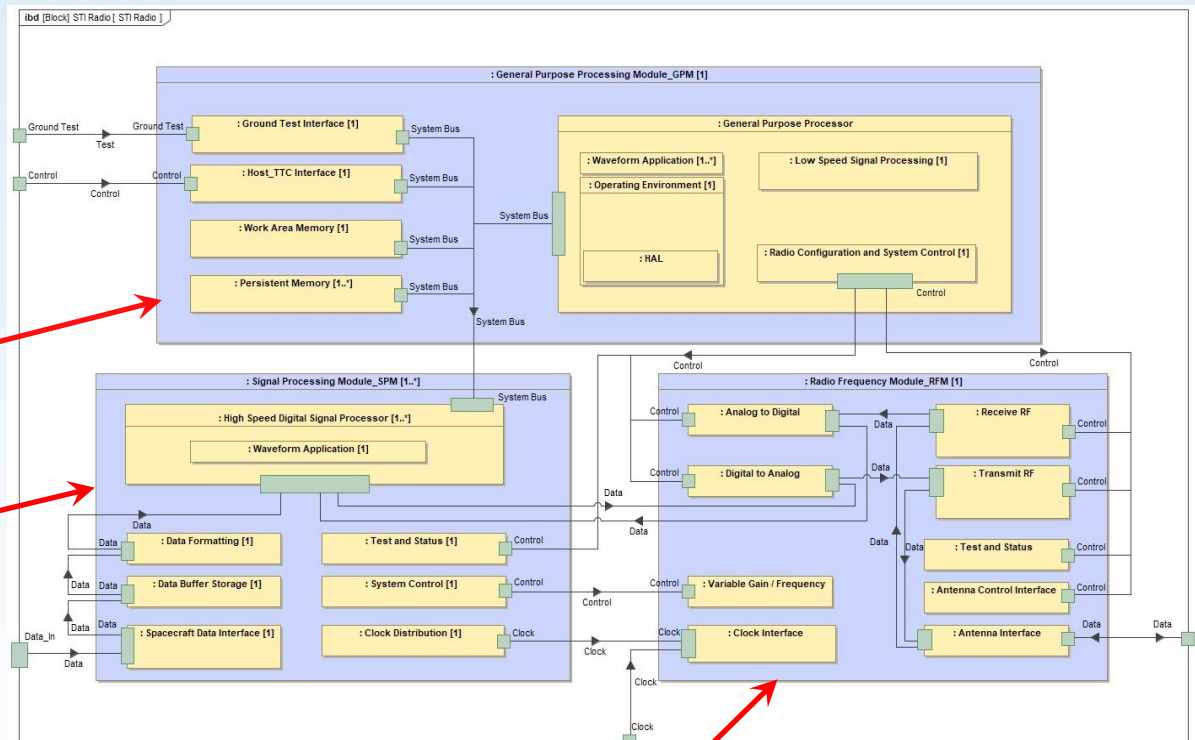
- STI defines the various roles and responsibilities of the stakeholders
  - Defined roles and integration points allows for more parallel development efforts, vendor independence
- Emphasis of standard is different for different system roles
  - Focus on a specific software interface (i.e. API) to ensure portability
  - Focus on documentation of system capabilities rather than prescribing a specific set
- This approach allows some component re-use while still allowing the overall system to be tailored to the specific deployment environment and requirements



# STI Overview – Hardware Architecture

STI defines fundamental blocks of a generic SDR platform

- General Processing Module (GPM) hosts the control plane
- Signal Processing Module (SPM) hosts the data plane
- Radio Frequency Module (RFM) provides the radio interface





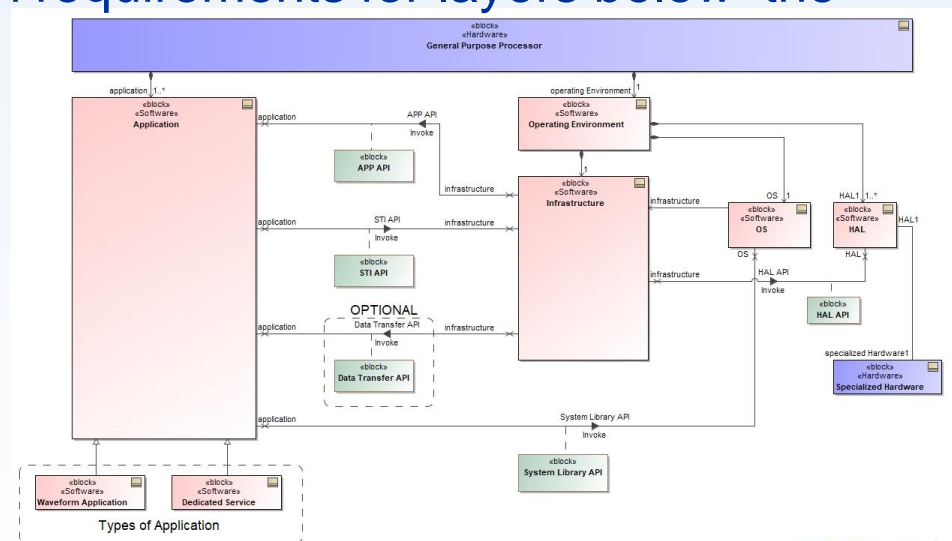
# STI Software Operating Environment Model

Proposal prescribes specific API requirements for items between the STI Infrastructure and waveform/application services layers

- Allows portability of software elements between different OE implementations

Proposal prescribes documentation requirements for layers below the STI Infrastructure

- Specialized hardware and hardware system limitations/capabilities defined in vendor-supplied documentation.

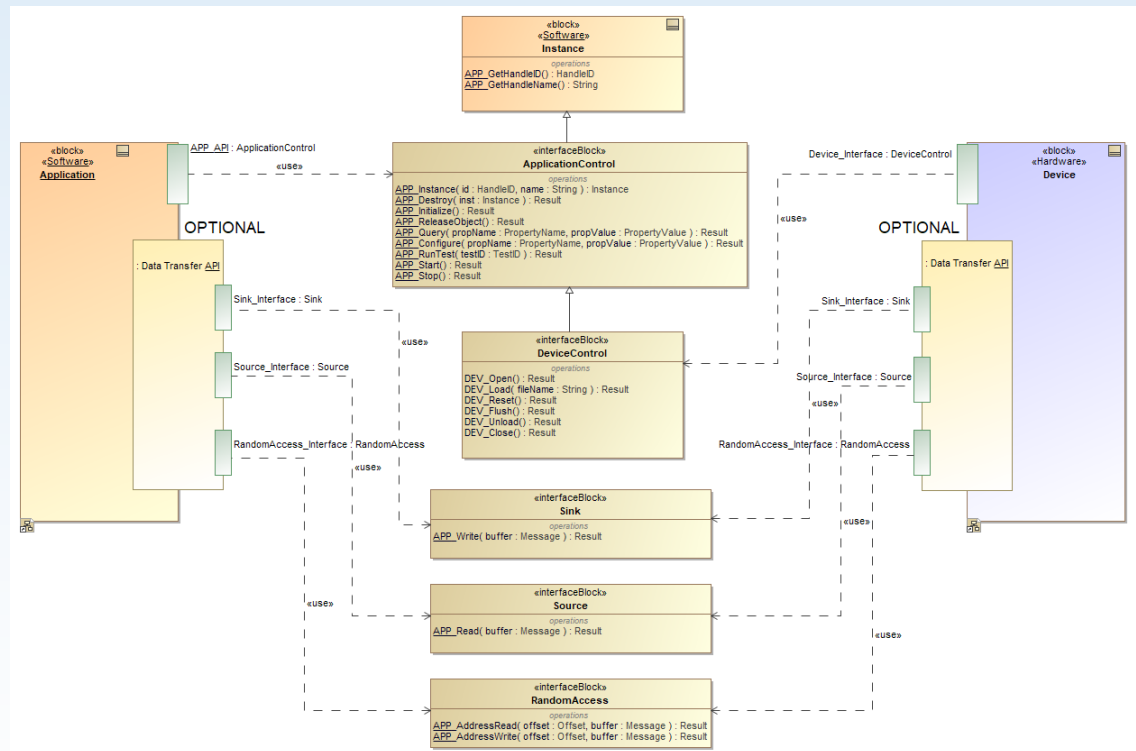






# STI Application Software Interface Structure (was)

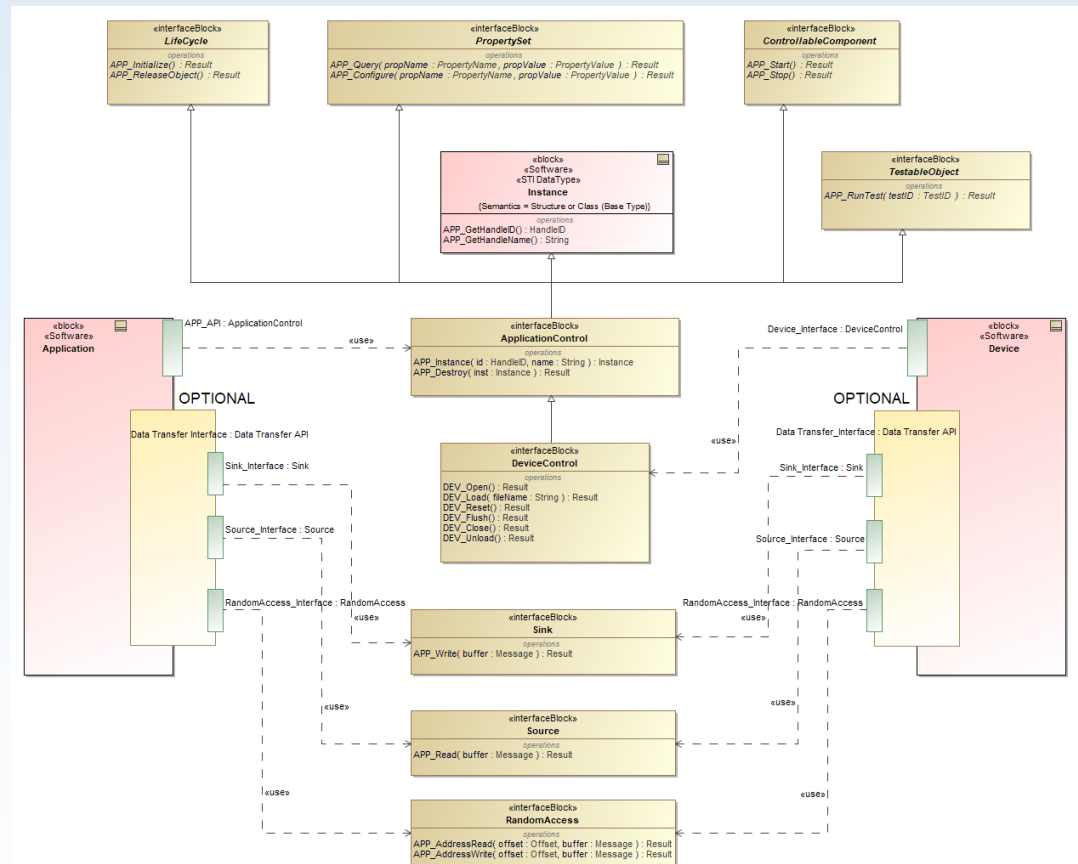
- Proposes a SW Interface structure similar to existing SDR standards (NASA STRS, SWRADIO, SCA)
- Software written for these other environments should be usable without extensive rewrites or refactoring





# STI Application Software Interface Structure (updated)

- Proposes a SW Interface structure similar to existing SDR standards (NASA STRS, SWRADIO, SCA)
- Software written for these other environments should be usable without extensive rewrites or refactoring





## Compliance Points (from RFP section 6.5.2)

- 1) Standard interfaces for control, management and status retrieval of the subsystems.
  - Provided in section 10.6 of proposal (STI API); Subsystem lookup APIs defined in 10.6.1.2, various control and management APIs defined in 10.6.2.
- 2) Control interfaces with functionality to control the synchronization of subsystems.
  - Specialized device control in section 10.6.3, Generic Messaging, Event Publish/Subscribe, Logging, Time sync APIs defined in sections 10.6.4 – 10.6.8
- 3) Interfaces that allow setting and querying parameters defined in the hardware abstraction of subsystem elements.
  - PropertySet interfaces defined in section 10.6.2.3
- 4) Application interfaces and related metadata defined separately for each subsystem.
  - Application interfaces defined in section 10.5 (Application and Device Control Interface)
  - Proposal dictates that each subsystem/instance has separate objects in memory, separate properties and property definitions



## RFP Items not fully addressed in Proposal

### Networking (RFP section 6.5.3)

- STI is primarily defining a system architecture and control plane and is agnostic to the data plane
  - Any type of underlying network routing/structure could be accommodated while still complying with the architecture
  - Scheduling, intermittent connectivity can all be handled via applications/waveforms running in the environment

### Security (RFP section 6.5.4)

- A security manager is part of the overall architecture but the specific role is not defined in the PIM
  - Different SDR deployments have different security requirements
- Architecture allows each waveform to be executed in a “secure enclave”
  - Transparent to applications without changing the general system architecture



## Summary

- The STI proposal is based on a proven and deployed predecessor
  - Addresses the needs of real space SDR deployments
  - Clear upgrade path for existing software/hardware investments
- Uses an architecture similar to existing SDRP/SCA specifications
  - STI upgrades/updates these concepts/paradigms to SysML
  - Simplified for Space Domain where relevant
- Addresses main compliance points from the STI RFP

Std Proven to help Optical Comms Immensely



## Submissions

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- Space Telecommunications Interface (STI) Request For Proposal (RFP) approved by AB 9/26/19. [mars/19-09-21](#)
- Inventory file: <https://www.omg.org/cgi-bin/doc?mars/2020-11-02>
- XML: <https://www.omg.org/cgi-bin/doc?mars/2020-11-07>
- Images (SVG): <https://www.omg.org/cgi-bin/doc?mars/2020-11-08>
- Document: <https://www.omg.org/cgi-bin/doc?mars/2020-11-01>



## Changes since the March OMG meeting

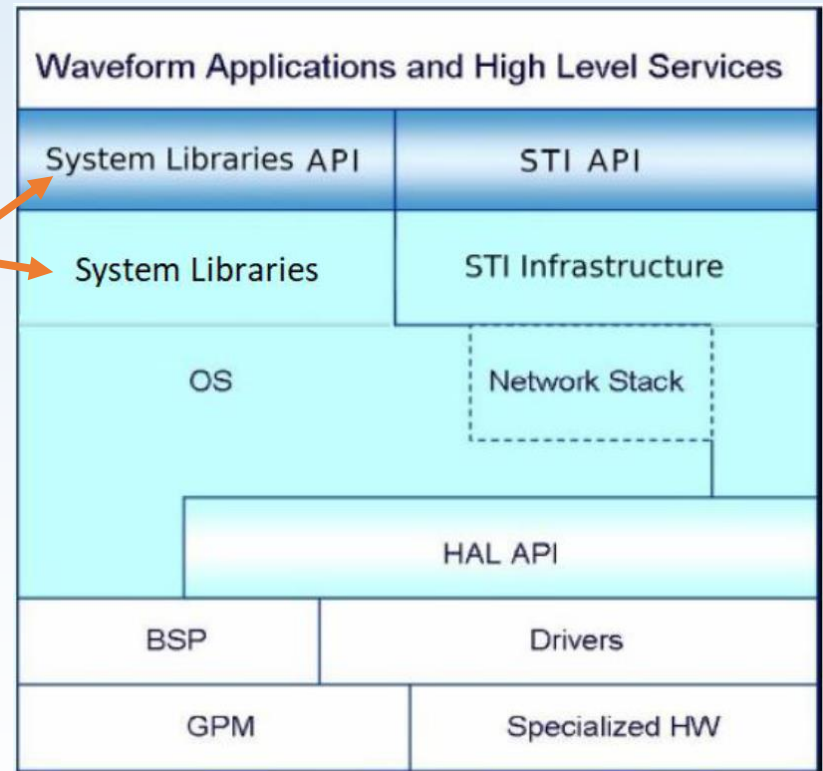
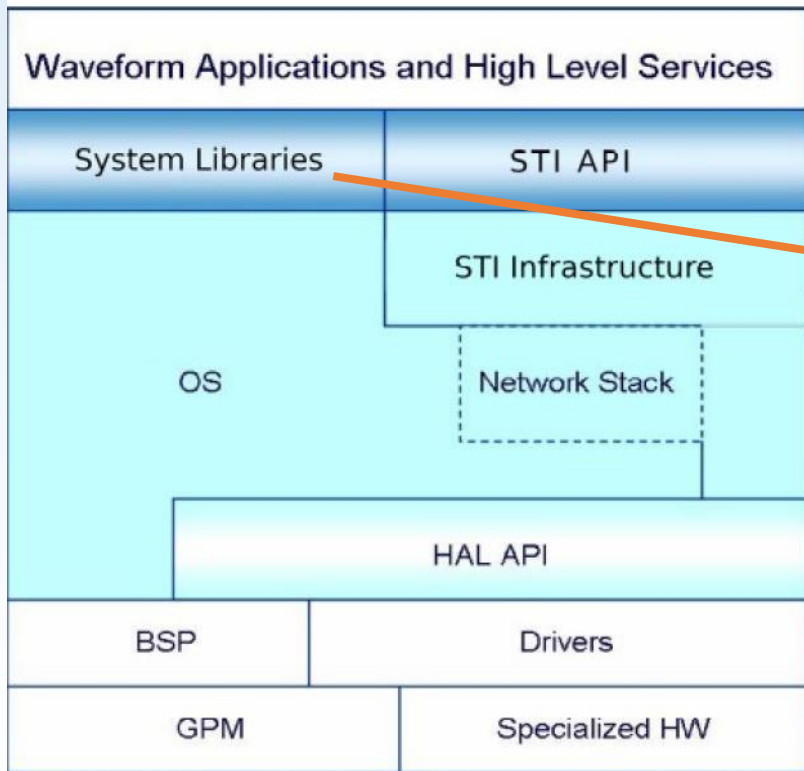
- Fixed error in Table 49 (method name *stop* was shown as *initialize*)
- Made a few minor editorial changes for grammar and clarity
  - Fixed misspelled words, repeated words, spacing, a vs an, etc.
  - Moved table numbers and labels above the tables rather than below
- Made a few minor obfuscations in section numbers due to copying from one format to another (these will be fixed)
- Updated figure 9, STI Layer Cake Model (see next slide)



# Changes to Figure 9: Software Execution Model

Before:

After:

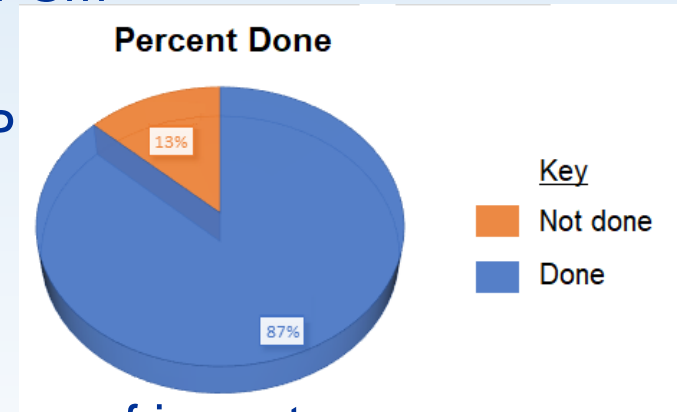


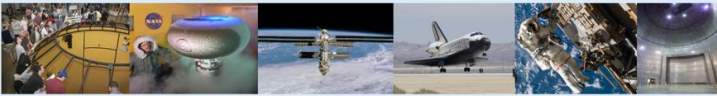




## Changes since the June OMG meeting

- Responded directly to 99 out of 114 OMG AB reviewers' comments
  - Some of the others are addressed in the PSM
- Added Section 0 to describe how STI 1.0 addresses the “shall” statements in the RFP
- Clarified nominal portions and corrected grammar errors
- Made diagrams more consistent
  - Eliminated figures that did not explain issues of importance
  - Updated figures to conform to SysML
- Corrected errors also found in proofreading
- Increased formality and combined requirements with corresponding tables



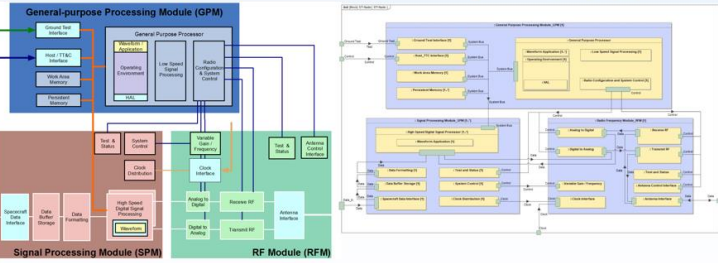


### Changes to Figure 3: Notional STI Hardware Architecture

Before:

After:

(Deleted figure 2 specifying colors)

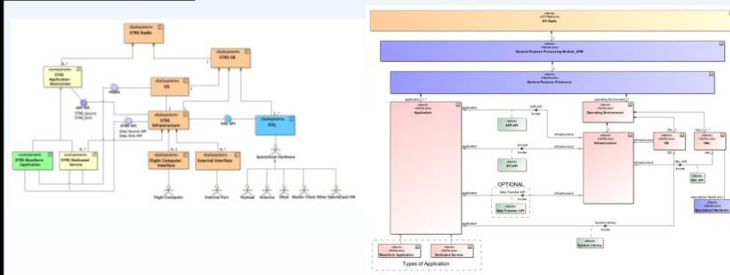


National Aeronautics and Space Administration



### Figure 10: Layered Structure

After: (Became figure 7)

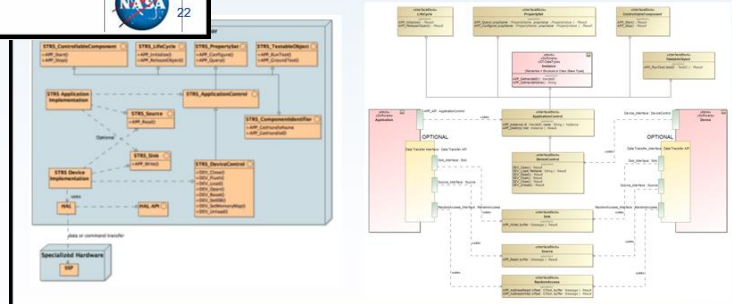


National Aeronautics and Space Administration



### Figure 14: Application and Device Structure

After: (Became figure 9)



National Aeronautics and Space Administration



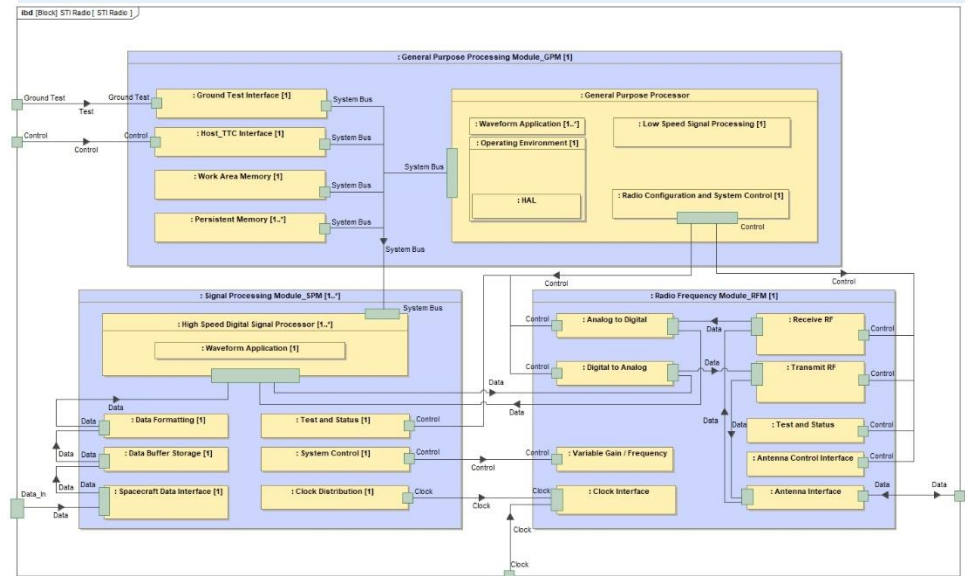
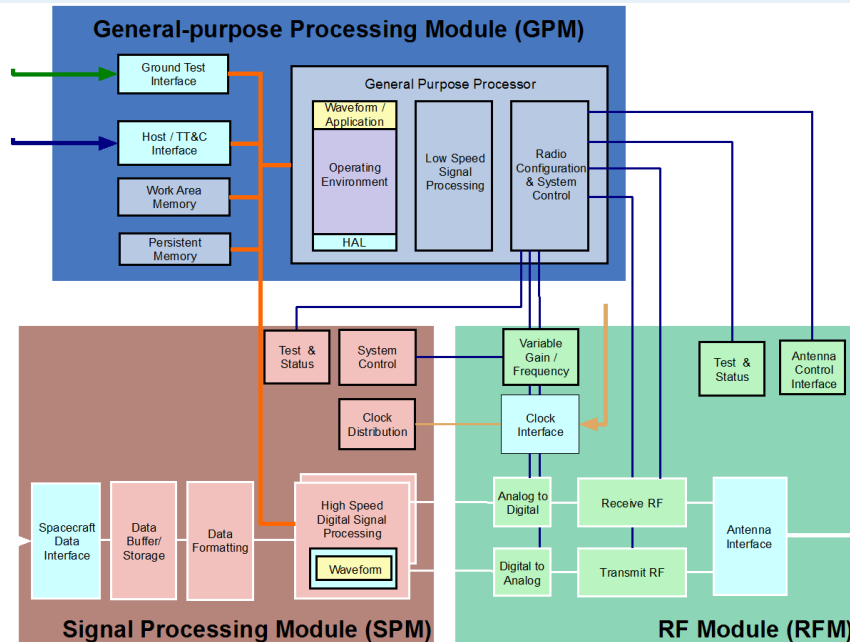


# Changes to Figure 3: Notional STI Hardware Architecture

Before:

After:

(Deleted figure 2 specifying colors)

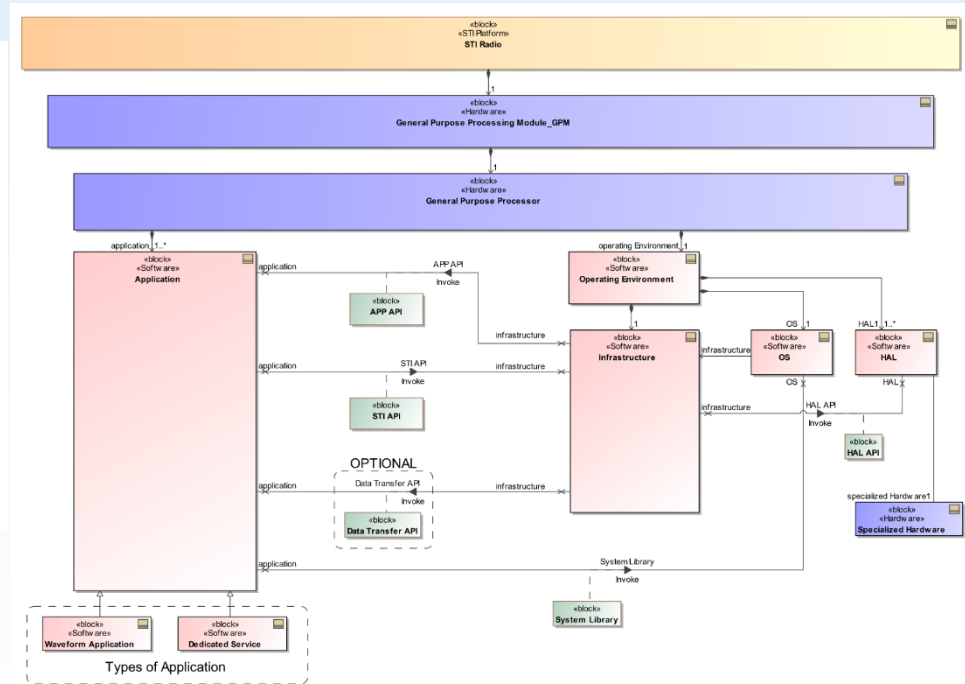
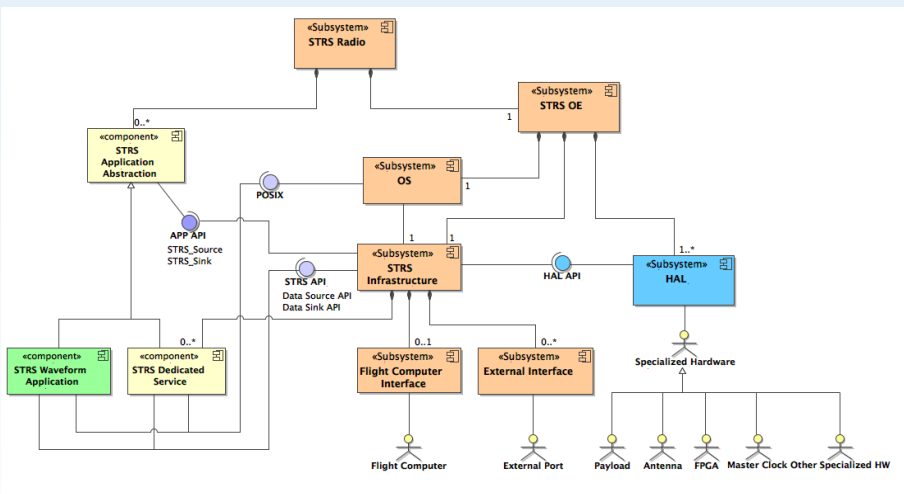




# Changes to Figure 10: Layered Structure

Before:

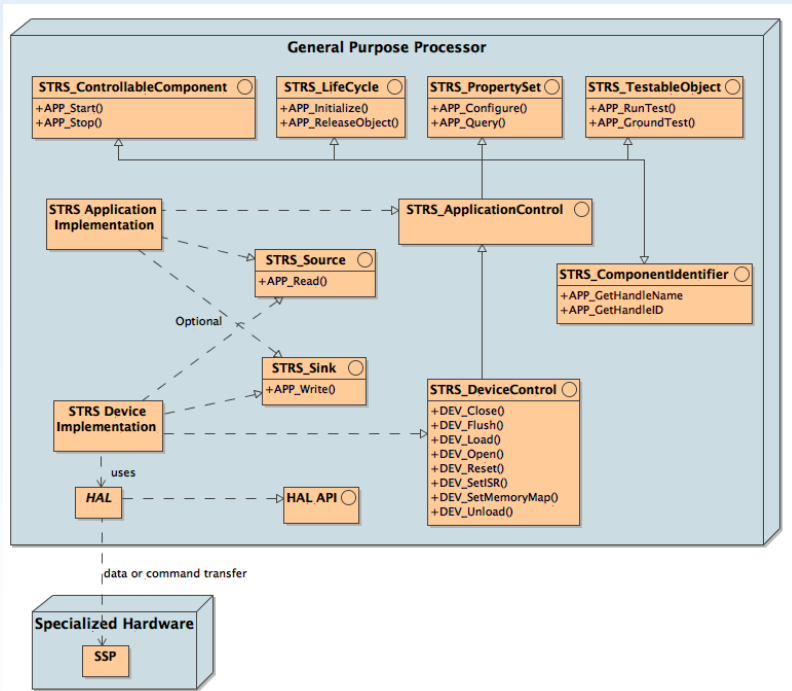
After: (Became figure 7)



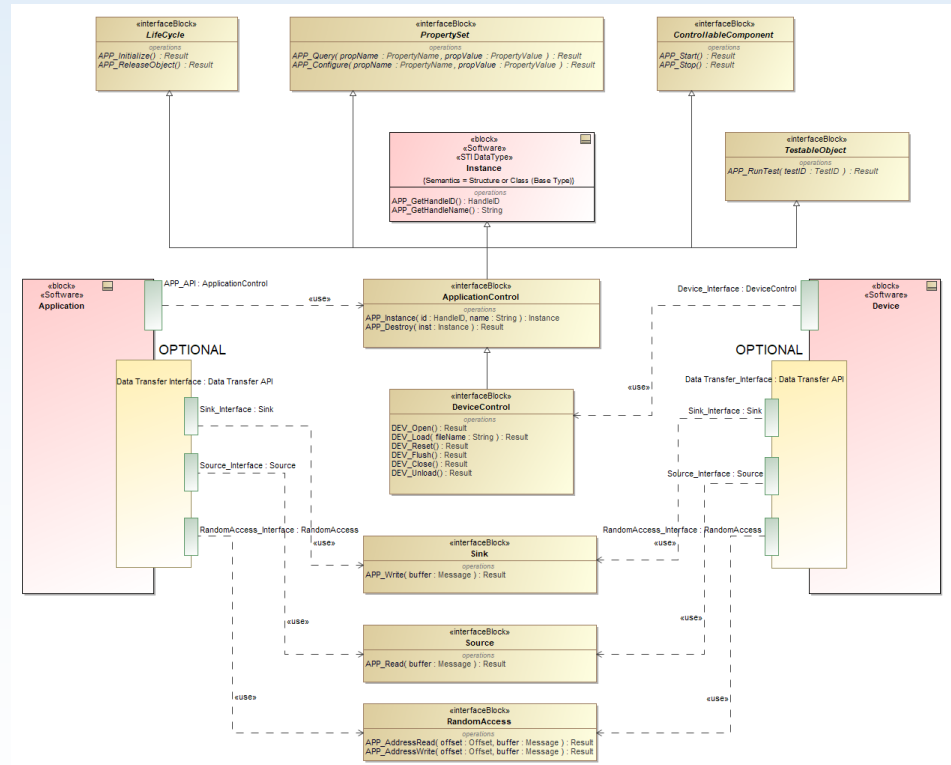


# Changes to Figure 14: Application and Device Structure

Before:



After: (Became figure 9)





## Current Status

- Comments to FTF Closed on June 15, 2021- 15 issues resolved
- Comments can still be made for revisions and a future Revision Task Force will address – website: <https://issues.omg.org/issues/task-forces/STI>
- FTF resolved 15 issues over last 6 months – finalizing beta spec for final publishing in Dec 2021
- More information can be found at:
  - **Beta Spec available now for review & comments:** <https://www.omg.org/spec/STI/About-STI/>
  - **FTF Spec:** <https://www.omg.org/spec/STI/20211101/ptc/21-11-26>
  - **Blog:** <https://pub.omg.org/>
  - **Public Release Announcement - New Object Management Group Specification Enables Open Software-Defined Radios for Space/Navigation Communications** <https://www.omg.org/news/releases/pr2021/03-09-21.htm> > *Spec reduces life-cycle costs for space and ground platforms-* March 9, 2021



## JIRA Issues

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- Fix typos, correct English usage, and improve appearance
- Fix links
- Change BufferSize to Integer
- Fix inconsistencies in calling sequence
- Improve SysML consistency and refactor Figures 7 and 9
- Update calendar format, changing Figure 14 accordingly
- Add file type parameter to the FileOpen method



## Questions and Answers





## Acronyms

- AB: Architectural Board
- API: Application Programmer's Interface
- FTF: Finalization Task Force
- NASA: National Aeronautics and Space Administration
- OMG: Object Management Group
- PIM: Platform Independent Model
- PSM: Platform Specific Model
- RFP: Request for Proposal
- SCA: Software Communications Architecture
- SCaN: Space Communications and Navigation
- SDR: Software-Defined Radio
- STI: Space Telecommunications Interface
- XMI: XML Metadata Interchange
- XML: eXtensible Markup Language