STRS

Space Telecommunications Radio System

STRS Architecture

Tutorial – Project Management

STRS Architecture

- STRS Background
- STRS Project Benefit
- STRS Project Burden
- STRS Project Management Considerations

STRS Background

STRS Goals and Objectives

- Applicable to space and ground missions of varying complexity
- Decrease the development time and cost of deployed capabilities
- Increase the reliability of deployed radios
- Accommodate advances in technology with minimal rework
- Adaptable to evolving requirements
- Enable interoperability with existing radio assets
- Leverage existing or developing standards, resources, and experience
- Maintain vendor independence
- Enable waveform portability between compliant platforms
- Enable cognitive radio concepts

STRS Project Benefit

STRS Benefits

- Software Defined Radios (SDRs) accommodate advances in SDR capabilities with minimal rework
  - Adaptable to evolving requirements
  - Allows software modification later in development cycle or even after deployment
  - Enables cognitive radio concepts
  - SDRs are common in commercial and military industries
- SDRs allow encapsulation of functionality.
  - Allows vendors to work on different parts of the radio at once
  - Allows updates to one part not to affect the other parts of the radio
  - Promotes multiple vendors and vendor independence

STRS Benefit

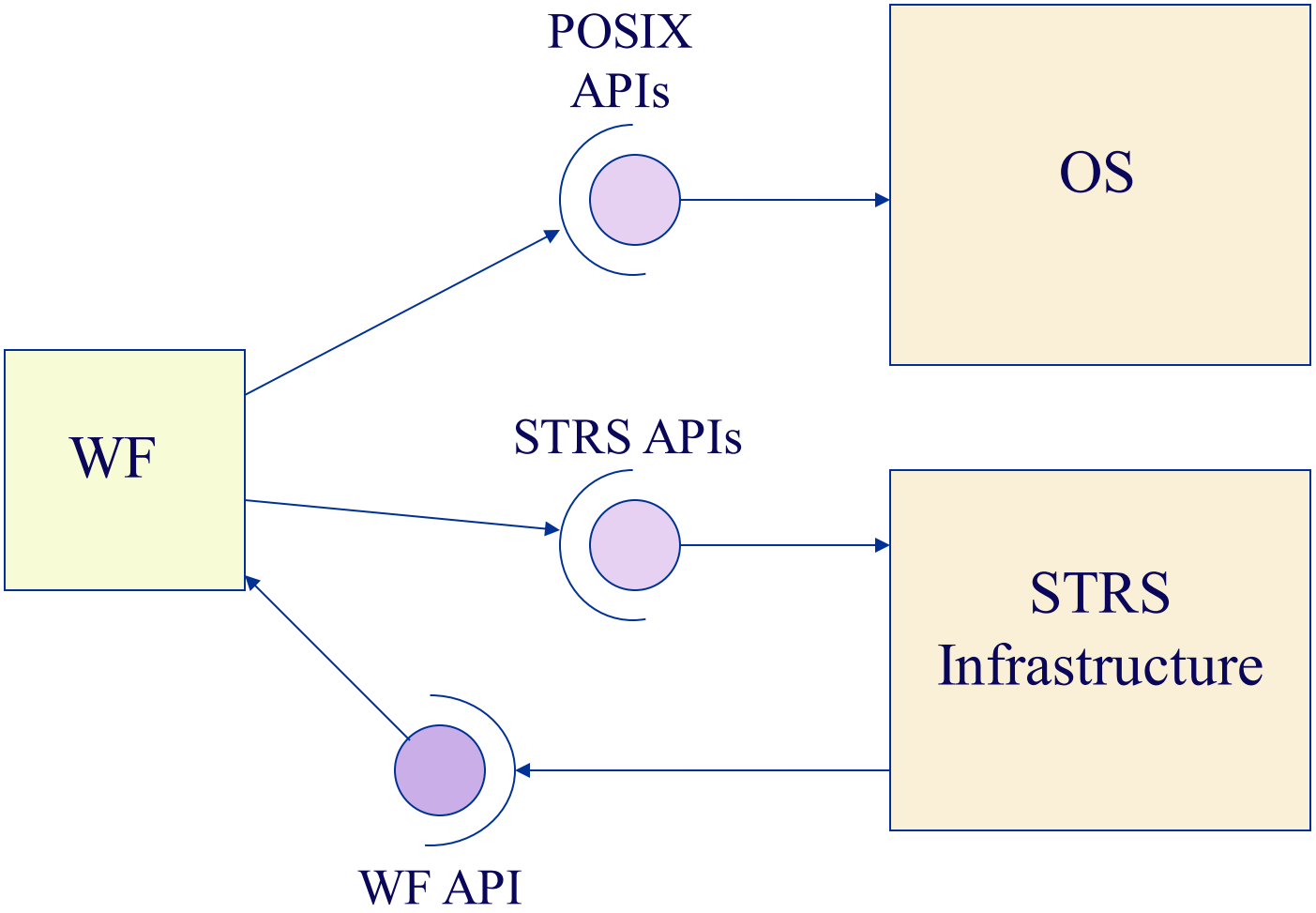
- Increase the reliability and decrease the development time and cost of deployed SDR capabilities
  - Leverage existing or developing standards, resources, and experience
  - Enable waveform portability between compliant SDR platforms
  - May obtain artifacts from STRS Application Repository for porting or reuse
  - Leverage software and firmware design and implementation processes and tools to lower risk and increase reliability
  - Gain knowledge from past experience i.e. lessons learned
  - Gain experience that is directly transferable
- Interoperable with existing radios

STRS Project Burden

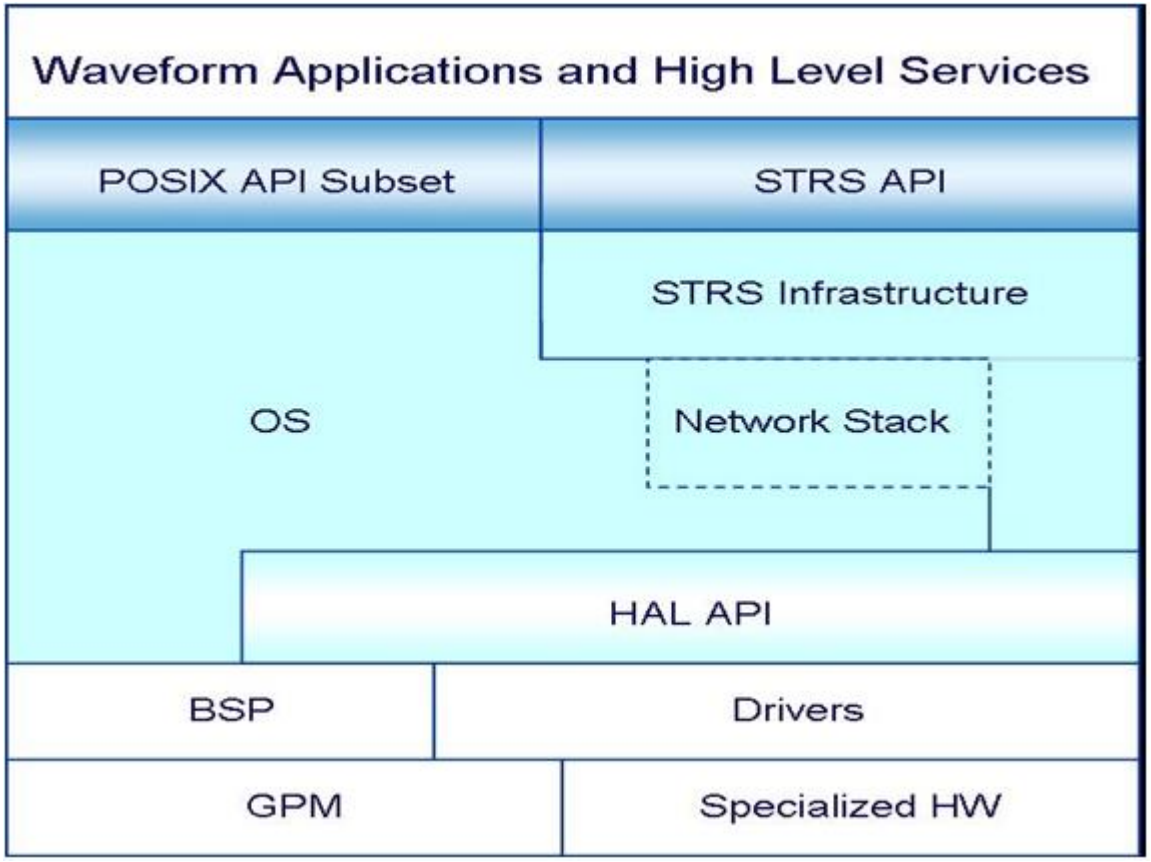
STRS Project Burden

- A general purpose processor is required in the radio
- STRS API is required to promote portability
- Configuration files are required to define initial state
- STRS compliance testing is required
- Documentation is required
  - High level system or component software model
  - Application firmware external interfaces
  - Hardware Interface Description (HID)
  - Hardware Abstraction Layer (HAL)
  - STRS application behavior
  - Application development environment and tool suite
  - Test plan and results documentation
  - Identification of Flight Software Development Standards used

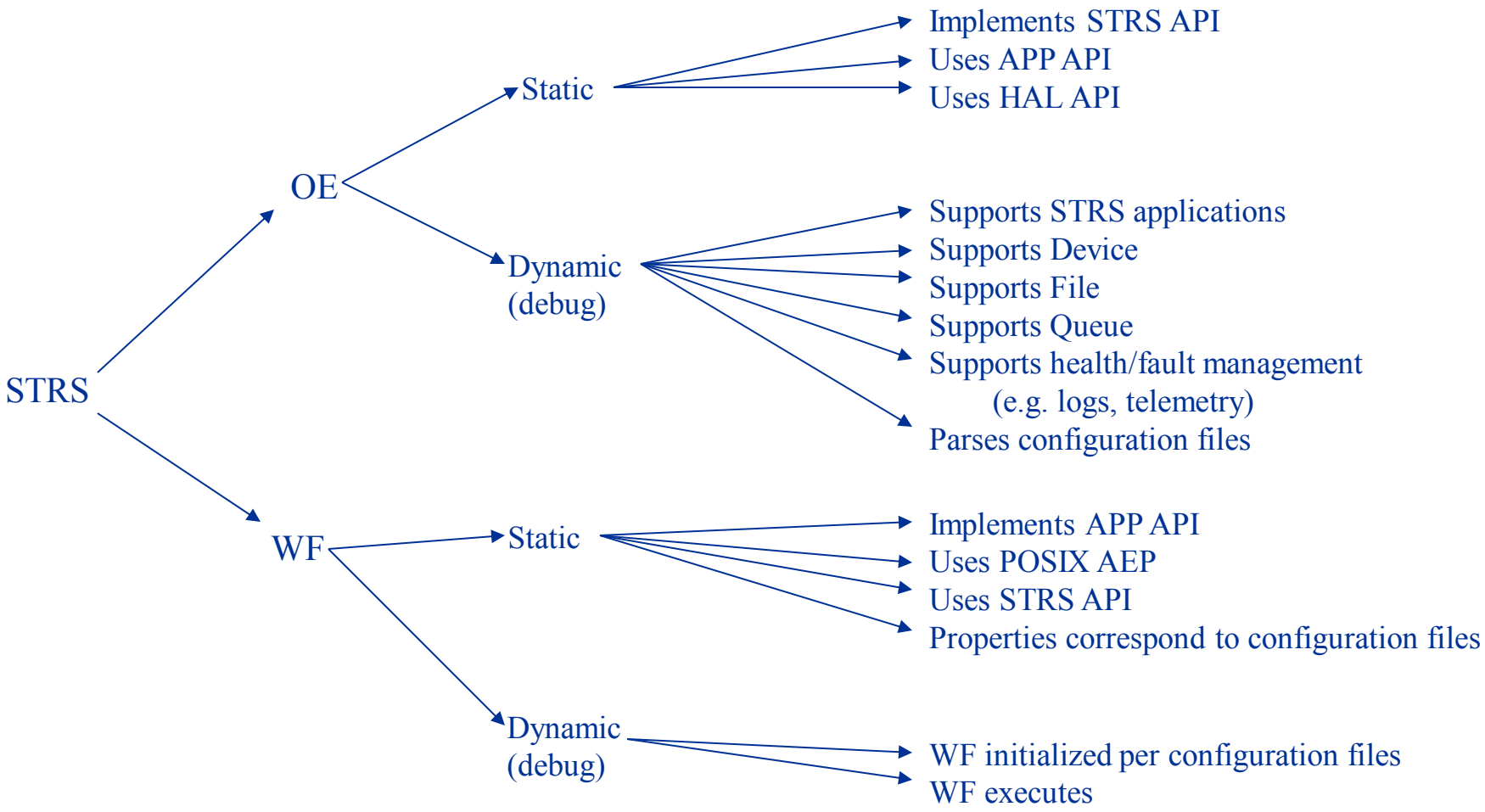
Simplified STRS Diagram



STRS Layer Cake Diagram

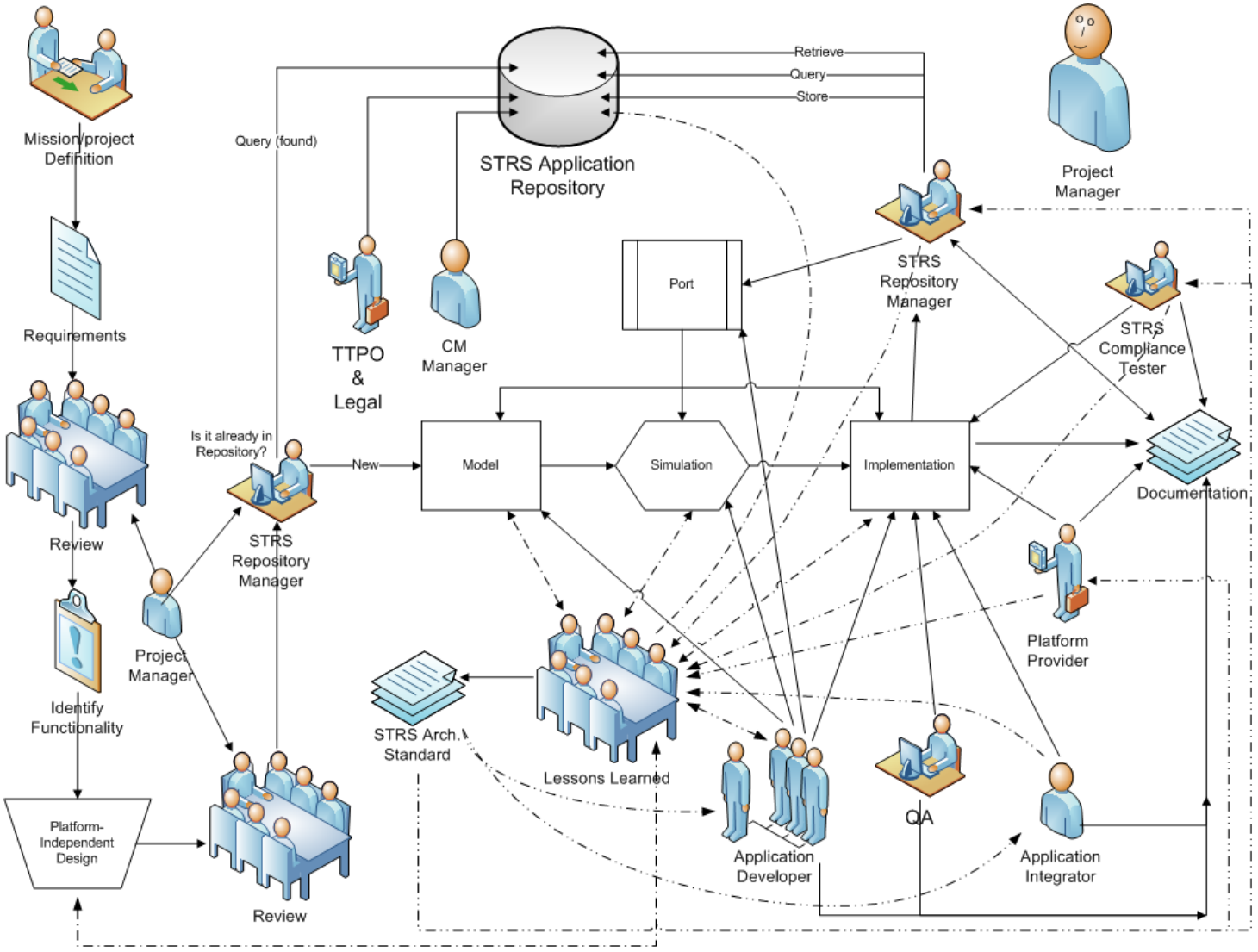


STRS Compliance



STRS Project Management Considerations

STRS Application Life Cycle



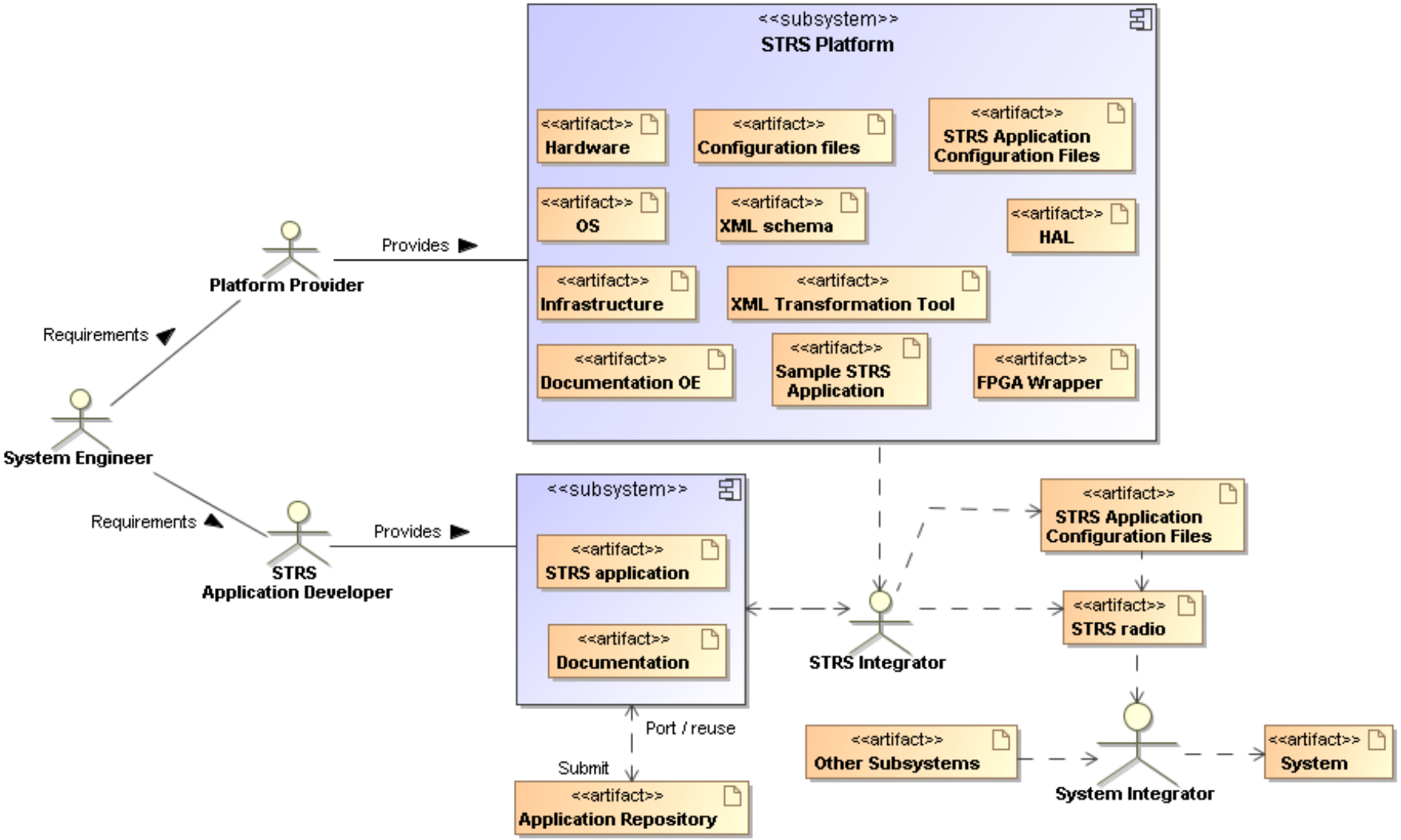
STRS Considerations

The mission/project should define the responsible organizations corresponding to the STRS roles specified in the STRS Architecture Standard and each organization's deliverables accordingly.

- STRS Roles
  - Platform Provider
  - Application (Waveform) Developer
  - Integrator
- Additional roles to be identified

  (provided by STRS team at GRC)
  - STRS Liaison
  - STRS Repository Manager
  - STRS Compliance Testing

STRS Roles & Responsibilities



STRS Project Management Considerations

Detail

(stop here if only overview)

STRS Considerations (1)

1 The mission/project should require any hardware and software developers to use the STRS Architecture Standard with a specified version.

- Some entity has to actually require that STRS shall be used on specific radios for a specific mission.
- When the STRS Architecture Standard becomes a NASA Standard, NASA-STD-4009, this version will become the standard to be used on all NASA radios.
- However, currently STRS version 1.02.1 is the latest approved version.

STRS Considerations (2)

3 The mission/project should review the goals/objectives and level 1 requirements and decide which operational capabilities are required.

- Most of the requirements at level 1 are stated in the form “STRS architecture shall allow” but that doesn’t means that every STRS implementation must have that operational capability.
- Examples:
  - Scalability, flexibility, reliability, extensibility, adaptability, interoperability, reconfigurability, reprogrammability,
  - Built-in testing and status reporting
  - Simultaneous operations
  - See also 7 on the next slide

STRS Considerations (3)

7 The mission/project should specify whether multiple STRS applications are necessary, whether they may be simultaneous, etc.

- See also 3 on the previous slide.

STRS Considerations (4)

4 The mission/project should provide resources for collection, identification, and submission of artifacts to NASA's STRS Application Repository.

- The STRS Application Repository is designed to support application software and firmware identification and reuse.
- The STRS Application Repository allows for survival of knowledge and artifacts after the project ends.
- The STRS Application Repository supports porting of software, firmware, and/or design.
- The mission/project should negotiate agreements that require submission of artifacts to the STRS Application repository and allow their subsequent release with appropriate restrictions.

STRS Considerations (5)

5 The mission/project should provide resources for capturing lessons learned.

- Need to address deviations and non-compliances.
- Need to provide lessons learned to STRS team primarily via the STRS website. The URL for STRS lessons learned is:

  https://strs.grc.nasa.gov/repository/forms/lessons-learned/

STRS Considerations (6)

6 The mission/project should provide resources for addressing STRS non-compliances and responding to STRS-related questions and comments.

- The mission/project should specify how to address non-compliances and issue waivers.

STRS Considerations (7)

12 The mission/project should determine whether there are one or more external command sources for the radio and whether the commands are parsed the same way or differently.

- Command and Control from ground station may be direct to the radio or indirect through another radio.
- Testing may use different ports.

STRS Considerations (8)

8 The mission/project should determine what external commands are needed to exercise what features of the STRS architecture.

- The mission/project should determine whether to standardize portions of the external interface command dictionary when multiple radios are involved.
- Alternately, there might be a standardized operations diagram that includes the STRS applications.
- The mission/project should determine requirements for built-in-tests, externally commanded tests, and externally queryable information.

STRS Considerations (9)

9 The mission/project should decide whether synchronization with external clocks or timers is necessary, for what purpose, and at what frequency.

- The reason is to help determine whether having a low accuracy clock in the GPP is sufficient or whether a high accuracy clock is needed.
- The project should define STRS_Synch functionality based on the mission needs.

STRS Considerations (10)

10 The mission/project should specify whether there are operator requirements.

- Most radios in space are autonomous and have no co-located user.
- Most radios in space are commanded from the ground or other satellite.

STRS Considerations (11)

11 The mission/project should specify whether there are data flow requirements.

- Data rate (internal and external).
- Quality of Service (QoS).
- Path & end points.
- Antenna requirements.

STRS Considerations (12)

13 The mission/project should determine how errors are recognized and processed.

- Is there a watchdog timer? If so, there are two sets of requirements needed: one for the radio to create a heartbeat signal and one for the flight computer or other component used to monitor the heartbeat signal and reboot the radio if the heartbeat dies.
- It is up to the mission/project to define whether there are alternate ways of rebooting under different circumstances.

STRS Considerations (13)

15 The mission/project should check whether the required functionality already exists in the STRS Application Repository.

- Much savings is from reuse and porting.

STRS Considerations (14)

16 The mission/project should identify required data and control parameters for each STRS application as well as the STRS infrastructure.

- The required configurable parameters and queryable parameters need to be specified.
- For example, if the mission would want the waveform applications to be created to process a range of data rates, that would have to be required up front with test considerations for specific data rates.

STRS Considerations (15)

17 The mission/project should determine whether telemetry is provided using a polling technique where the data is provided only upon request or sent at a periodic rate.

- This should correspond to whether the telemetry is created by the OE using STRS_Query or by the application using STRS_Log?
- The OE should handle any timed telemetry to avoid every application vying for time.
- The application should obtain the data, appropriate for telemetry. There should be requirements about how data is formatted.

STRS Considerations (16)

18 The mission/project should determine whether a service would be needed to monitor the values of temperature, pointing angle, etc. against some limits and what action should be taken at each limit.

- A value such as the temperature could signal the need for an action such as heating or cooling to avoid problems. In some cases, it would signal the need for a partial shutdown to lessen power consumption.
- Additional monitoring would be required if cognitive capabilities were desired.

STRS Considerations (17)

19 The mission/project should determine the software classification described in NASA Procedural Requirements (NPR) 7150.2 and follow the corresponding requirements for software management, engineering, support, test, and documentation, or the equivalent.

14 The mission/project should determine what level of testing is to be performed by whom and the corresponding reporting requirements.


NASA