
# Considerations for the Next Revision of STRS

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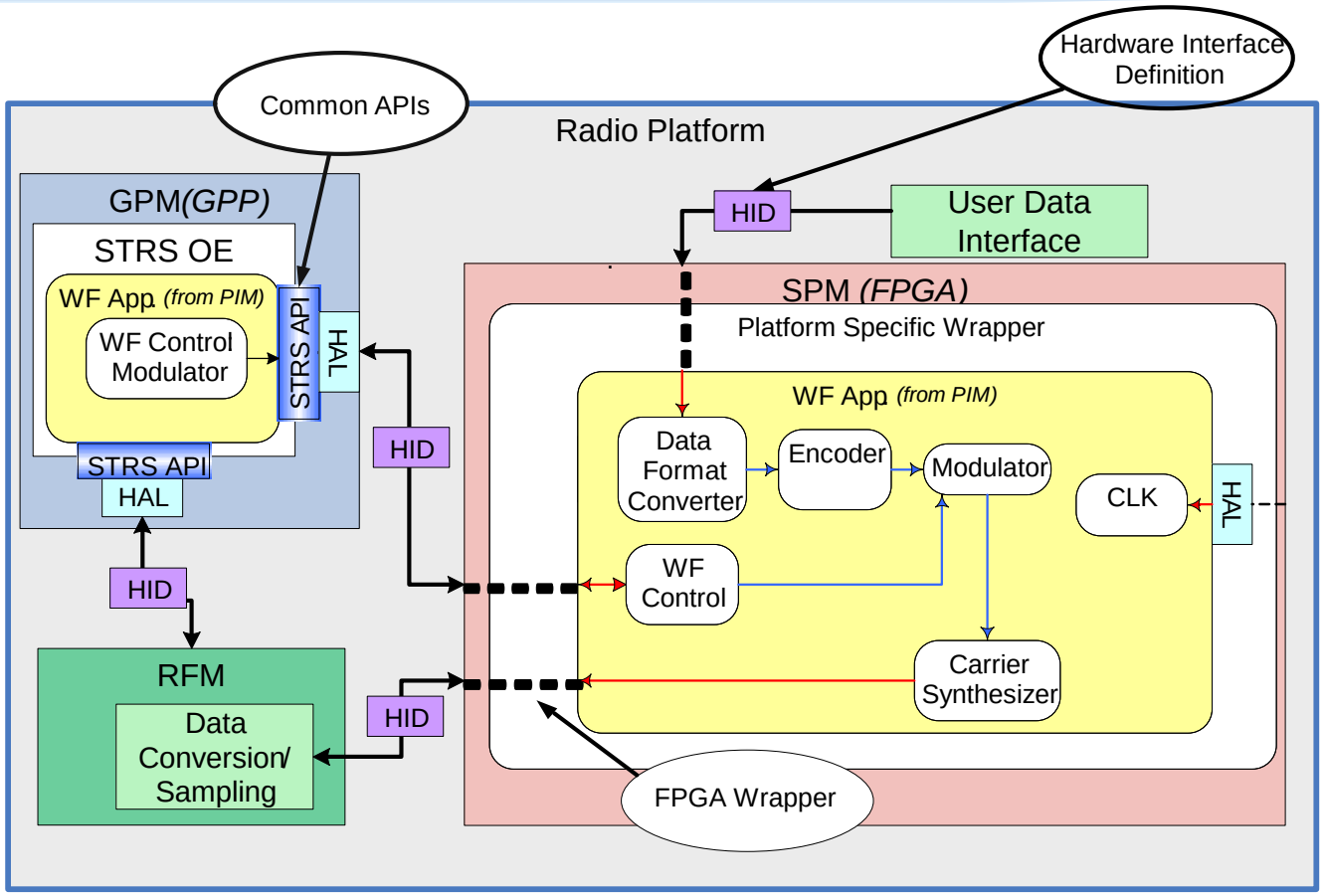
# Agenda

- STRS Overview
- Tenets and Benefits of STRS
- Considered Updates
  - Clarification for STRS Devices
  - Handle Names and IDs
  - STRS Timing
  - Operating Environment Information
  - SDRs without GPMs
  - Cognitive Radio
  - Acquisition Guidance
  - Standardized Platform Services
- Future Work
- STRS Repository Current and Future Submittals

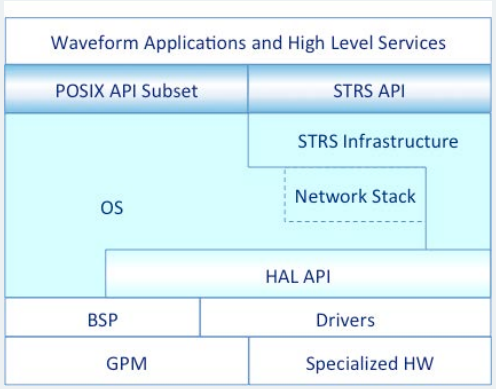
# What is STRS?

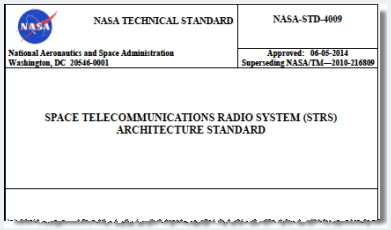



- Space Telecommunication Radio System
- STRS focus: constrained space environment
- STRS architecture:  APIs and open HID and HAL

# Tenets and Benefits of STRS

## STRS architecture and Standard





NASA TECHNICAL STANDARD

NASA-STD-4009

National Aeronautics and Space Administration
Washington, DC 20546-0001

Approved: 06-05-2014
Superseding NASA/TM—2010-216809

SPACE TELECOMMUNICATIONS RADIO SYSTEM (STRS)
ARCHITECTURE STANDARD

**Reduces effort to port applications**, especially configuration and control portion. VHDL/Verilog porting effort may still be significant depending on platform differences. Development guidance (e.g. modularity, documentation) supports reuse.

**Reduces vendor dependence** allowing application development by third party on SDR platform.

**Enables parallel development** of platform and application, reducing development time.

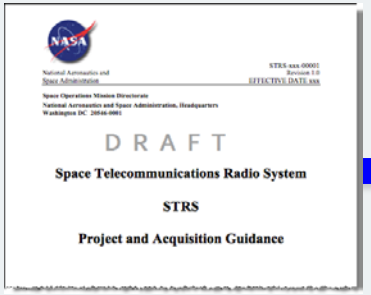
## STRS Repository

**Pre-existing code** is available from multiple potential sources.

**Sharing of documentation** across projects reduces effort and improves documents and procedures.

**Knowledge Retention** across projects improves quality.

## Guidance for SDR Acquisitions


DRAFT

Space Telecommunications Radio System

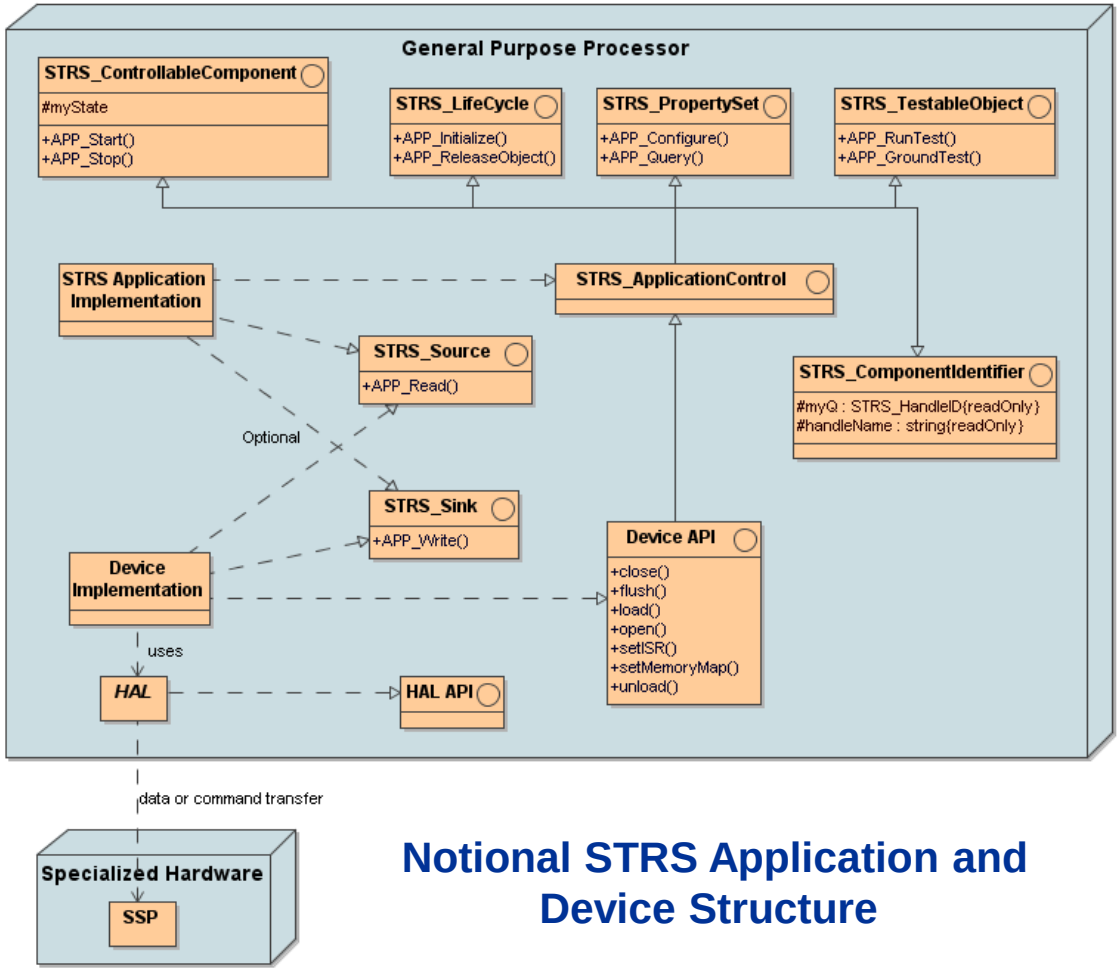
STRS

Project and Acquisition Guidance

**Guidance on unique SDR/STRS** requirements, development, test approach, and data rights is provided.

**Knowledge gained** on the unique aspects of procuring SDR platforms and applications can be shared among projects.

# Issue: Use of STRS Devices




**Notional STRS Application and Device Structure**

## STRS Device Definition

- Extension of an STRS application with a set of unique (non-STRS standard) APIs
- Proxy for the data and/or control path to the actual hardware.

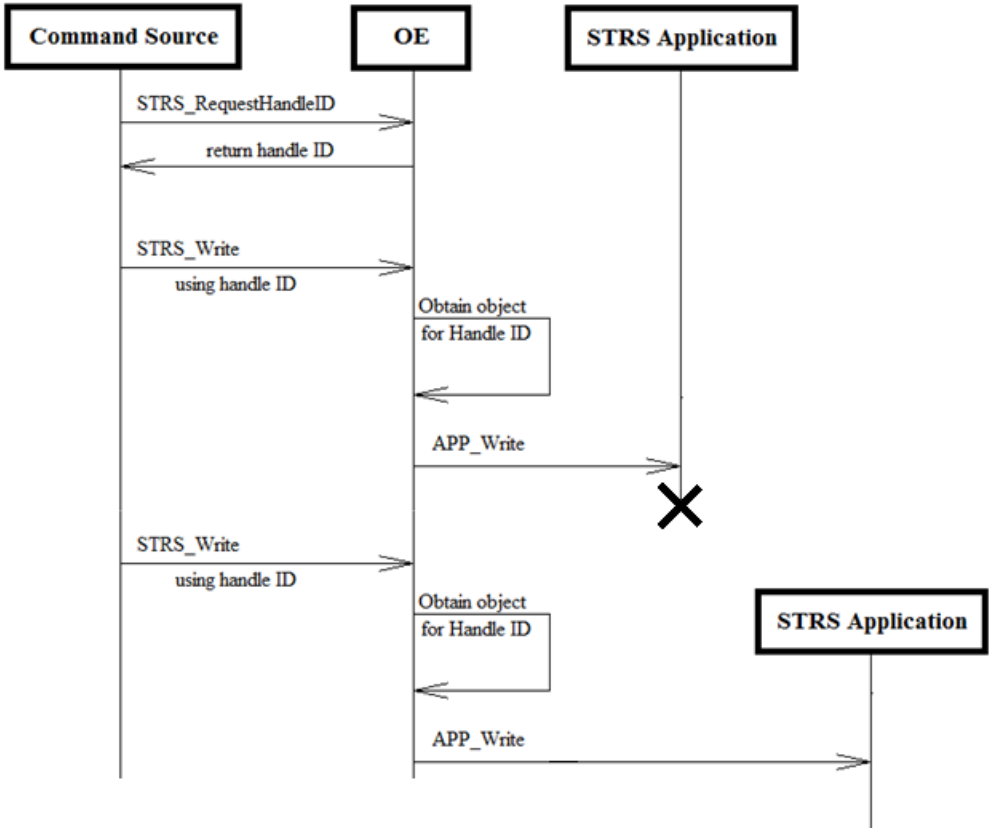
## Discussion:

- Suggestion from commenters: Use standard device APIs to enable device portability across platforms.
- Device portability is not an STRS objective. It may limit platform option and add complexity that might affect performance.

## Resolution:

- Add definition and detail in the supporting STRS Handbook, NASA-HDBK-4009, with suggestions that may aid device portability.
- No changes to the STRS architecture.

# Issue: Uniqueness and Valid Timeframe of Handle Names and IDs




**Handle Names and ID**

- Defined with STRS_InstantiateApp()

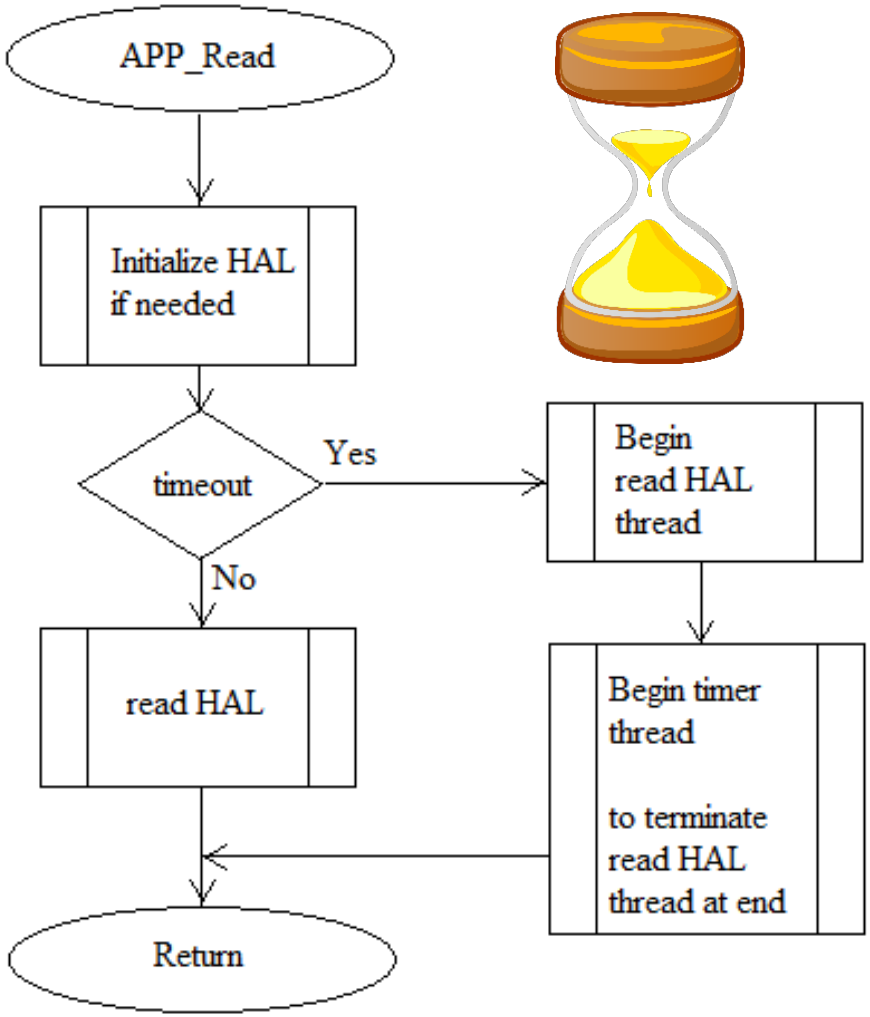
**Discussion:**

- Potential problem: reuse of handle IDs for different handle names for different purposes.

**Resolution:**

- Description field for STRS_InstantiateApp() updated to add: *Configuration file must specify handle names and it must be unique.*
- Section added to STRS Handbook to address suggestion Handle Name time concerns and determination of Handle ID.

# Issue: Standardizing Timing Services using STRS Timing APIs




## STRS time APIs

- Platform provider determines format and use of time contents needed for time stamps and event coordination.
- Must be defined by the mission.

## Discussion:

- Questions arose concerning epoch, timestamps of messages, and use of dependent and independent timers.

## Resolution:

- A new integer types will be added to allow for varying lengths for STRS_Seconds and STRS_Nanoseconds with guidance to prevent rollover for missions with a long operational lifetime.
- Recommendations added STRS Handbook about the use of the STRS time APIs and time conversion tool availability.

# *Issue: Ability of Application to Obtain Operating Environment Information*

**OE information required by some applications**

- Application may need current information about the STRS Operating Environment such as version numbers, active applications, resources used and free, and faults.

**Discussion**:

- STRS_Query can be used, but without standard handle name and ID for OE, application not portable.

**Resolution**:

- New requirement to be added to require a standard handle name and handle ID available to obtain run-time details about the OE with STRS_Query.

# *Issue: Use of STRS in SDRs without General-Purpose Processing Modules*

**Small SDR platforms rely on external system for general purpose processing**

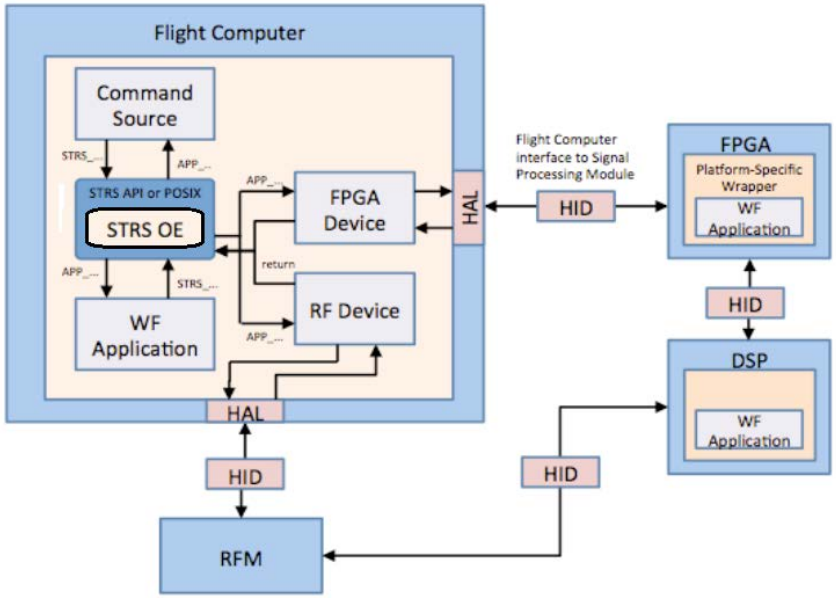
- STRS requires GPM for STRS API implementation.

**Discussion**:

- Compliant and non-compliant approaches to add STRS functionality suggested.

**Resolution**:

- This issue will continue to be scrutinized as digital signal processing hardware advances.




**Option 1: Distribute functionality**

- Compliant with current version of STRS
- Implement STRS OE on the flight computer.
- Adds burden to flight computer and multiple vendor integration.

**Option 2: Control the SPM using non-STRS methods**

- Increases application portability effort.
- Continues to offer advantages over non-STRS SDRs due to other STRS requirements (HAL, test applications, third party development).

**Option 3: Control the SPM via the Application**

- SPM respond independently by parsing bits from command stream.
- Same pros/cons as Option 2.

# Issue: Implementation of STRS-compliant Cognitive Radio

**Cognitive capabilities to be added to future SDRs at NASA**

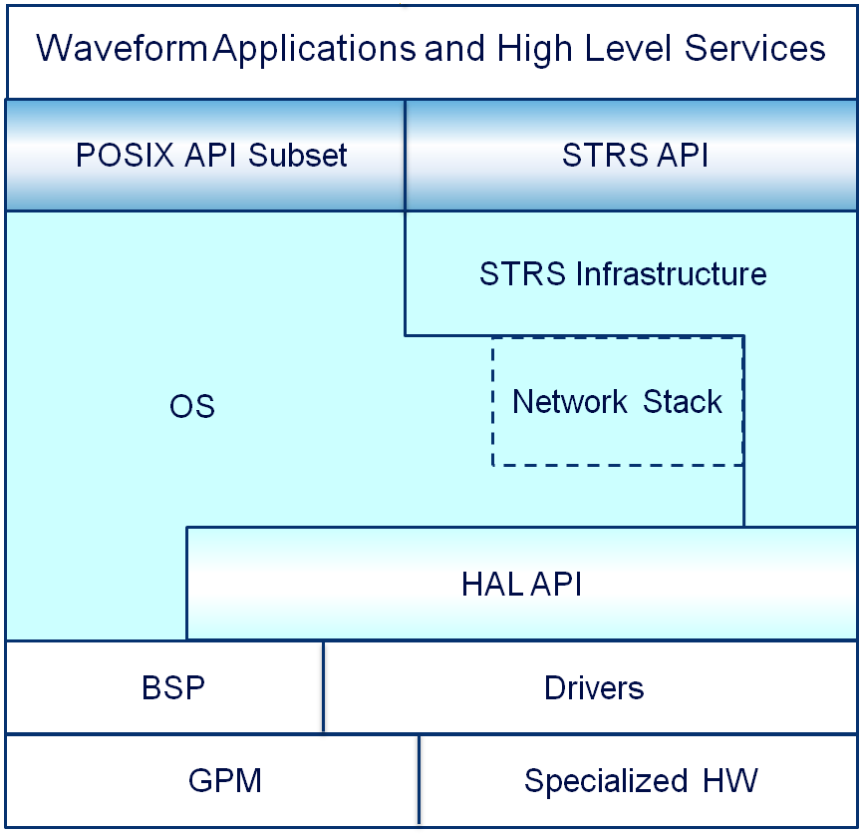
- SDRs ideal platform for implementing autonomous decision making ability.
- STRS has appropriate methods to implement cognition.

**Discussion**:

- Current STRS architecture adds an "adapter" layer between the application layers and the cognitive engine.

**Resolution**:

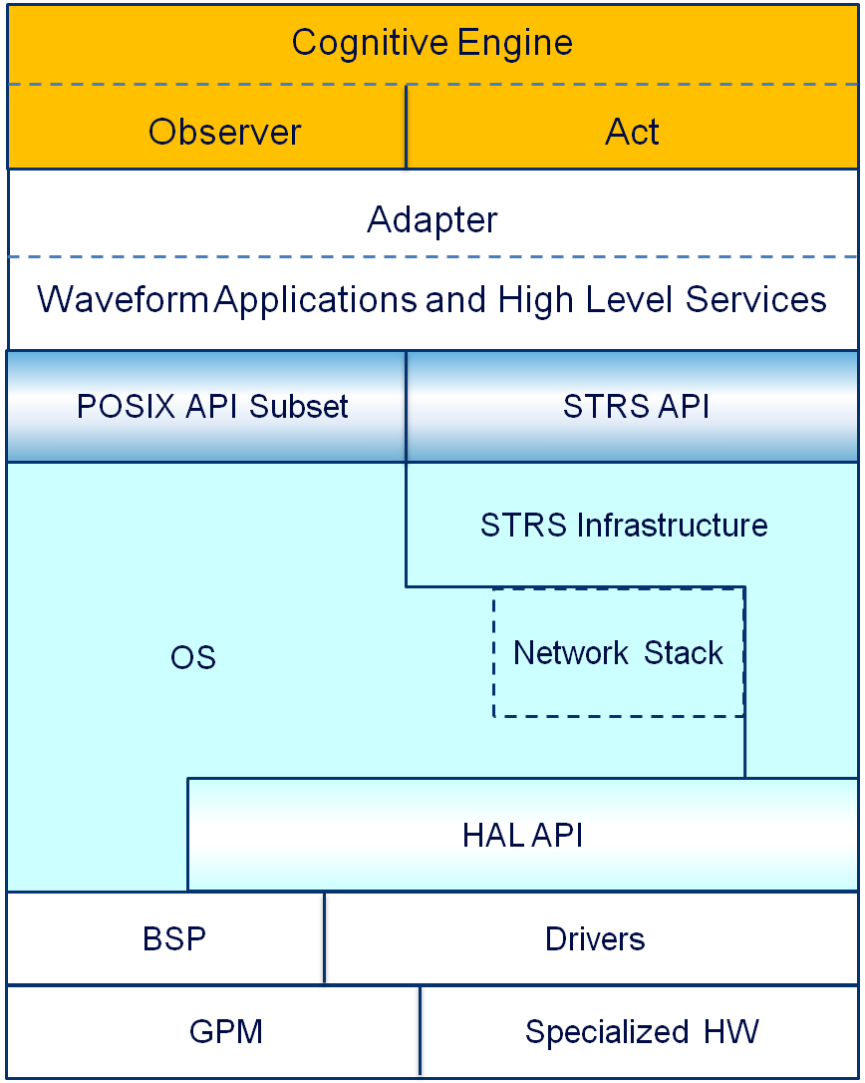
- Concept is currently being studied in a prototype system.




Existing STRS Layer Cake

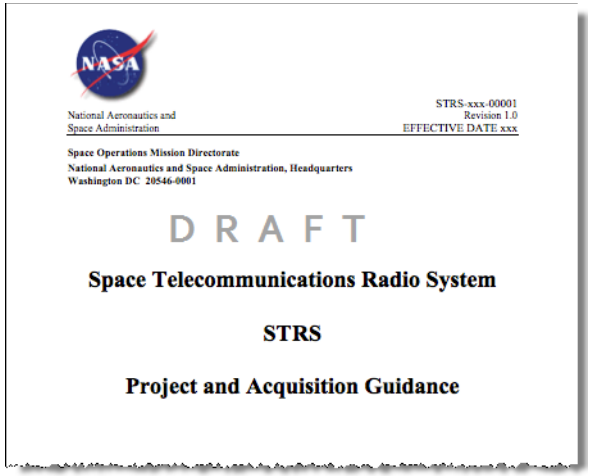
# Cognitive Radio

- The “adapter” layer in the STRS architecture informs the cognitive engine about the radio environment.
- The cognitive engine can learn autonomously from experience and take appropriate actions to adapt the radio operating characteristics.
- Optimize performance under adverse conditions such as
  - mitigating the effects of unplanned interference,
  - maximize the data throughput,
  - reconfiguring due to propagation effects




STRS Layer Cake

# *Issue: Capturing Acquisition Guidance*


National Aeronautics and Space Administration

STRS-xxx-00001
Revision 1.0
EFFECTIVE DATE xxx

Space Operations Mission Directorate
National Aeronautics and Space Administration, Headquarters
Washington DC 20546-0001

D R A F T

**Space Telecommunications Radio System**

**STRS**

**Project and Acquisition Guidance**

## Mission-specific Guidance

- Some requirements are based on mission needs - not part of the STRS Architecture Standard.
- Solution: Write the "STRS Project and Acquisition Guidance" document.

## Examples of Content Scope

- Data rights (OE, wrapper, application, documentation, source code).
- Required documentation for SDR procurements.
- STRS-specific needs for projects (training, compliance, development systems).
- Flexible command and telemetry structure.
- Verification and Validation considerations.
- Test waveforms.

# Future Work

- Complete updates to identified documents and obtain concurrence. Expected to be completed in FY17.
- Any suggested software changes will be coded and the NASA GRC's reference implementation will be changed accordingly to assure accuracy.
- Continue to capture Lessons Learned for future updates.
- Infusion to promote STRS for use in future flight hardware missions.

**STRS Website**
https://strs.grc.nasa.gov

# STRS Repository Current and Future Submittals

| | Developer | Waveform/Component Description | Data Rights | Submittal Year |
|---|---|---|---|---|
| Complete or near complete | GRC | ✓ STRS Compliance Tools | GPR | FY14 |
| | GRC | ✓ GRC GSFC TDRSS (GGT) Waveform for JPL SDR | GPR | FY14, FY15, FY16 |
| | GRC | Harris SDR Capture Test Waveform | GPR | FY15 |
| | JPL | ✓ Short Blocklength LDPC Codes for SDRs | GPR | FY15 |
| | JPL | ✓ General Purpose LDPC Codes for SDRs | GPR | FY15 |
| | GRC | ✓ Reconfigurable Bandwidth-Efficient Transmit Waveform for High-rate Telemetry | GPR | FY15/FY16 |
| | JPL | ✓ OE & Test Waveform Applications | GPR | FY15/FY16 |
| | GRC | ✓ STRS Reference Implementation | GPR | FY16 |
| | GD | Baseline S-band TDRSS waveform software | Limited | FY14 |
| | Harris | Baseline Ka-band TDRSS waveform software | Limited | FY14 |
| In development | GRC | SNR estimator component | GPR | FY16 |
| | GRC | ACM component | GPR | FY16 |
| | JPL | ~15 components and 10 waveforms | GPR | FY15-FY18 |
| | Comm Largo* | Scintillation-Hardened GPS waveform | Open | FY16 |
| | GRC | VCM component | GPR | FY16 |
| | GRC | DVB-S2 waveform | GPR | FY16-FY18 |
| | Virginia Tech | Signal Classification and Interference Mitigation component | GPR | FY16/17 |
| | Worcester Polytechnic | Intelligent Media Access Protocol component | GPR | FY16/17 |
| | GRC | Cognitive Engine on an SDR | GPR | FY17 |

GPR = Government Purpose Rights

* Additional funding for development needed

✓ Requested