# Resource Management Subsystem

## Carrie Williams

**17 October 1995**

# Real-Time Task Distribution Process Map

| Real-Time Server | Data Server | User Station | IST |
|---|---|---|---|
| **String Manager**<br>**Resource Monitor**<br><br>NCC Input<br>NCC Output<br>EDOS Input<br>EDOS Output<br><br>Format Command<br>FOP Command<br>Transmit Command<br><br>Decom<br>Memory Dump<br>State Check<br>Parameter Server | | **String Manager**<br><br>Decom<br>Parameter Server | **String Manager**<br><br>Decom<br>Parameter Server |
| COTS | | COTS | COTS |

# Driving Requirements

- " . . .  multiple EOC operators access to the same data stream"
- " . . . multiple IST operators access to the same data stream"
- " . . . single EOC operator access to multiple data streams"
- ". . . single IST operator access to multiple data streams"
- ". . . ensure single point of command for a given spacecraft"
- ". . . correct failure condition with a redundant component within one minute of operator request

# Resource Management Subsystem Overview

**String Manager Process Key Responsibilities**

- **Logical String Management**
- **User Connection**
- **Backup Processing Synchronization**
- **Ground Configuration Changes**
- **Failure Recovery**

**Resource Monitor Process Key Responsibilities**

- **Ensures that critical hardware and software resources are monitored for status changes**
- **Issue Event messages upon failure**

# String Manager Process Features

**Service Oriented**

- **Resources allocated upon user request**
- **Resources deallocated when no longer needed**

**Role Based**

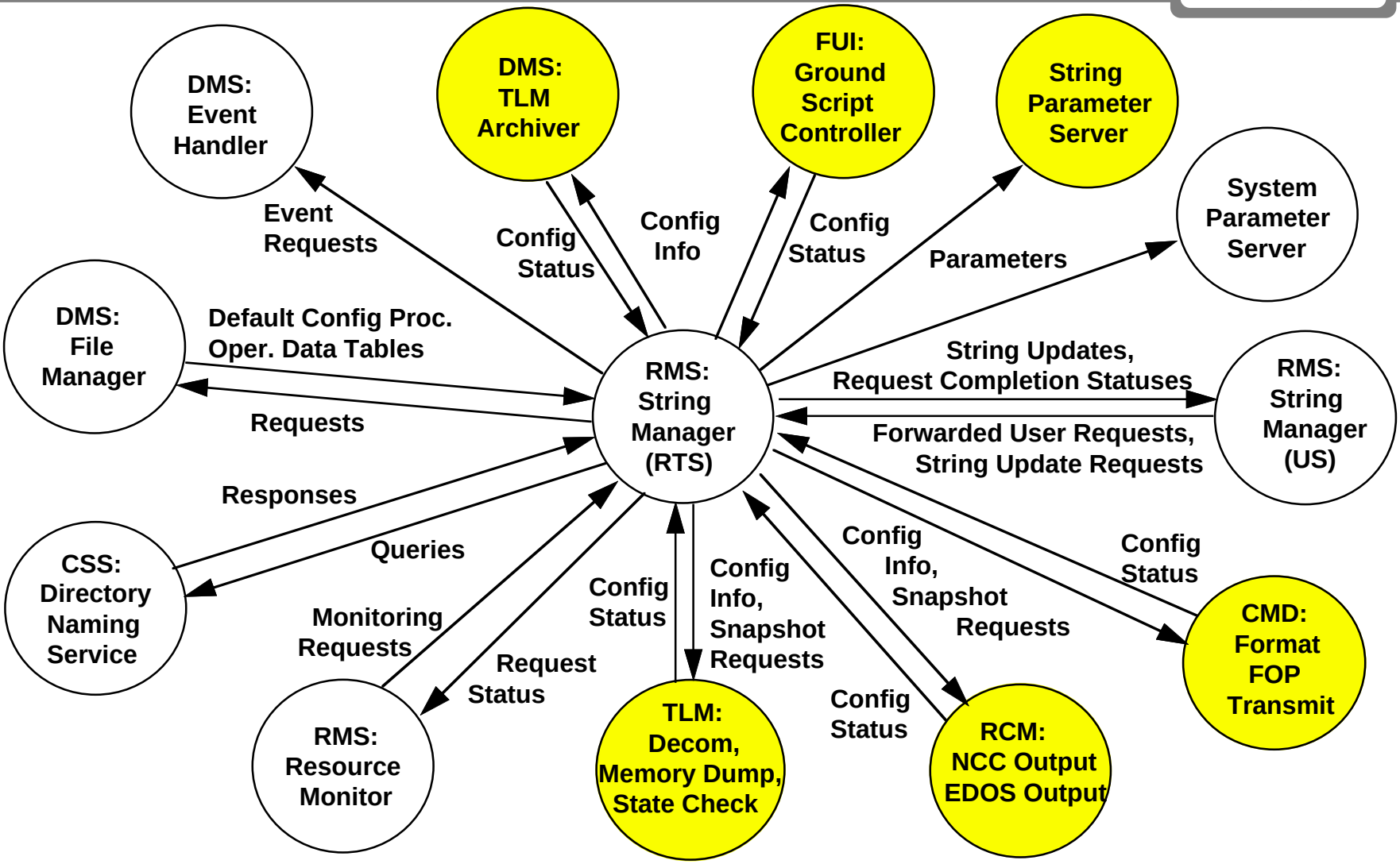
- **Operational Data Table dictates role played by String Manager Process on a given host**
- **Two Roles Currently Defined**
  - **Real-Time Server**
  - **User Station / IST**

# Logical String Identification

**Logical Strings uniquely identified by 5 pieces of information**

| | RTS 1 |
|---|---|
| Mission ID | AM-1 |
| Data Source (Real-Time, Simulation, Replay) | RT |
| Mode (Operational, Test, Training) | OPER |
| Operational Data Table ID | AM01 |
| State (Active, Inactive, Backup) | Active |

# String Manager (RTS) Context Diagram






Shaded processes are part of the full complement of logical string specific software

# String Manager RTS Role Description

**Creates Logical Strings to support Shared Activities**

**Accesses Default Configuration File at startup**

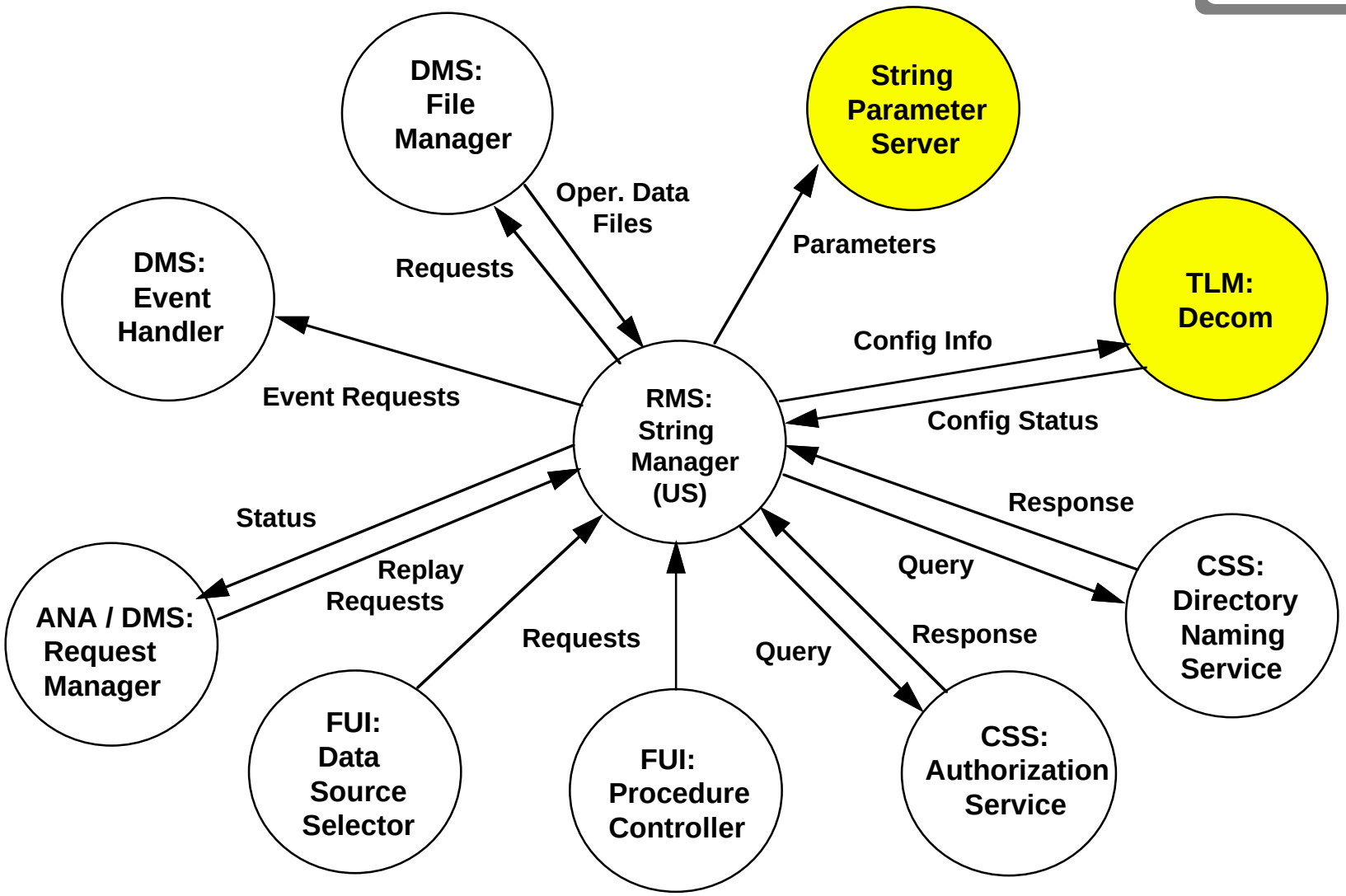
**Responsible for changes to Shared Logical String configurations**

**Responsible for maintaining user privileges**

- **command authority**
- **ground control**

**Mirrored User Connection Synchronization**

# String Manager (US) Context Diagram






Shaded processes are part of the full complement of logical string specific software

# String Manager User Station Role Description

**Provides visibility into RTS Activities**

**Creates Logical Strings locally to support:**

- **Dedicated Activities**
  - **replay of historical data dedicated to single user**
- **User connections to existing Shared Logical Strings**
  - **connection to Real-Time logical string to monitor real-time contact**

**Responds to all user requests**

- **Forwards applicable requests to RTS(s)**
- **Facilitates Back-up Logical String Synchronization**
- **Facilitates Mirrored Connection Synchronization**

**Interface with CSS Authorization Service**

# Real-Time Logical Strings

**REAL-TIME, OPERATIONAL Logical Strings**

- **Full Complement of Real-Time Processes created on RTS**
- **Used For:**
  - **Monitoring Real-Time Telemetry**
  - **Spacecraft Commanding**
  - **Ground Configuration Changes**

**ECL Directive Example**

- **STRING CREATE REALTIME AM-1 OPER AM01 RTS01**

# Real-Time Logical String Creation Illustrated

| | RTS 1 | RTS 2 |
|---|---|---|
| String ID | 101 | |
| Mission ID | AM-1 | |
| Data Source | RT | |
| Mode | OPER | |
| Oper. Data ID | AM01 | |
| State | Active | |

| | US 01 |
|---|---|
| String ID | 101 |
| Mission ID | AM-1 |
| Data Source | RT |
| Mode | OPER |
| Oper. Data ID | AM01 |
| State | Active |

# Back-up Logical Strings

**BACK-UP Logical String**

- **Full Complement of Real-Time Processes created on RTS**
- **Used for Failure Recovery**
- **One logical switch in each BACK-UP process**

**ECL Directive Example**

- **STRING CREATE BACKUP RTS02 101**

# Back-up Logical String Creation Illustrated (1 of 2)

| | RTS 1 | RTS 2 |
|---|---|---|
| String ID | 101 | 201 |
| Mission ID | AM-1 | AM-1 |
| Data Source | RT | RT |
| Mode | OPER | OPER |
| Oper. Data ID | AM01 | AM01 |
| State | Active | Backup |

US 01

| | | |
|---|---|---|
| String ID | 101 | 201 |
| Mission ID | AM-1 | AM-1 |
| Data Source | RT | RT |
| Mode | OPER | OPER |
| Oper. Data ID | AM01 | AM01 |
| State | Active | Backup |

# Back-up Logical String Creation Illustrated (2 of 2)

| | RTS 1 | | RTS 2 | RTS 3 |
|---|---|---|---|---|
| String ID | 101 | 102 | 201 | 301 |
| Mission ID | AM-1 | PM-1 | AM-1 | PM-1 |
| Data Source | RT | RT | RT | RT |
| Mode | OPER | OPER | OPER | OPER |
| Oper. Data ID | AM01 | PM02 | AM01 | PM02 |
| State | Active | Backup | Backup | Active |

US 01

| | | | | |
|---|---|---|---|---|
| String ID | 101 | 102 | 201 | 301 |
| Mission ID | AM-1 | PM-1 | AM-1 | PM-1 |
| Data Source | RT | RT | RT | RT |
| Mode | OPER | OPER | OPER | OPER |
| Oper. Data ID | AM01 | PM02 | AM01 | PM02 |
| State | Active | Backup | Backup | Active |

# Shared Replay Logical Strings

**Shared REPLAY Logical Strings (RTS)**

- **Telemetry Processes created for reprocessing of historical spacecraft telemetry for user display**
- **Real-Time Contact Management Input Processes created for:**
  - **reprocessing of historical NCC user performance data or**
  - **reprocessing of historical EDOS CODAs**

**ECL Directive Examples**

- **REPLAY TLM HK RTS02 AM-1 <StartTime> <StopTime>**
- **REPLAY NCC RTS03 AM-1 <StartTime> <StopTime>**
- **REPLAY EDOS RTS03 AM-1 <StartTime> <StopTime>**

# Shared Replay Logical String Creation Illustrated

| | RTS 1 | | RTS 2 | | RTS 3 |
|---|---|---|---|---|---|
| String ID | 101 | 102 | 201 | 202 | 301 |
| Mission ID | AM-1 | PM-1 | AM-1 | AM-1 | PM-1 |
| Data Source | RT | RT | RT | Replay | RT |
| Mode | OPER | OPER | OPER | | OPER |
| Oper. Data ID | AM01 | PM02 | AM01 | AM01 | PM02 |
| State | Active | Backup | Backup | | Active |

US 01

| | | | | | |
|---|---|---|---|---|---|
| String ID | 101 | 102 | 201 | 202 | 301 |
| Mission ID | AM-1 | PM-1 | AM-1 | AM-1 | PM-1 |
| Data Source | RT | RT | RT | Replay | RT |
| Mode | OPER | OPER | OPER | | OPER |
| Oper. Data ID | AM01 | PM02 | AM01 | AM01 | PM02 |
| State | Active | Backup | Backup | | Active |

# Dedicated Replay Logical Strings

**Dedicated REPLAY Logical Strings (US)**

- **Telemetry Processes created for reprocessing of historical spacecraft telemetry for:**
  - **user display or**
  - **off-line analysis**

**ECL Directive Example**

- **REPLAY TLM HK AM-1 <StartTime> <StopTime>**

# Dedicated Replay Logical String Creation Illustrated

| | RTS 1 | | RTS 2 | | RTS 3 |
|---|---|---|---|---|---|
| String ID | 101 | 102 | 201 | 202 | 301 |
| Mission ID | AM-1 | PM-1 | AM-1 | AM-1 | PM-1 |
| Data Source | RT | RT | RT | Replay | RT |
| Mode | OPER | OPER | OPER | | OPER |
| Oper. Data ID | AM01 | PM02 | AM01 | AM01 | PM02 |
| State | Active | Backup | Backup | | Active |

US 01

| | | | | | | |
|---|---|---|---|---|---|---|
| String ID | 001 | 101 | 102 | 201 | 202 | 301 |
| Mission ID | AM-1 | AM-1 | PM-1 | AM-1 | AM-1 | PM-1 |
| Data Source | Replay | RT | RT | RT | Replay | RT |
| Mode | | OPER | OPER | OPER | | OPER |
| Oper. Data ID | AM01 | AM01 | PM02 | AM01 | AM01 | PM02 |
| State | | Active | Backup | Backup | | Active |

# User Connection

**Applies to Shared Logical Strings**

**Coordinated by US String Manager**

**Logical String Connection Types**

- **Mirrored (configuration)**
- **Tailored (configuration)**

**ECL Directive Examples**

- **STRING CONNECT 101 MIRRORED**
- **STRING CONNECT 301 TAILORED**

# User Connection Illustrated

| | RTS 1 | | RTS 2 | | RTS 3 |
|---|---|---|---|---|---|
| String ID | 101 | 102 | 201 | 202 | 301 |
| Mission ID | AM-1 | PM-1 | AM-1 | AM-1 | PM-1 |
| Data Source | RT | RT | RT | Replay | RT |
| Mode | OPER | OPER | OPER | | OPER |
| Oper. Data ID | AM01 | PM02 | AM01 | AM01 | PM02 |
| State | Active | Backup | Backup | | Active |

US 01

| | | | | | |
|---|---|---|---|---|---|
| String ID | 101 | 102 | 201 | 202 | 301 |
| Mission ID | AM-1 | PM-1 | AM-1 | AM-1 | PM-1 |
| Data Source | RT | RT | RT | Replay | RT |
| Mode | OPER | OPER | OPER | | OPER |
| Oper. Data ID | AM01 | PM02 | AM01 | AM01 | PM02 |
| State | Active | Backup | Backup | | Active |

# Back-up and Mirrored Processing Synchronization

**Coordinated by US String Manager**

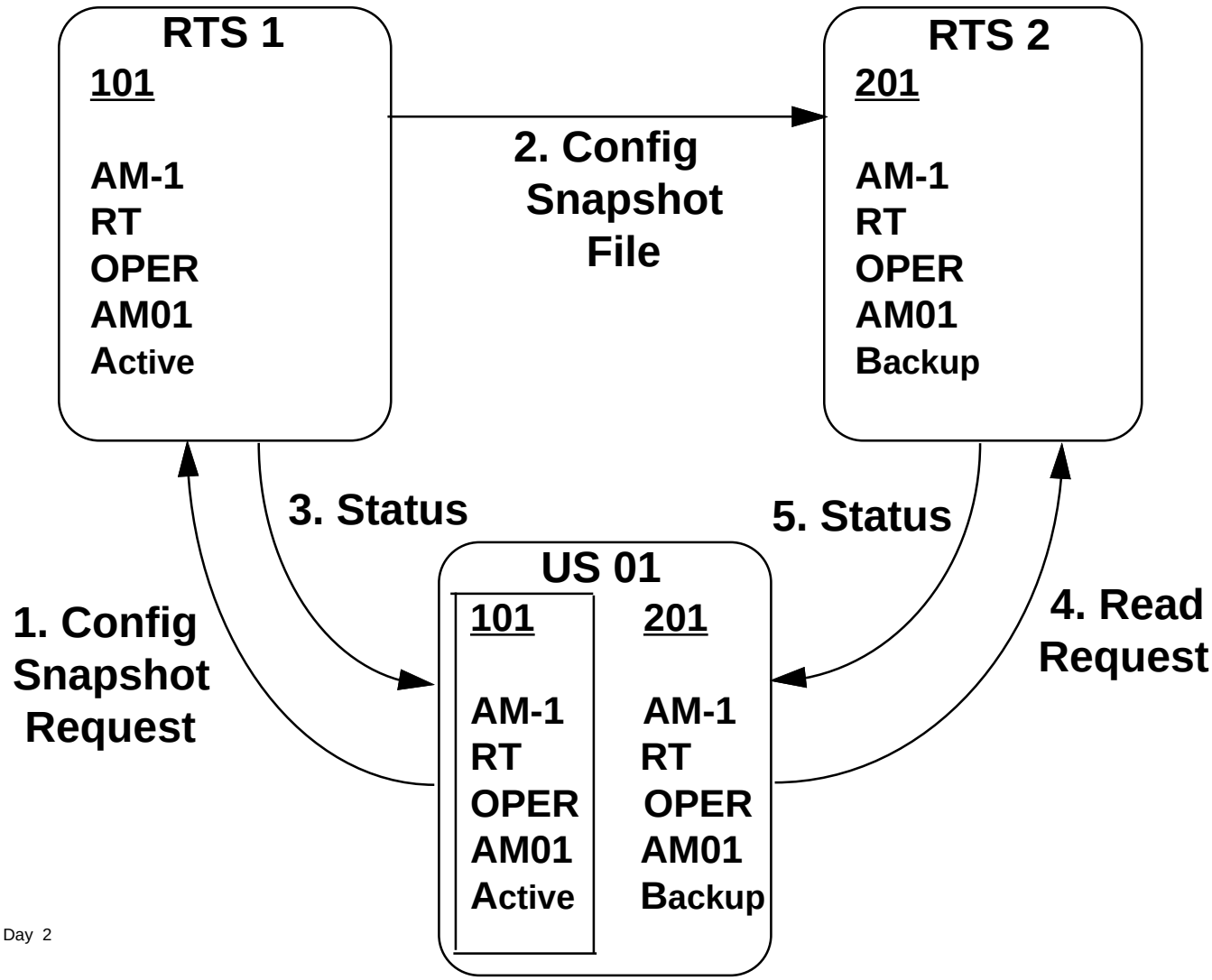
**Back-up: String Manager Processes on 2 RTSs respond to direction**

**Mirrored: String Manager Processes on 1 RTS and 1 US respond to direction**

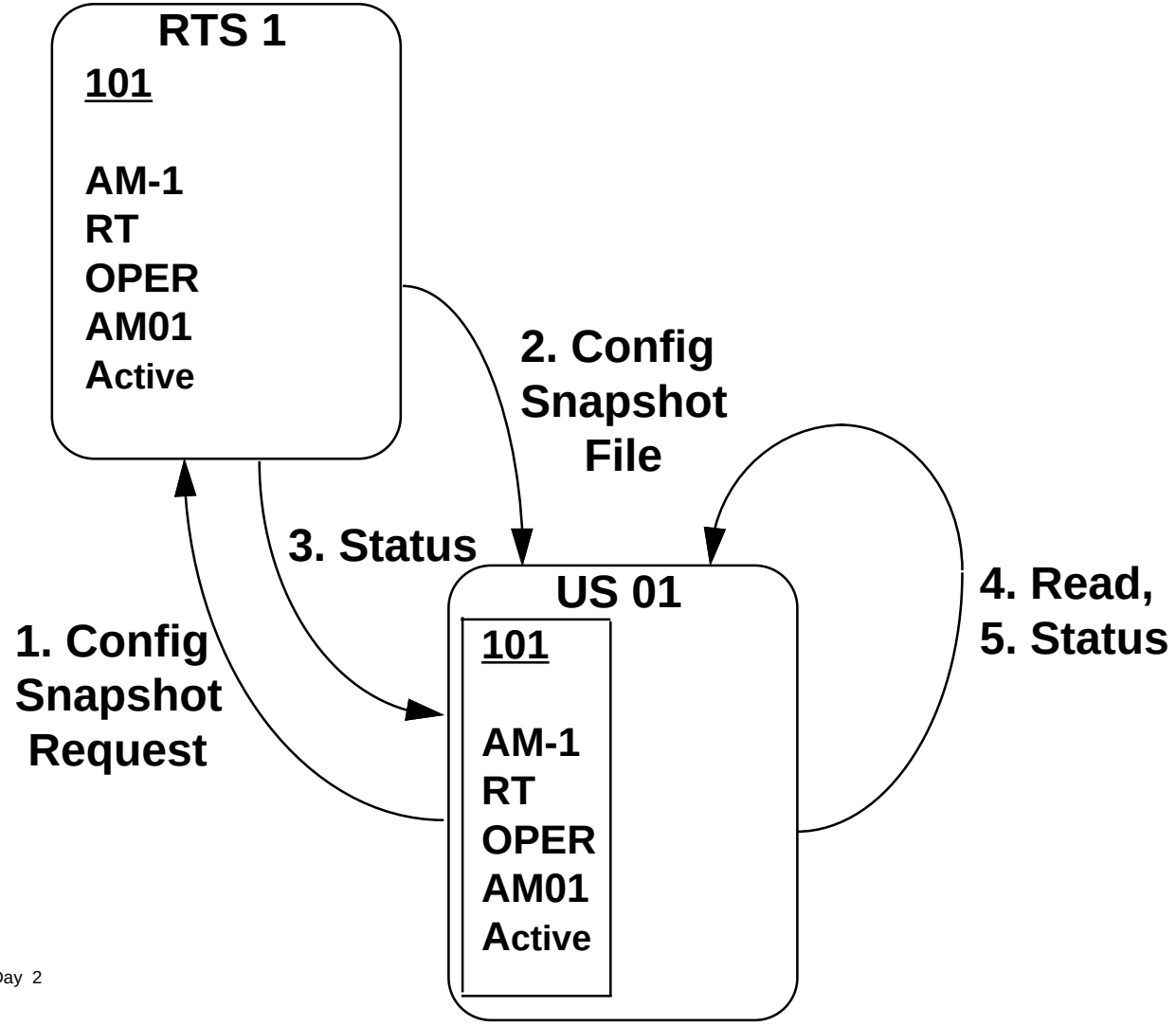
**Procedure:**

- **Active processes receive “snapshot” request from US String Manager**
- **Active processes send completed “snapshot” of configuration to specified host**
- **Back-up processes access “snapshot” file and load configuration information**
- **US String Manager coordinates statuses from 2 hosts to ensure that configuration synchronization is achieved**

# Back-up Logical String Synchronization Illustrated



# Mirrored Connection Synchronization Illustrated



# Ground Configuration Change Synchronization

**Back-up String Synchronization coordinated by US String Manager**

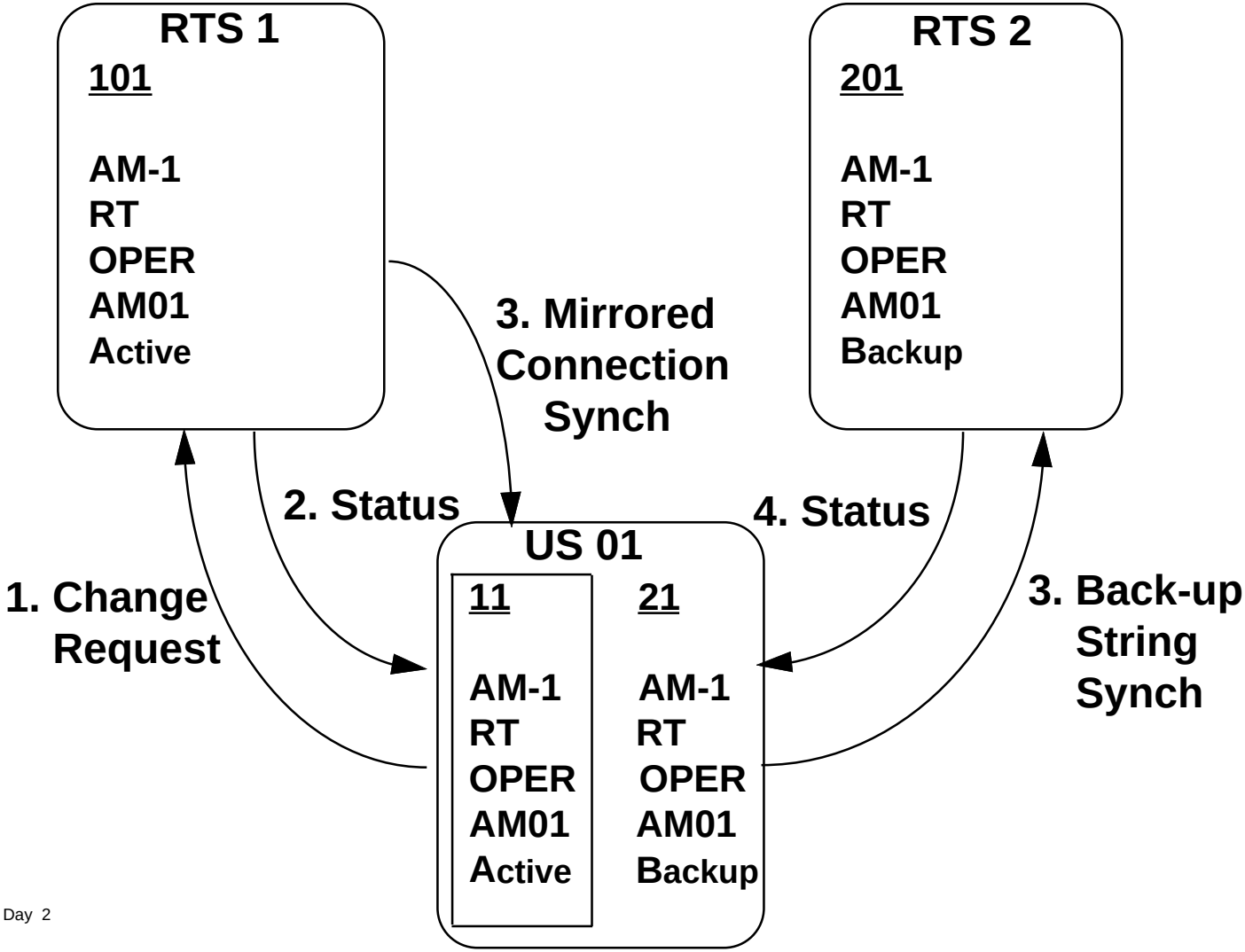
**Mirrored Connection Synchronization coordinated by RTS String Manager**

**EOC User must request Ground Control Privilege prior to successful change of ground configuration**

**Procedure:**

- **US String Manager verifies that the requesting user has GC Privilege**
- **US String Manager forwards the request to the RTS String Manager**
- **RTS String Manager forwards the request to the responsible process**
- **Responsible process accepts the change and returns status**
- **RTS String Manager returns status to US String Manager**
- **IF TLM configuration change, RTS String Manager sends change request to US String Manager(s) responsible for Mirrored Connections**
- **US String Manager forwards change to RTS String Manager responsible for Back-up Logical String**

# Ground Configuration Change Synchronization Illustrated



# Failure Recovery

**Coordinated by US String Manager**

**Failure Recovery is an <u>automated</u> not automatic function**

**Failure Recovery directive can be initiated by EOC Users with mirrored connection to the "failed" logical string and the Ground Control Privilege**

**String Manager Processes on 2 RTSs respond to direction**

- **ACTIVE process statuses change to INACTIVE**
- **BACKUP process statuses change to ACTIVE**

**Users with mirrored or tailored connections will be automatically connected to the new ACTIVE string**

**ECL Directive Example**

- **STRING FAILOVER 101 201**

# Failure Recovery Illustrated

| | RTS 1 | | RTS 2 | | RTS 3 |
|---|---|---|---|---|---|
| String ID | 101 | 102 | 201 | 202 | 301 |
| Mission ID | AM-1 | PM-1 | AM-1 | AM-1 | PM-1 |
| Data Source | RT | RT | RT | Replay | RT |
| Mode | OPER | OPER | OPER | | OPER |
| Oper. Data ID | AM01 | PM02 | AM01 | AM01 | PM02 |
| State | Active | Backup | Backup | | Active |

US 01

| | | | | | |
|---|---|---|---|---|---|
| String ID | 101 | 102 | 201 | 202 | 301 |
| Mission ID | AM-1 | PM-1 | AM-1 | AM-1 | PM-1 |
| Data Source | RT | RT | RT | Replay | RT |
| Mode | OPER | OPER | OPER | | OPER |
| Oper. Data ID | AM01 | PM02 | AM01 | AM01 | PM02 |
| State | Inactive | Backup | Active | | Active |

# String Manager Design Summary

**String Manager Process Key Responsibilities**

- **Logical String Management**
- **User Connection**
- **Backup Processing Synchronization**
- **Failure Recovery**

**String Manager Features**

- **Service Oriented**
- **Role Based**

# Real-Time Task Distribution Process Map

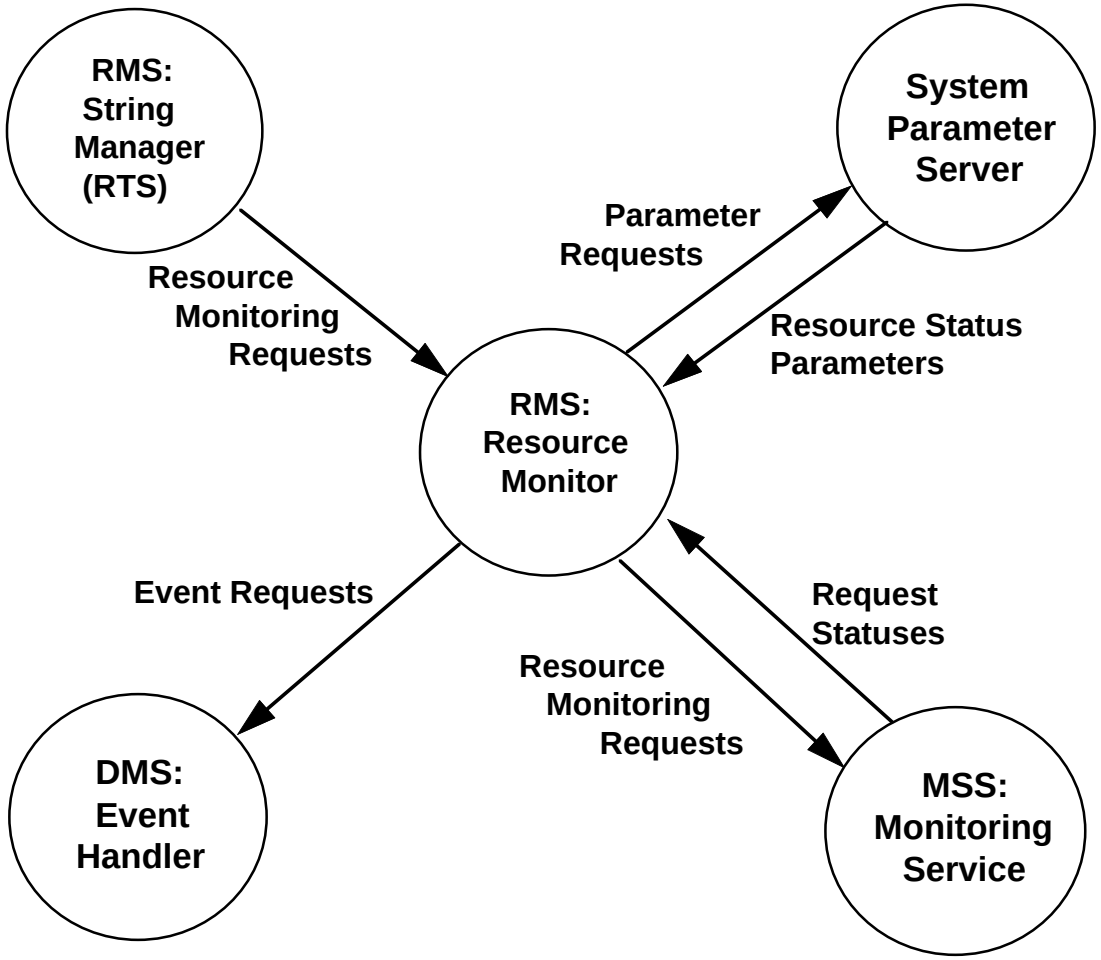
| Real-Time Server | Data Server | User Station | IST |
|---|---|---|---|
| String Manager<br>**Resource Monitor**<br><br>NCC Input<br>NCC Output<br>EDOS Input<br>EDOS Output<br><br>Format Command<br>FOP Command<br>Transmit Command<br><br>Decom<br>Memory Dump<br>State Check<br>Parameter Server | | String Manager<br><br>Decom<br>Parameter Server | String Manager<br><br>Decom<br>Parameter Server |
| COTS | | COTS | COTS |

# Resource Monitor Process Features

**Resource status received upon request from System Parameter Server (String Manager process not burdened with status I/O)**

**Tracks responsibilities of EOC resources and issues an event message in the event of a failure**

# Resource Monitor Context Diagram



# Resource Monitor Design

**Receives monitoring requests from String Manager (RTS)**

- **when a new software resource is created**
- **when a privilege is granted to a user**

**Registers new software resources for monitoring by MSS Monitoring Service**

**Registers interest in critical hardware and software resources with the Parameter Server**

**Receives notification of updates in resource statuses from the System Parameter Server**

**Issues “Smart” event messages upon failure**

# Resource Monitor Design Summary

**Resource Monitor Process Key Responsibilities**

- **Registration of Critical Processes for Monitoring**
- **Registering interest in Critical HW and SW status changes**
- **Receive Notification of Changes of HW and SW statuses**
- **Issues “Smart” Event messages upon failure**

**Resource Monitor process and System Parameter Server interface used to lighten load on RMS String Manager**

# Real-Time Contact Management

## Carrie Williams

**17 October 1995**

# Real-Time Task Distribution Process Map

| Real-Time Server | Data Server | User Station | IST |
|---|---|---|---|
| String Manager<br>Resource Monitor<br><br>NCC Input<br>NCC Output<br>EDOS Input<br>EDOS Output<br><br>Format Command<br>FOP Command<br>Transmit Command<br><br>Decom<br>Memory Dump<br>State Check<br>Parameter Server | | String Manager<br><br>Decom<br>Parameter Server | String Manager<br><br>Decom<br>Parameter Server |
| COTS | | COTS | COTS |

# Real-Time Contact Management Subsystem Overview

**Driving Requirements**

- Receive and process messages from NCC during contact
- Send request messages to NCC during contact
- Receive and process status messages from EDOS during contact
- Send messages to EDOS during contact
- Serve incoming message contents to users

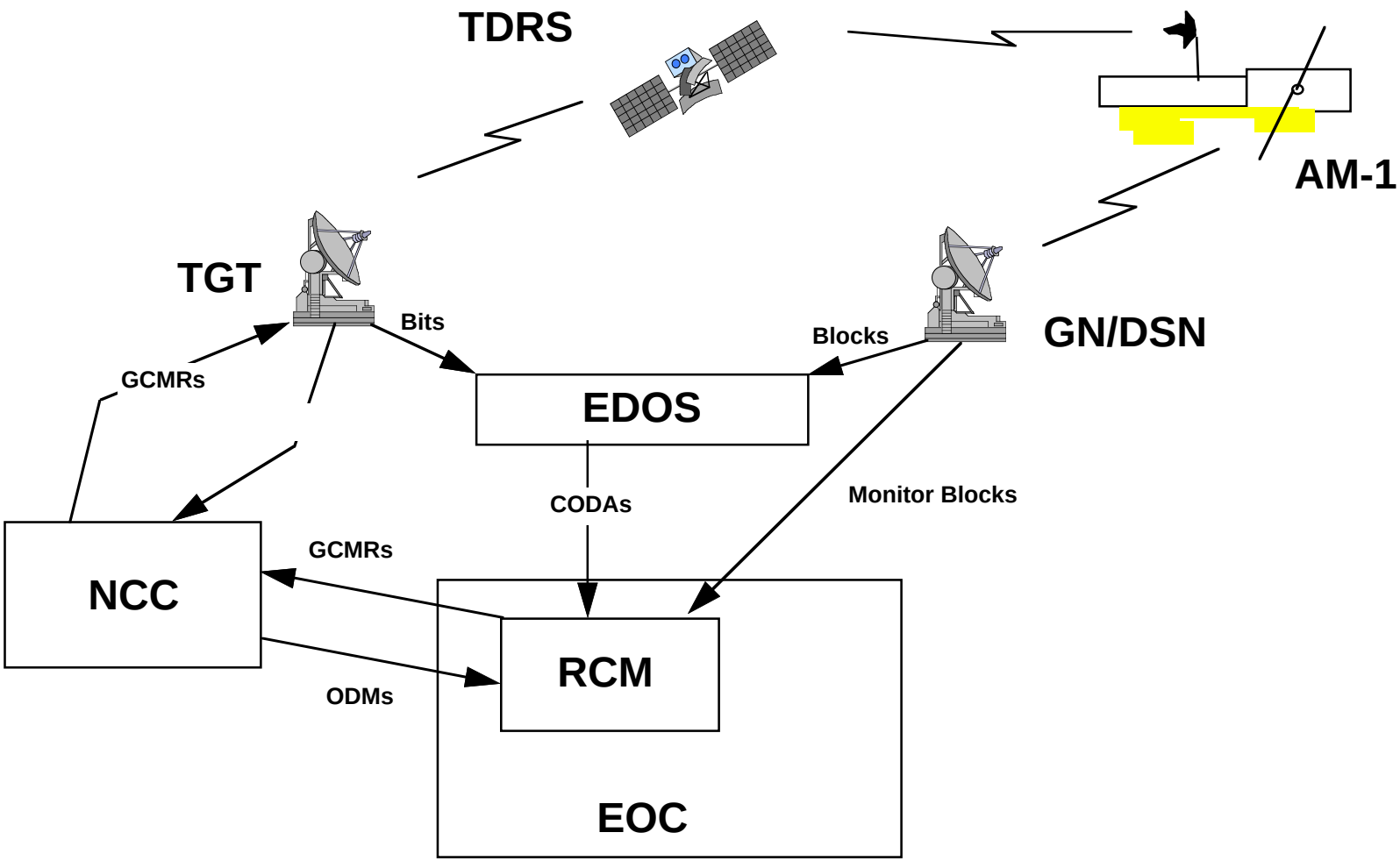
**Analyses Performed**

- Extensive study of a proven design: TPOCC Polar Project

**Design Goals**

- Adaptability to changing requirements

# RCM External Functional Flow Diagram



# Real-Time Contact Management Subsystem Features

**Modular Design**

- **Output Component created and configured by RMS String Manager**
- **Input Component created and configured by RCM Output Component**
- **Incoming and outgoing messages handled by separate processes**
  - **Isolates internal and external interfaces**
  - **Easy to adapt to requirements changes**
- **Message definitions embedded in message objects**
- **Operational data file used for definition of incoming and outgoing message objects**

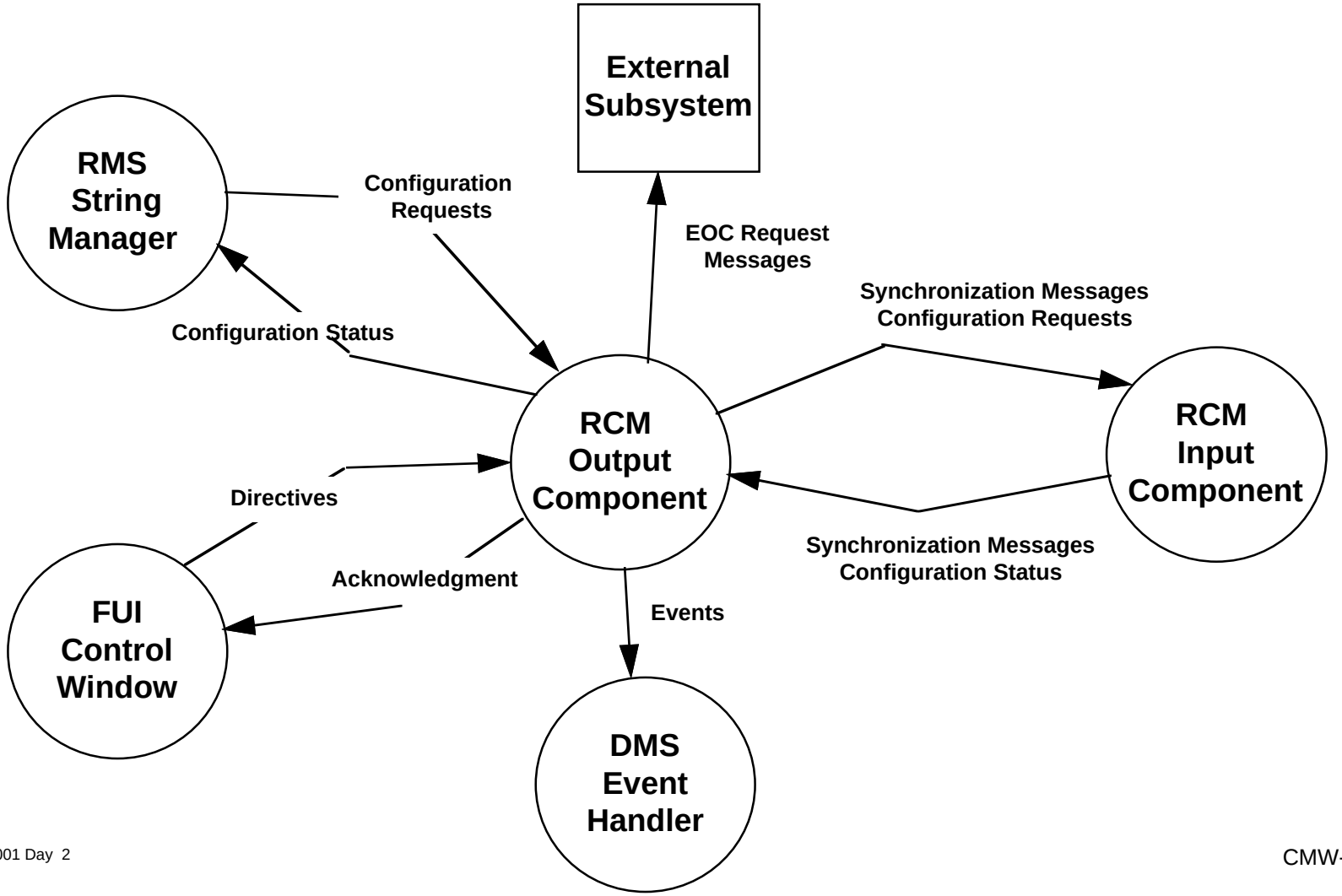
**Input Components capable of processing historical as well as real-time external interface messages**

# RCM Output Component Description

**Handles outgoing messages to external interfaces**

- **Formulates outgoing messages based on user requests**
- **Ensures that outgoing messages conform to external ICD**
- **Stores outgoing messages for possible re-transmission (if applicable)**
- **Sends synchronization messages to corresponding Input Component (if applicable)**
- **Starts Timer to wait for acknowledgment from corresponding Input Component (if applicable)**

# RCM Output Component Context Diagram



# RCM Input Component Description

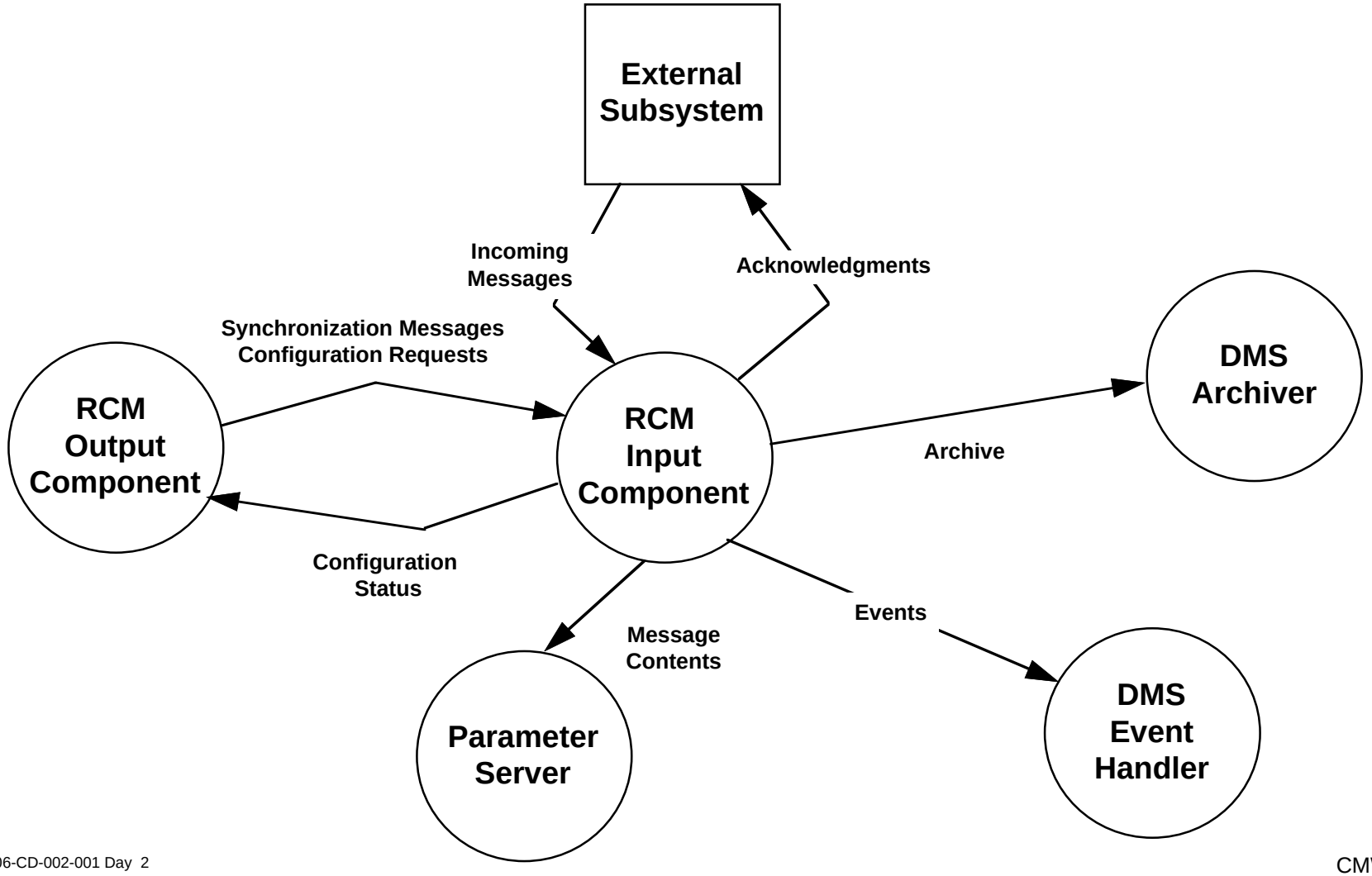
**Handles incoming messages from external interfaces**

- **Archives incoming messages to DMS Archiver**
- **Validates incoming messages**
- **Assembles multi-block messages (if applicable)**
- **Serves content of complete and valid incoming messages to users through Parameter Server**

**Capable of processing historical external interface messages**

- **for user display**
- **for input to user defined algorithms**

# RCM Input Component Context Diagram



# Real-Time Contact Management Design Summary

**Accommodates established external interfaces such as NCC**

**Adapts to developing external interfaces such as EDOS**

**Modular design allows**

- **add/delete message objects**
- **change structure of existing message object**
- **add/change communication message layer**
- **add/delete external interface support**