

# DAP Prototype Test Bed Requirements

November 23, 1998

## Outline

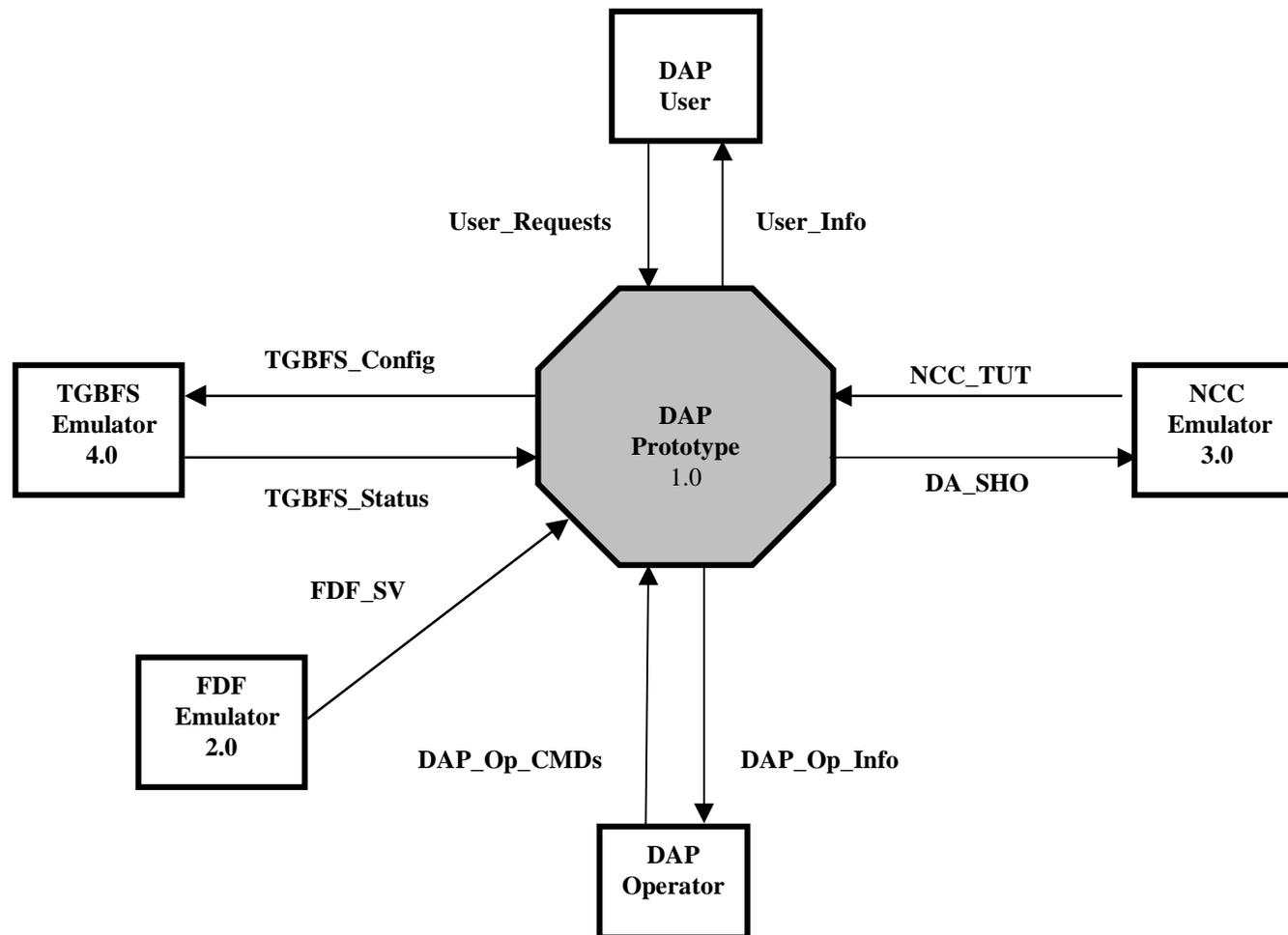
- Underlying assumptions behind requirements
- DAP Prototype Function and Interface Requirements
- DAP Prototype External Entity Requirements

## Requirements Assumptions

- Test bed consists of the DAP prototype and the emulators for the NCC, FDF, and TGBFS that are external entities that interact with the DAP
- DAP Users and the DAP Operator interact with the DAP to enter requests for MA services and to control the DAP, respectively
- DAP Users can obtain MA service planning information from the DAP
- DAP Prototype does not process real or simulated MA forward and return data
- DAP Prototype demonstrates only the control and networking aspects of a fully operational DAP
- Only the DAP User interface is GUI based

# **DAP Prototype Function and Interface Requirements**

# DAP Prototype Function (1.0) Requirements External Data Flow Diagram



## DAP Prototype (1.0) Processing Requirements

- For each DAP User, the DAP Operator, NCC, FDF, and TGBFS Emulator input, the DAP Function responds in the following manner:
  - If a request for service planning information is received from the DAP User, the function does the following:
    - > Responds to DAP User requests for service planning information with planning information reports derived from satellite visibility and resource availability analysis
    - > Supports DAP Users with automated DA service planning information to lessen the user's burden of decision making in setting up services
  - If the DAP User requests a DA service, the function does the following:
    - > Checks to ensure that the DA service request specifications can be implemented
    - > Implements valid user requests for DAF or DAR service in the following ways:
      - Users are serviced on a first come, first served basis
      - If DAF request is being implemented, the function does the following:
        - Constructs and sends DA forward link service requests to the NCC Emulator for implementation as a MAF service

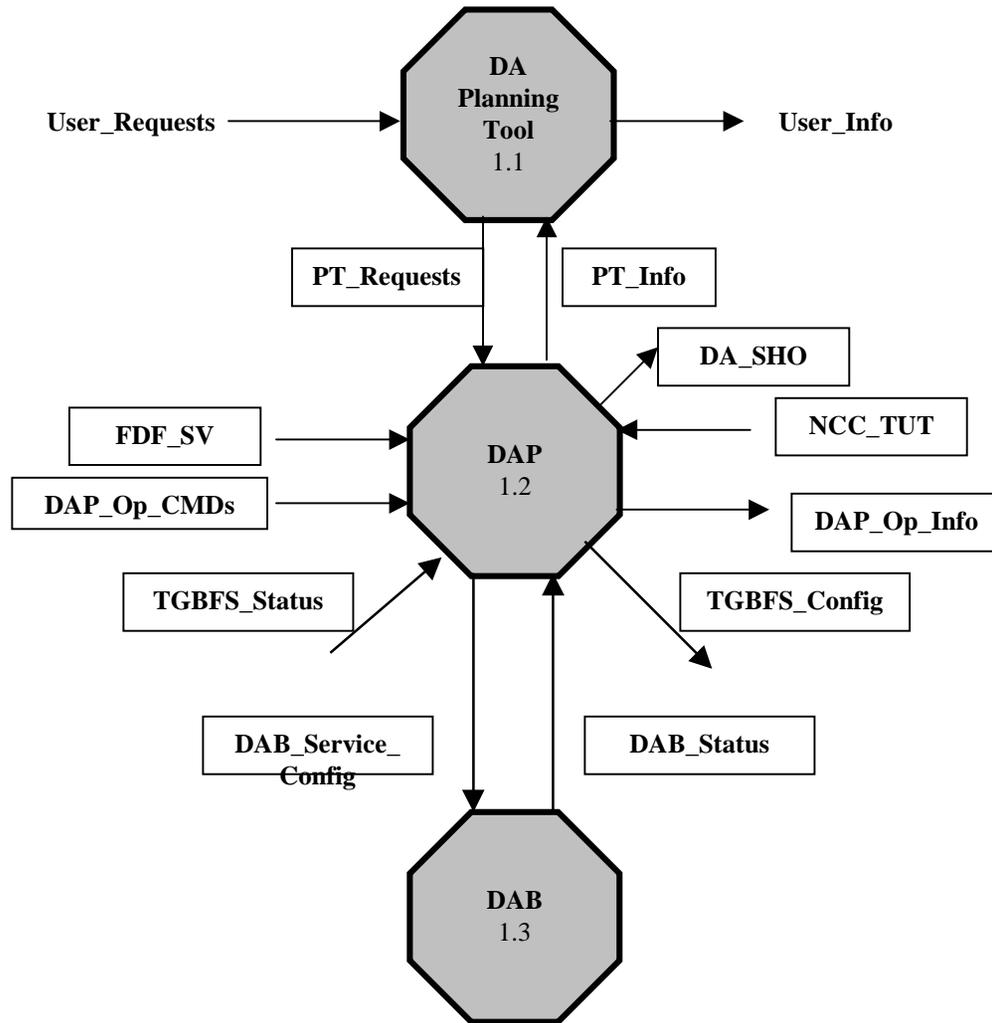
## DAP Prototype (1.0) Processing Requirements (Continued)

- Sends NCC Emulator coordinated DAF status reports to the DAP User
- If a system control request is received from the DAP Operator, the function does the following:
  - > Transforms DAP Operator requests for system control operations (start up, configure, and terminate) into the appropriate system responses
  - > Collects status information from the NCC and TGBFS Emulators and display status reports for the DAP User and Operator
- If TUT schedule or satellite state vector updates are received, the function does the following:
  - > Uses TUT schedule updates for the satellite visibility assessments that support planning information and service requests
  - > Propagates satellite state vectors for the satellite visibility assessments that support planning information and service requests

# DAP Prototype Function (1.0) External Interface Requirements

DATA FLOW NAME	SOURCE	DESTINATION	CONTENTS
DA_SHO	DAP Prototype Function (1.0)	NCC Emulator	<ul style="list-style-type: none"> <li>• Requests for normal MAF service within the TUT schedule</li> <li>• TDRSS and DAF resource reports</li> </ul>
DAP_Op_CMDS	DAP Operator	DAP Prototype Function (1.0)	<ul style="list-style-type: none"> <li>• DAP system configuration data</li> </ul>
DAP_Op_Info	DAP Prototype Function (1.0)	DAP Operator	<ul style="list-style-type: none"> <li>• System configuration and status reports</li> </ul>
FDF_SV	FDF Emulator	DAP Prototype Function (1.0)	<ul style="list-style-type: none"> <li>• USAT and TDRSS state vectors</li> </ul>
NCC_TUT	NCC Emulator	DAP Prototype Function (1.0)	<ul style="list-style-type: none"> <li>• TUT schedules</li> </ul>
TGBFS_Config	DAP Prototype Function (1.0)	TGBFS Emulator	<ul style="list-style-type: none"> <li>• MAR service hardware and software configuration data</li> <li>• TGBFS system configuration data</li> </ul>
TGBFS_Status	TGBFS Emulator	DAP Prototype Function (1.0)	<ul style="list-style-type: none"> <li>• TGBFS service and equipment status</li> </ul>
User_Requests	DAP User	DAP Prototype Function (1.0)	<ul style="list-style-type: none"> <li>• Planning information and DA service requests in GUI presentation data format</li> </ul>
User_Status	DAP Prototype Function (1.0)	DAP User	<ul style="list-style-type: none"> <li>• Planning information in GUI presentation format</li> <li>• DA service status in GUI format</li> </ul>

# DAP Prototype Function (1.0) Requirements Decomposition



## DA Planning Tool Function (1.1) Processing Requirements

- For each DAP User request, the DA Planning Tool Function (1.1) responds in the following manner:
  - If a DAP User service planning information request is received, the function does the following:
    - > Transforms planning information request data accepted from user friendly GUI forms and data files into internal DAP representation for transmission to the DAP Function (1.2)
  - If a DAP User service request is received, the function does the following:
    - > Accepts DAP service request data from user friendly GUI forms for internal DAP representation for use by the DAP Function (1.2)
    - > If a report is received from the DAP Function (1.2), the function does the following:
      - > Accepts system status reports indicating acknowledgements to user requests, service progress reports, DAP run-time performance monitoring reports from the DAP Function (1.2) and displays for the DAP User

## **DA Planning Tool Function (1.1) Processing Requirements (Continued)**

- > Accepts service request response data from the DAP Function (1.2) in internal DAP representation and formats that as reports for presentation on GUI forms
- > Transforms planning information request response data from the DAP Function (1.2) in internal DAP representation and formats that as reports for presentation on GUI forms

# Planning Tool Function (1.1) Interface Requirements

DATA FLOW NAME	SOURCE	DESTINATION	CONTENTS
PT_Info	DAP Function (1.2)	DA Planning Tool Function (1.1)	<ul style="list-style-type: none"> <li>• Planning data in GUI format</li> <li>• Service status reports</li> </ul>
PT_Requests	DA Planning Tool Function (1.1)	DAP Function (1.2)	<ul style="list-style-type: none"> <li>• Planning information request in DAS internal format</li> <li>• DA service requests in DAS internal format</li> </ul>
User_Requests	DAP User	DAP Prototype Function (1.0)	<ul style="list-style-type: none"> <li>• Planning information and DA service requests in GUI presentation data format</li> </ul>
User_Status	DAP Prototype Function (1.0)	DAP User	<ul style="list-style-type: none"> <li>• Planning information in GUI presentation format</li> <li>• DA service status in GUI format</li> </ul>

## DAP Function (1.2) Processing Requirements

- For each DA Planning Tool Function (1.1), DAP Operator, DAB Function (1.3), as well as the NCC, FDF, and TGBFS Emulator input, the DAP Function responds in the following manner:
  - If DA User planning information request is received from the DA Planning Tool Function (1.1), the DAP function does the following:
    - > Accepts the planning information request specifications and optional user defined satellite visibility constraints
    - > Assesses the validity of the requests for DA User planning information
    - > Analyze TDRSS resource availability, TUT schedules, and satellite visibility information to provide planning information that meets the constraints of the request
    - > Issues the results of the request analysis as planning reports to the DA Planning Tool Function (1.1)
  - If DAP User DAF or DAR service request is received from the DA Planning Tool Function (1.1), the DAP function does the following:
    - > Accepts the service request specifications and optional user defined satellite visibility constraints on a first come, first serve basis

## DAP Function (1.2) Processing Requirements (Continued)

- > Assesses the validity of the DA service request by analyzing TDRSS resource availability, TUT schedules, and satellite visibility information to provide planning information that meets the constraints of the request
- > Processes valid service requests in the following manner:
  - If the request is for a DAF service, the function does the following:
    - Orchestrates the implementation of DA forward service by providing service configuration specifications to the NCC Emulator via a SHO-like service request and sends to the DAB Function (1.3)
  - If the request is for a DAR service using DA equipment, the function does the following:
    - Orchestrates the implementation of DA return services by providing service configuration specifications to the NCC and TGBFS Emulators as well as the DAB Function (1.3)
    - Considers requests for shared return service equipment based on its availability
    - Controls the beamforming and TGBFS Emulator and the DAB Function (1.3), respectively, during DAR service operations
    - Reports DAP TDRSS resource utilization to the NCC Emulator

## DAP Function (1.2) Processing Requirements (Continued)

- If the request is for a DAR service using existing MAR equipment, the function does the following:
  - Orchestrates the implementation of DA return services by providing service configuration specifications to the NCC via a SHO-like service request
- If TUT schedules and satellite state vectors are received from the NCC and FDF, respectively, the function does the following:
  - > Propagates or interpolates updated TDRSS spacecraft and USAT state vectors and ephemerides, respectively, to obtain spacecraft positions as a function of time and record ephemerides in the DAP Database
  - > Sends the instantaneous direction sine and cosine user data associated with each USAT-TDRS geometry to the TGBFS Emulator
  - > Processes TUT schedules to determine DAF service availability and records them in the DAP Database

## **DAP Function (1.2) Processing Requirements (Continued)**

- If DAP Operator system control request is received, the function does the following:
  - > Assesses the validity of the request
  - > Orchestrates DAP Operator system control, test, and configuration request activities among the DAP functions for each SGLT with a DAP equipment implementation
- If TGBFS Emulator or DAB Function (1.3) status reports are received, the function does the following:
  - > Constructs performance monitoring status reports and sends them to the DA Planning Tool Function (1.1)
  - > Constructs and sends service progress status reports to the DA Planning Tool Function (1.1)
  - > Constructs system control reports and sends them to the DAP Operator

## DAP Function (1.2) Interface Requirements

DATA FLOW NAME	SOURCE	DESTINATION	CONTENTS
DA_SHO	DAP Prototype Function (1.0)	NCC Emulator	<ul style="list-style-type: none"> <li>Requests for normal MAF service within the TUT schedule</li> <li>TDRSS and DAF resource reports</li> </ul>
DAP_Op_CMDS	DAP Operator	DAP Prototype Function (1.0)	<ul style="list-style-type: none"> <li>DAP system configuration data</li> </ul>
DAP_Op_Info	DAP Prototype Function (1.0)	DAP Operator	<ul style="list-style-type: none"> <li>System configuration and status reports</li> </ul>
FDV_SV	FDV Emulator	DAP Prototype Function (1.0)	<ul style="list-style-type: none"> <li>USAT and TDRSS state vectors</li> </ul>
NCC_TUT	NCC Emulator	DA Planning Tool Function (1.1)	<ul style="list-style-type: none"> <li>TUT schedules</li> </ul>
PT_Info	DAP Prototype Function (1.0)	DA Planning Tool Function (1.1)	<ul style="list-style-type: none"> <li>Planning data in GUI format</li> <li>Service status reports</li> </ul>
PT_Request	DA Planning Tool Function (1.1)	DAP Prototype Function (1.0)	<ul style="list-style-type: none"> <li>Planning information request in DAS internal format</li> <li>DA service requests in DAS internal format</li> </ul>
TGBFS_Config	DAP Prototype Function (1.0)	TGBFS Emulator	<ul style="list-style-type: none"> <li>MAR service hardware and software configuration data</li> <li>TGBFS configuration data and direction cosines</li> </ul>
TGBFS_Status	TGBFS Emulator	DAP Prototype Function (1.0)	<ul style="list-style-type: none"> <li>TGBFS service and equipment status</li> </ul>

## DAP Function (1.2) Interface Requirements (Continued)

DATA FLOW NAME	SOURCE	DESTINATION	CONTENTS
DAB_Service_Config	DAP Prototype Function (1.0)	DAB Function (1.3)	<ul style="list-style-type: none"> <li>• DA service buffering, formatting, and routing specifications</li> <li>• DAB Function system control request specifications</li> <li>• DAB Function test request specifications</li> </ul>
DAB_Status	DAB Function (1.3)	DAP Prototype Function (1.0)	<ul style="list-style-type: none"> <li>• DA service buffering, formatting, and routing status reports</li> <li>• DAB Function performance monitoring and fault isolation reports</li> </ul>

## DAB Function (1.3) Processing Requirements

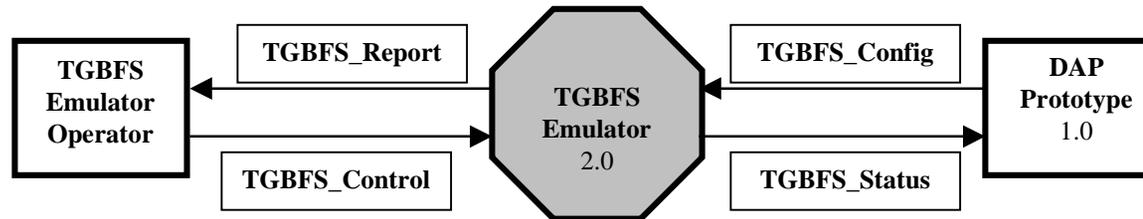
- For each service configuration request the DAB Function responds in the following manner:
  - If a service configuration request is received, the function does the following:
    - Simulates the implementation of the specifications for forward and return link data buffering, formatting, and routing
    - Constructs buffering, formatting, and routing status reports and sends them to the DAP Function (1.2)

## DAB Function (1.3) Interface Requirements

DATA FLOW NAME	SOURCE	DESTINATION	CONTENTS
DAB_Service_Config	DAP Prototype Function (1.0)	DAB Function (1.3)	<ul style="list-style-type: none"> <li>• DA service buffering, formatting, and routing specifications</li> <li>• DAB Function system control request specifications</li> <li>• DAB Function test request specifications</li> </ul>
DAB_Status	DAB Function (1.3)	DAP Prototype Function (1.0)	<ul style="list-style-type: none"> <li>• DA service buffering, formatting, and routing status reports</li> <li>• DAB Function performance monitoring and fault isolation reports</li> </ul>

# **DAP Prototype Function (1.0) External Entity Requirements**

# TGBFS Emulator Function (2.0) Processing Requirements

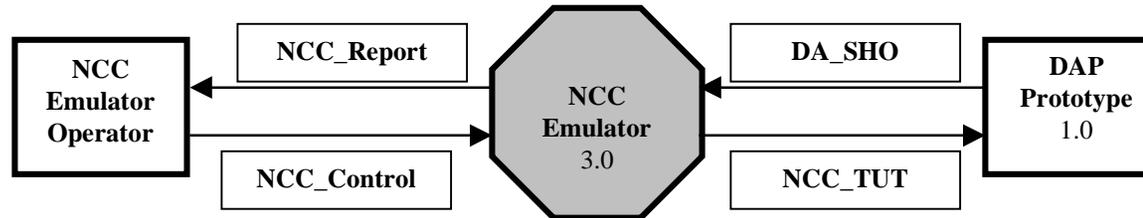


- If a control request is received from the TGBFS Emulator Operator, the function starts or terminates depending on the request specifications
- If a configuration request is received from the DAP Prototype Function (1.0), one of the following is performed:
  - Updates and maintains a database of simulated TGBFS equipment status
  - Accepts TDRS and USAT state vectors and propagates them with a simple two-body propagator and stores them in a local database
  - Exports state vector propagation results
- Displays locally to the TGPFS Emulator Operator the results of each of the emulator's activities

# TGBFS Emulator Function (2.0) Interface Requirements

DATA FLOW NAME	SOURCE	DESTINATION	CONTENTS
TGBFS_Config	DAP Prototype Function (1.0)	TGBFS Emulator Function (2.0)	<ul style="list-style-type: none"><li>• TGBFS equipment and DA service configuration data</li><li>• TGBFS equipment test requests</li></ul>
TGBFS_Control	TGBFS Emulator Operator	TGBFS Emulator Function (2.0)	<ul style="list-style-type: none"><li>• Emulator control specifications</li></ul>
TGBFS_Report	TGBFS Emulator Function (2.0)	TGBFS Emulator Operator	<ul style="list-style-type: none"><li>• Emulator status</li><li>• Propagated ephemerides</li></ul>
TGBFS_Status	TGBFS Emulator Function (2.0)	DAP Prototype Function (1.0)	<ul style="list-style-type: none"><li>• TGBFS equipment performance monitoring and fault isolation reports in internal DAS format</li></ul>

## NCC Emulator Function (3.0) Processing Requirements

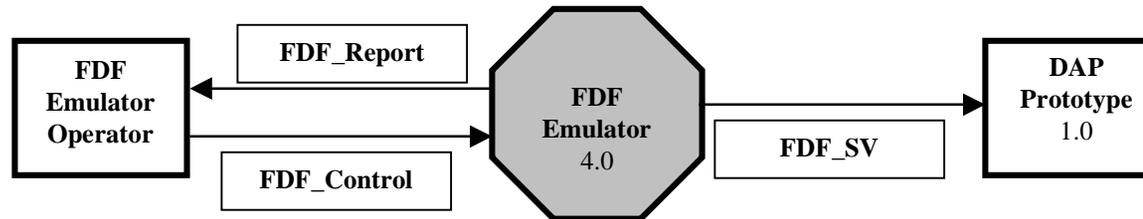


- If a control message from the NCC Emulator Operator, one of the following processing steps is performed:
  - Starts or terminates processing operations
  - Accepts NCC TUT for local database storage
  - Retrieves stored NCC TUT and sends it to the DAP Prototype Function (1.0)
  - Reports NCC Emulator status to the NCC Emulator Operator
- If a SHO-like message is received from the DAP Prototype Function (1.0), one of the following is performed:
  - Simulates the scheduling of the MAF request and reports the status of the MAF service to the DAP Prototype Function (1.0)

# NCC Emulator Function (3.0) Interface Requirements

DATA FLOW NAME	SOURCE	DESTINATION	CONTENTS
NCC_TUT	NCC Emulator Function (3.0)	DAP Prototype Function (1.0)	<ul style="list-style-type: none"> <li>• Daily NCC TUT schedules for DAF allocation use</li> <li>• Status of DAF service requests</li> <li>• Status of existing MAR equipment DAR service requests</li> </ul>
DA_SHO	DAP Prototype Function (1.0)	NCC Emulator Function (3.0)	<ul style="list-style-type: none"> <li>• Requests for normal MAF service within the TUT schedule</li> <li>• Requests for existing MAR equipment chain to support DAR services</li> <li>• TDRSS resource reports</li> </ul>
NCC_Report	NCC Emulator Function (3.0)	NCC Emulator Operator	<ul style="list-style-type: none"> <li>• Emulator status</li> </ul>
NCC_Control	NCC Emulator Operator	NCC Emulator Function (3.0)	<ul style="list-style-type: none"> <li>• NCC TUT schedules</li> <li>• Commands to send TUT schedules</li> <li>• System control commands</li> </ul>

## FDF Emulator Function (4.0) Processing Requirements



- If a control request is received from the FDF Emulator Operator, one of the following processing steps are performed:
  - Starts or terminates processing operations
  - Accepts TDRS or USAT state vectors for local database storage
  - Generates simulated attitude correction data
  - Propagates the satellite state vector using a  $J_2$  two-body propagator
  - Stores propagated state vectors and ephemerides in local database
  - Retrieves and forwards state vectors and ephemerides to the DAP Prototype Function (1.0) on FDF Emulator Operator command
  - Displays locally to the FDF Emulator Operator the results of each of the emulator's activities

# FDF Emulator Function (4.0) Interface Requirements

DATA FLOW NAME	SOURCE	DESTINATION	CONTENTS
FDF_SV	FDF Emulator Function (4.0)	DAP Prototype Function (1.0)	<ul style="list-style-type: none"><li>• Satellite state vectors and ephemerides</li><li>• Attitude correction data</li></ul>
FDF_Report	FDF Emulator Function (4.0)	FDF Emulator Operator	<ul style="list-style-type: none"><li>• Emulator status</li></ul>
FDF_Control	FDF Emulator Operator	FDF Emulator Function (4.0)	<ul style="list-style-type: none"><li>• Satellite state vectors</li><li>• System control commands</li></ul>