Fallback from NCC 98 to NCC 97

Options and Recommendation

February 4, 1998

Fallback from NCC 98 to NCC 97

Options and Recommendation

Introduction

The goal of this paper is to describe what a fallback of Network Control Center (NCC) operations from NCC 98 to NCC 97 is, the conditions under which it may be required, suggested operational constraints that would make fallback easier, the procedures and software necessary to accomplish it, and the cost/effectiveness of implementing these procedures.

General Concepts

Fallback of Space Network (SN) operations to NCC 97 means to restore the SN NCC operations to the current baseline system, after a partial or complete transition to the new NCC 98 system. The fallback procedures would be instituted by NCC operations based on some criteria of failure of NCC 98. After the determination of failure, there would be a preparation for transfer of operations back to NCC 97, such as preparing the NCC 97 database, configuring the internal LANs to the NCC 97 configuration, and preparing operations to move back to the NCC 97 workstations.

The criteria for determining that a fallback is necessary will be developed as part of the transition planning. Some obvious conditions are: major subsystem(s) becomes inoperable; database becomes inconsistent; performance becomes unacceptable.

The normal mechanisms of advising the SN of NCC status, freezing of requests, etc. would be used to keep the SN elements aware of the state of the NCC during a fallback. Operations would be restored on NCC 97 after the appropriate segment databases were configured and the system started.

The degree of effort required in a fallback depends on when in the transition the fallback is initiated. This is discussed further below.

Fallback Scenarios

There are three time frames in which different fallback procedures would be performed; these are described below. The discriminator for these time frames is the degree of change between the current SN schedule and the schedule before the transition. As time progresses and more features of NCC 98 come into operations, the divergence between the pre-transition schedule and the current schedule and operations increases. After a significant period of NCC 98 operations (three weeks or more), it is unlikely that any problem that occurs would be solved by a fallback rather than a fix to NCC 98.

Fallback during Transition

The first fallback timeframe is during the transition to the NCC 98, when the NCC is frozen or shortly after it resumes normal operations. The significant point here is that the schedule and vector information in the NCC database is the same on both systems and no special software or procedures are necessary. A fallback in this situation is accomplished by "disconnecting" NCC 98 from the external network and "reconnecting" NCC 97 to it. If the transition is to a separate string of equipment (as is usually the case), this may not require more than changing tables in a front-end router. NCC 97 should be left up but in a "disconnected" state; after the external network connections are made, the system would be brought back on line by enabling the external sites and the input functions of NCC 97. If equipment is shared by both NCC 97 and NCC 98 (besides the router), additional time would be required to reconfigure the shared equipment. There is also time required for the operational personnel to move from the NCC 98 workstations back to the NCC 97 workstations (ITS).

It may be useful to freeze the active period after transition for a longer time (a day or so if feasible) to get more experience with NCC 98 and to make the fallback easier if necessary.

After limited active period changes

The second fallback timeframe is when the NCC 98 has been on-line sufficiently long for some changes to have been made to the active schedule by the external MOCs (for mission support reasons), but not to the extent that the changes cannot be retransmitted by the MOCs or otherwise reentered. In this case the fallback can be as described above, but after NCC 97 is back on-line, the schedule changes (schedule adds or deletes) will be entered.

After extensive schedule changes

After the NCC 98 has scheduled a number of requests with some flexibility, or after a complete schedule generation period, and schedule messages have been distributed, a fallback is most easily implemented by performing a database migration from NCC 98 to NCC 97. Because of the different scheduling algorithms used in NCC 97 and NCC 98, the same SARs cannot be simply sent to NCC 97 for scheduling to recreate the distributed NCC 98 schedule. It would be very difficult to try to match the events scheduled by each system with the matching SARs and somehow communicate this information to the MOCs so that the MOCs' databases would be correct.

The fallback database migration is like the transition migration in reverse. It is somewhat easier, in that the recommended constraints below will keep the two databases from diverging much; primarily the SARs and events will be migrated. The analysis in Appendix A describes in detail the database migration necessary from NCC 98 to NCC 97.

One possible alternative to fallback database migration is to keep restrictions on flexibility for a longer period of time and run NCC 97 in parallel with NCC 98, with a technique similar to the "shadowing" testing described later. This approach may work for a limited time, but the conflict resolution done during the schedule generation period would have to be repeated on the NCC 97, and the whole process may become too much operator-intensive and prone to errors. This approach is not considered further in this paper.

Another alternative is to do the fallback in the same way as for the second case above, and accept the additional work required to get the SN back to normal operations. This scenario would be supported by keeping the CCS active schedule as full as possible by transmitting SHOs up to the capacity of the ground terminals (600 per ground terminal), which would cover several days of support.. The fallback would be done by transferring the CCS event data from NCC 98 to NCC 97, so that ongoing events and events in the next several days could be supported even without the SPS (Unisys) database. This time would be used for the customers to retransmit their requests (changes to existing CCS schedule, those in the active period that are further in the future than the existing CCS schedule, and those for the forecast period) and for the NCC operator to generate a forecast schedule if necessary.

Suggested Operational Constraints

To reduce the divergence of the two databases in the initial phase of NCC 98 operation, a number of constraints are recommended. The following paragraphs list those constraints that will minimize the problems of fallback. A transition period of approximately three weeks will let the SN gain experience with the NCC 98; this will cover receiving forecast period SARs, generating schedules and having the events go active. After that period the network can move to using more of the features of NCC 98.

Limit Space Network Changes

This analysis assumes that the timing of the transition can be controlled so that no major network and customer changes will occur during the first few weeks of the transition. This will minimize or eliminate the need to migrate changes to the static data base to NCC 97.

The User Planning System (UPS) for NCC 98 does not support the NCC 97 message formats. To avoid customers having to fallback to UPS 97, they should not transition to UPS 98 until the time frame for the possibility of fallback to NCC 97 has been passed.

Restrict use of NCC 98 Features

To avoid features that are not supported by the baseline system, the following restrictions are recommended:

- No full support customers (e.g., no flexible requests)
- No TDRS sets used
- Avoid use of multiple batch schedules in forecast period.
- Keep requests out of invalid or late queues.

Limit Schedule Changes

To minimize the number of changes that are made to the active schedule, the transition should be planned to occur when there are no spacecraft launches or early mission operations. In particular, Shuttle launches and Shuttle mission support frequently cause many changes to the schedule because of launch slips and maneuvers during flight operations.

Retransmit Vectors

In common with other forward migrations, it is assumed that vectors can be retransmitted after a fallback, rather than being migrated. This eliminates the cost of software to do the migration, and eliminates the possibility of error in such software. This assumes that the transition will occur when there are no spacecraft launches, and that any effects of Delta-T adjustments can therefore be ignored.

Keep CCS Active Schedule Database Full

As described earlier, one of the ways to keep the SN running if a fallback occurs is to keep as much as possible of the active schedule in CCS by transmitting SHOs to the ground terminals.

Implementation

The implementation of the fallback process for the first two timeframes discussed above is primarily a matter of developing procedures and details on how to configure and reconfigure the systems, particularly the network devices such as DNS servers, firewalls, and routers. This is somewhat the inverse of the procedures for the transition to NCC 98, and can be developed in parallel with little additional cost.

For the third timeframe discussed above, the reverse database migration requires custom software to be developed to extract the scheduled events and possibly also requests from the NCC 98 database and use it to create an NCC 97 database with the same information. This will require development of either SQL and Perl scripts and/or a special C/C++ program to extract the information from the Oracle database on NCC 98 and Unisys software to load the information into the Unisys DMS 1100 database. There is also a need for utilities to load miscellaneous other data items on the Unisys. Even if one of the other options for fallback in the third period is to be used, procedures to fall back in this period must be developed and tested (including external customers).

For implementing the reverse database migration, a rough guess for the number of lines of code to be developed is 1000 DSI for the HP and 500 for the Unisys. Some of the HP code may be reused, thus reducing the amount of new code to be developed. There is also a cost in testing this new code, as well as the cost of testing the procedures in all three timeframes. There are plans to test the forward transition to NCC 98, but none to test fallback; additional testing resources must be identified to avoid a possible schedule impact on the transition to NCC 98.

Cost Effectiveness and Risk

Pre-transition Testing

The probability of a fallback should be very small because of the extensive quality control procedures and independent testing at segment, integration, system and acceptance test levels. The probability of a fallback is further reduced by the pre-transition testing activities of the OET. The NCC 98 will run in parallel with NCC 97 for a period of time, in a “shadowing” mode in which input to NCC 97 is also routed to NCC 98, but output from NCC 98 is sent to NTS for logging and review purposes. Because of the different scheduling algorithms used in

NCC 97 and NCC 98, this shadowing will be somewhat limited and manually intensive in analyzing the results. Ideally, it will be done for a period sufficient for generation of the forecast period and past the time when the generated events become active, and will include both normal and shuttle events. This use of real operational data will avoid a problem that occurred during a previous transition, when testing did not include a configuration that was used operationally and that resulted in a corrupted schedule. This shadowing will continue until the OET is satisfied with the functionality, stability and performance of NCC 98. Agreement on transition to NCC 98 will be decided at an Operational Readiness Review (ORR); NCC 98 will have to pass the detailed transition criteria for transition to take place.

Procedural Methods of Fallback

The cost of having the procedures in place for fallback in the first two timeframes is minimal; the major component of the cost is testing the procedures. Given the probability that a failure sufficient to require fallback is most likely to occur in the first few hours or days of operation, this seems to be a cost effective approach to reducing the risk of an NCC 98 failure.

Reverse Database Migration

For the third timeframe the situation is not so clear. Most of the NCC 98 components will have been successfully operating for a reasonable period, and thus the probability of a failure in those components is expected to be smaller (i.e., the subsystems are past the "infant mortality" stage). However, it is in this period that the events generated by the forecast schedule are created and become active, and problems with this area would first show up in this time frame.

The cost of implementing the reverse database migration for the fallback is significant, principally in the area of validation testing, an activitiy currently unplanned within the NCC 98 schedule. The probability of a failure occurring requiring a fallback is impossible to quantify, but the extensive testing planned should insure that it is very low. Since there are other contingencies for handling the impact of an NCC 98 failure (e.g., direct communication with the ground terminals for scheduling events, or falling back to NCC 97 with the CCS event data), a failure would not endanger any missions in the short term, and fallback to the NCC 97 by gradual retransmission of SARs could be accomplished as described above. The cost/effectiveness of the fallback database migration approach is low, and a decision on implementing this should be considered with regard to other needs of the NCC 98 project. Diverting resources to develop and test reverse database migration could inversely impact the necessary requirements, EIF and operational readiness testing and training already planned for NCC 98.

Recommendation

Based on the cost/effectiveness analysis above, NCC System Engineering recommends that procedural methods for falling back to NCC 97 be implemented, but the reverse database migration not be implemented. Pre-transition testing should include all operationally-supported customer configurations in schedule requests, and the events resulting from these requests should be followed over a time period from forecast schedule to the events going active. The suggested constraints on operations should be in effect for the first few weeks of NCC 98 operation; after that time, any problems with NCC 98 should be corrected through a workaround approach until a quick fix is available, rather than falling back to NCC 97.

Appendix A

NCC 98 to NCC 97 Database Fallback Analysis

The database fallback from NCC 98 (i.e., SPSR database) to NCC 97 (i.e., SPS database) requires SQL scripts on SPSR to write information to a file that can be read by either QLP scripts or FORTRAN programs on SPS to populate the SPS database. The following table lists the SPS database records and indicates how they are to be populated in case of a fallback.

NCC 97 Database Fallback Actions

NCC 97 Database Record	Fallback action	Comments
Configuration Codes	None - assume no change	
Prototype Events	None - assume no change	
SUPIDEN	None - assume no change	
Passwords	None - assume no change	
Schedule Distribution	None - assume no change	
Nascom Parameters	None - assume no change	
Service Type	None - assume no change	
Protocol	None - assume no change	
Site	None - assume no change	
Logon/Logoff	None - assume no change	
Database Control	None - assume no change	
TDRS Operational Names	None - assume no change	
Resource Model	None - assume no change	
DQM Parameters	None - assume no change	
TDRS/Ground Terminal Assignments	None - assume no change	
Schedule Request	Migrate from NCC 98	Flexibility parameters will be dropped
Events	Migrate from NCC 98	Events should be frozen
Services	Migrate from NCC 98	
SHO Information	Migrate from NCC 98	IDs for transmitted SHOs
Duty Factors	Rebuild from migrated services	
Resource Usage	Rebuild from migrated services	
Affected SHO List	Rebuild from SLRs messages resent from Ground Terminals at NCC request	
Vectors	Resend from MOCs, FDF	
CCS Static Data	Reload from save tape	
CCS Event Data	Reload from SPS after CCS cold start	

Appendix B

Equipment involved

The normal transition for NCC releases is to bring up the new release on a separate system (backup or DT&T). The NCC 98 transition should be done the same way; thus a nearly complete NCC 97 configuration will be available for fallback. The following table lists the equipment used in the NCC 97 operational configuration and what is required for fallback. Because the configuration is still changing, there are some TBD items. This table should be revised as more detailed transition plans are developed and the internal LANs and equipment configuration are defined.

Equipment in NCC 97 Configuration	To restore NCC 97 Configuration	Impact on NCC 98 Configuration
SPS (Unisys 2200)	Restore transition database or migrate from SPSR	Not used
CCS (VAX 8850)	Restore static data, reload dynamic data (events) from SPS.	Assume NCC 98 running on separate VAX
RAP	No change	Not used
ACRS	No change	Assume separate machine for ACRS 98
NFE	No change	Not used
Firewall	No change	Assume separate firewall used for NCC 98
DNS	No change	Assume separate DNS used for NCC 98
NPG	No change	Assume separate NPG used for NCC 98
ITS	No change	Not used for NCC 98
LAN configuration	Restore NCC 97 configuration (assume some cabling is common to both)	
External systems		
UPS	Customer must fall back to UPS 97 if UPS 98 is being used	
Other MOC Scheduling systems	TBD	
Nascom Routers	TBD	