

# Data Acquisition Processing and Handling Network Environment

## DAPHNE

### Software Classification Rationale

## 26 August 16

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### Background

The Near Earth Network (NEN) is a cornerstone mission within the Space Communications and Navigation (SCaN) program, dedicated to providing space-to-ground communication for near earth space missions. The NEN is comprised of tracking stations distributed throughout the world in locations including Svalbard, Norway; Kiruna, Sweden, Weilheim, Germany, Fairbanks, Alaska; Santiago, Chile; McMurdo, Antarctica; Wallops Island, Virginia; South Point, Hawaii; Dongara, Australia, Hartebeesthoek, South Africa, and White Sands, New Mexico. The NEN provides Telemetry, Tracking, and Commanding (TT&C) services to an extensive and diverse customer base, which includes approximately 35 space missions.

The Data Acquisition Processing and Handling Network Environment or DAPHNE is Phase 2 of an ongoing development effort to upgrade NEN's Data Transport Subsystem (DTS) and will significantly increase the telemetry data rates and storage volume that NEN can provide to its science satellite customers. The Data Transfer Subsystem separates telemetry data according to mission format and sends it to the Mission Operation Center (MOC) over the Communication Service Office data networks. The received telemetry data is buffered in the DTS to provide backup, as well as, to accommodate the data networks which may be slower than the incoming telemetry data.

The software was initially developed to support the Solar Dynamics Observatory (SDO). The software was then modified and enhanced under Phase 1, to support the Lunar Reconnaissance Orbiter (LRO) mission, Interface Region Imaging Spectrograph (IRIS) mission, and Soil Moisture Active Passive (SMAP) mission. The system was called the NEN Gateway or NENG for these missions and was deployed to the White Sands (WS1)

system, and to the McMurdo TDRSS Relay System (MTRS) Receive Ingest Portal (RIP) system. Phase 1 has provided years of highly reliable service for these missions already.

## Software Classification

The software will be managed in accordance with NPR 7150. The NPR gives management guidance according to various classifications levels. This documents recommends and provides justification for classification of the DAPHNE software project. The list of definitions of each software class taken from NPR 7150.2 is provided in the appendix:

## Recommendation

DAPHNE will implement “ground software that is used to analyze or process mission data,” which would suggest a C classification. However, for the reasons listed below, DAPHNE is inherently low risk, and the development team recommends a D classification for the software project.

- DAPHNE will be built on its proven Phase 1 predecessor. The original units were developed under a D classification and have been operational for many years providing reliable science telemetry distribution for SDO, LRO, IRIS and SMAP. DAPHNE will reuse approximately 90% of the Phase 1 software and the portions to be developed are of a low risk nature.
- DAPHNE is a ground system that can be easily supported through its full life cycle.
- DAPHNE will have a rigorous end-to-end test regime, well in advance of the launch, which will include mission hardware.
- DAPHNE is planned to be a secondary storage system, meaning that NEN will have a primary storage capability prior to DAPHNE. A DAPHNE malfunction will not result in a loss of science data from a given overpass.
- DAPHNE is being designed with single fault tolerance in mind and is expected to have higher reliability than Phase 1. A redundant path will be built in and controlled automatically virtually eliminating down time for any single failure. Commercial hardware will be used to allow cost effective sparing allowing speedy repairs.
- DAPHNE is a software system running on standard commercial computer hardware. The hardware is not specialized and is both replaceable and upgradeable.

- The gateways will be located at multiple NEN ground stations. If units at one site fail these other sites offer return link opportunities. Legacy hardware offer additional backup capability albeit at lower data rates.

## References

<http://software.gsfc.nasa.gov/AssetsApproved/PA1.0.2.doc>++

Appendix:

### Class A: Human Rated Space Software Systems

Human Space Flight Software Systems: (ground and flight) developed and/or operated by or for NASA that are needed to perform a primary mission objective of human space flight and directly interacts with human space flight systems.

### Class B: Non-Human Space Rated Software System or Large Scale Aeronautics Vehicles

Space Systems: Flight and ground software that must perform reliably to accomplish primary mission objectives, or major function(s) in Non-Human Space Rated Systems. Limited to software that is:

1. Required to operate the vehicle or space asset (e.g., orbiter, lander, probe, flyby spacecraft, rover, launch vehicle, or primary instrument), such as commanding of the vehicle or asset, or
2. required to achieve the primary mission objectives, or
3. directly prepares resources (data, fuel, power, etc.) that are consumed by the above functions.

Examples:

Examples of Class B software includes but are not limited to:

Space, Launch, Ground, EDL, and Surface Systems: propulsion systems; power systems; guidance navigation and control; fault protection; thermal systems; command and control ground systems; planetary/lunar surface operations; hazard prevention; primary instruments; science sequencing engine; simulations which create operational EDL parameters; subsystems that could cause the loss of science return from multiple instruments; flight dynamics and related data; launch and flight controller stations for non-human spaceflight.

Exclusions:

Class B does not include:

1. Software that exclusively supports non-primary instruments on Non-Human Space Rated Systems (e.g., low cost non-primary university supplied instruments) or
2. systems (e.g., simulators emulators, stimulators, facilities) used in testing Class B systems containing software in a development environment.

Class C: Mission Support Software or Aeronautic Vehicles or Major Engineering/Research Facility Software

Space Systems:

1. Flight or ground software that is necessary for the science return from a single (non-primary) instrument, or
2. flight or ground software that is used to analyze or process mission data, or
3. other software for which a defect could adversely impact attainment of some secondary mission objectives or cause operational problems, or
4. software used for the testing of space assets, or
5. software used to verify system requirements of space assets by analysis, or
6. software for space flight operations, that is not covered by Class A or B.

Examples

Space Systems: software that supports prelaunch integration and test; mission data processing and analysis; analysis software used in trend analysis and calibration of flight engineering parameters; primary/major science data collection storage and distribution systems (e.g., Distributed Active Archive Centers) [.....] command and control of non-primary instruments; ground mission support software used for secondary mission objectives, real-time analysis, and planning (e.g., monitoring, consumables analysis, mission planning)

Exclusions: Systems unique to a research, development, test, or evaluation activity in a Major Engineering/Research Facility or Airborne Vehicle where the system is not part of the facility or vehicle and does not impact the operation of the facility or vehicle.

Class D: Basic Science/Engineering Design and Research and Technology Software

Basic Science/Engineering Design:

1. Ground software that performs secondary science data analysis, or

2. ground software tools that support engineering development, or
3. ground software used in testing other Class D software systems, or
4. ground software tools that support mission planning or formulation, or
5. ground software that operates a research, development, test, or evaluation laboratory (i.e., not a Major Engineering/Research Facility), or
6. ground software that provides decision support for non-mission critical situations.

Exclusions:

Class D does not include:

1. Software that can impact primary or secondary mission objectives or cause loss of data that is generated by space systems, or
2. software which operates a Major Engineering/Research Facility, or
3. software which operates an airborne vehicle, or
4. space flight software.