USING PACKET TELEMETRY (CCSDS) FOR MISSILE PROGRAM TO ACHIEVE FLEXIBILITY AND COST REDUCTIONS

Arvid Askeland, Tom Rune Haukeli
Kongsberg Defence & Aerospace
New Anti-Ship Missile Program (NSM)

ABSTRACT

New Norwegian anti-ship missile program (NSM) has evaluated both the fixed format and the packet telemetry for its log/telemetry system. It is important that the NSM log system is easy to reconfigure, since the system shall be used during debugging, lab testing, system testing, test firings, and later on for operational evaluation firings. The packet telemetry standard has been selected because the packet telemetry provides dynamics and flexibility for changes, which are not easy to achieve with fixed format. Test results and system experience will be available before October and a summary will be presented at the ITC 2000 conference.

KEY WORDS

CCSDS, missile program, log system, flexibility, cost reduction

INTRODUCTION

A telemetry system consists of many data sources, each data source has normally two requirements to the telemetry system:

- Minimum allocated average bandwidth
- Maximum delay before transfer of a measurement

In fixed format these requirements are constant, whereas in packet telemetry the bandwidth and the delay may vary continuously. The bandwidth problem is comparable to that of a data bus or data network, where we demand an exceptionally high utilization of the bandwidth.

There are two standards that can be used for transferring telemetry data over a radio link, fixed format (IRIG-B) and packet telemetry (CCSDS). The fixed format has been used, for quite some time, as a

standard for transferring telemetry data from a missile to ground. The complexity of a missile has in recent years increased, missiles developed today have significant higher data processing requirements and more data are being exchanged between subsystems than a few years ago. Due to the restricted bandwidth of a telemetry system, only a limited amount of the data processed in a missile can be transferred to the ground and data that are to be transferred therefore needs to be carefully selected. In addition, the telemetry data requirements will vary with different phases in missile flight. A telemetry system based on fixed format may have difficulties fulfilling such requirements, packet telemetry may therefore be more suitable for telemetering in present and future missiles.

SELECTING A STANDARD

There are three main reasons for considering packet telemetry for a missile:

1. Flexibility
    - Data sources, which are a series of separate processes, may not be precisely synchronized in real time.
    - The bandwidth requirement for the different sources will vary greatly over time.
    - It is difficult at an early stage to define or predict exactly which telemetry requirements the individual processes will have.
    - Different data to be telemetred in different phases of the missile flight.
2. Suited for all phases of system/subsystem integration, system testing and test firings
    - Standardized packet telemetry format as log format in: lab testing, system testing and test firings.
3. Available COTS components
    - CCSDS reconstruction server available
    - Display clients with GUI software available

The goal is to increase the telemetry systems functionality until it becomes a log system. Such a log system will be responsible for logging various missile data during all missile tests. A log system can be used during all development testing and evaluation phases, this will reduce configuration setup time and the cost during tests.

THE PROCESS OF SELECTING TELEMETRY DATA FOR TEST FIRINGS

Selecting the right telemetry data requires experience and system understanding. One way of getting the experience and system understanding is to start selecting and using telemetry data as early as possible. Experience with analyzing telemetry data through the development phase of the project will reduce the risk of selecting wrong telemetry data. The log system gets more mature over time.

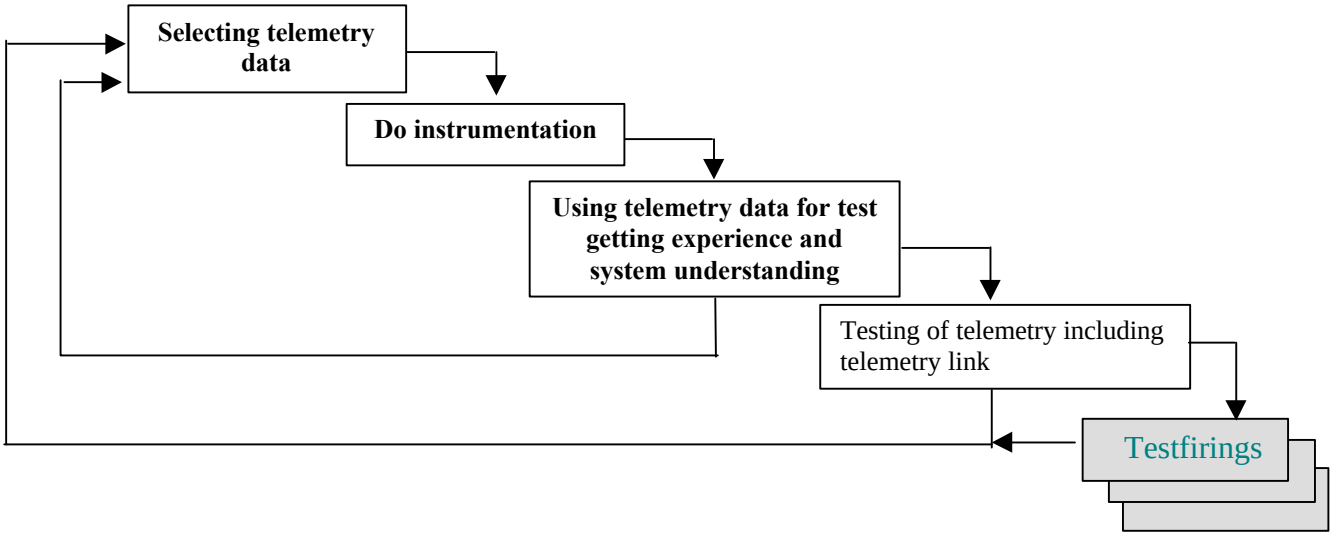

Figure 1: The processes of selecting telemetry data

DESIGN GOALS

When designing a log system it is important to specify all the requirements for such a system, it is also important to identify the design goals for a log system and to design the system so that it fulfills most of these design goals.

The requirements of a log system are normally hardware specific, involving bandwidth and delays. The design goals on the other hand, will describe expected functions of the log system much better.

- The log system must give the users the possibility to discover system errors and design weaknesses in the missile system at any phases in the development. This will be a prime goal for the log system.
- The log system must be available for all users that require logging of data, during the whole development phase.
- The users of the log system should have a simple interface towards the log system. The end-users will in addition require a presentation interface to view the logged missile data.
- Some parts of the log system will be integrated into the missile simulation software. Log data will be used as input for missile simulation. The intention is to reduce the amount of test firings and maximize the understanding of the result after each test.
- Available COTS components will reduce the developing time, the risk and the cost.

NSM LOG SYSTEM DEVELOPMENT

The concept of NSM log system is to retrieve, transport, store and/or present sensors or system data. The missile subsystems will decide what is to be logged by using the interface and the filter mechanism.
The log system does not need to know what kind of data that are transferred, the only equipment that require this kind of information is the display client or presentation unit. The log system shall to the extent possible be independent of the missile data, the missile software will therefore be responsible for packing missile data into messages.

The NSM log system development consists of four increments. The first increment is a simple software debugging system, while the second increment is a log system for an aircraft. The third increment is a log system for subsystem integration and the fourth increment contains a complete telemetry link for test firing.

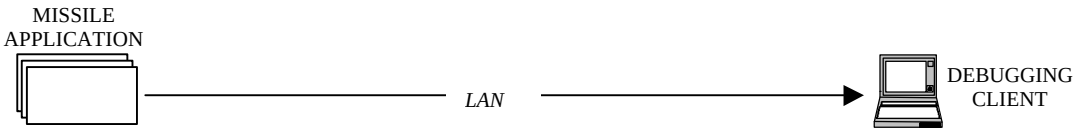

Figure 2: First increment.

The log system in the second increment will be used during aircraft testing of the missile subsystems. The missile application and sensors will be the main users of the log system.

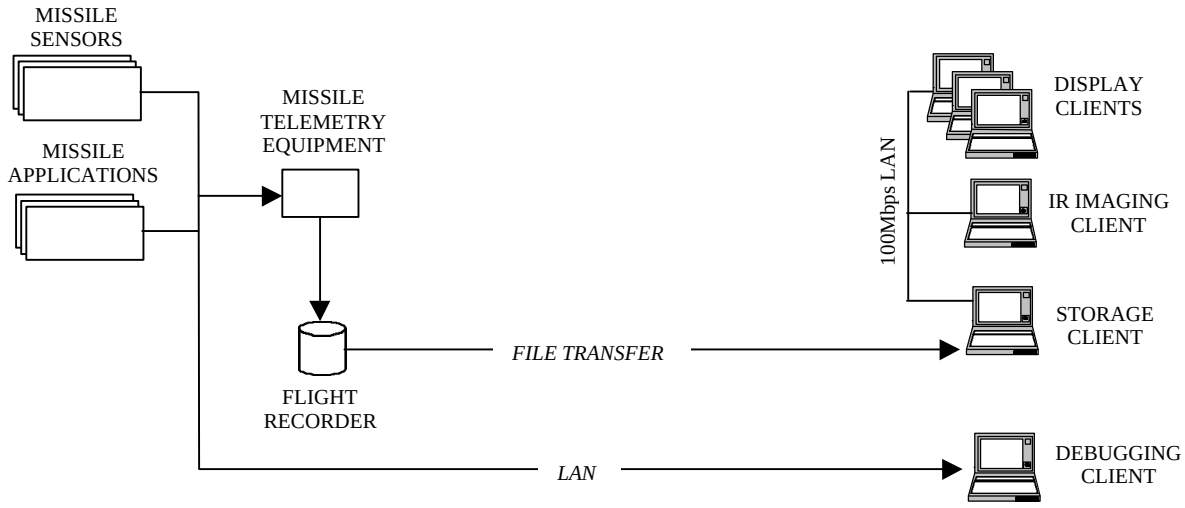

Figure 3: Second increment

The third and fourth increment consists of the entire NSM log system. The difference between third and fourth increment is the telemetry part. The fourth increment will mainly be used during the missile test firings, but it will also contain the functionality from increment 1 and 2. The telemetry system will contain the encryption and decryption modules and the telemetry server.

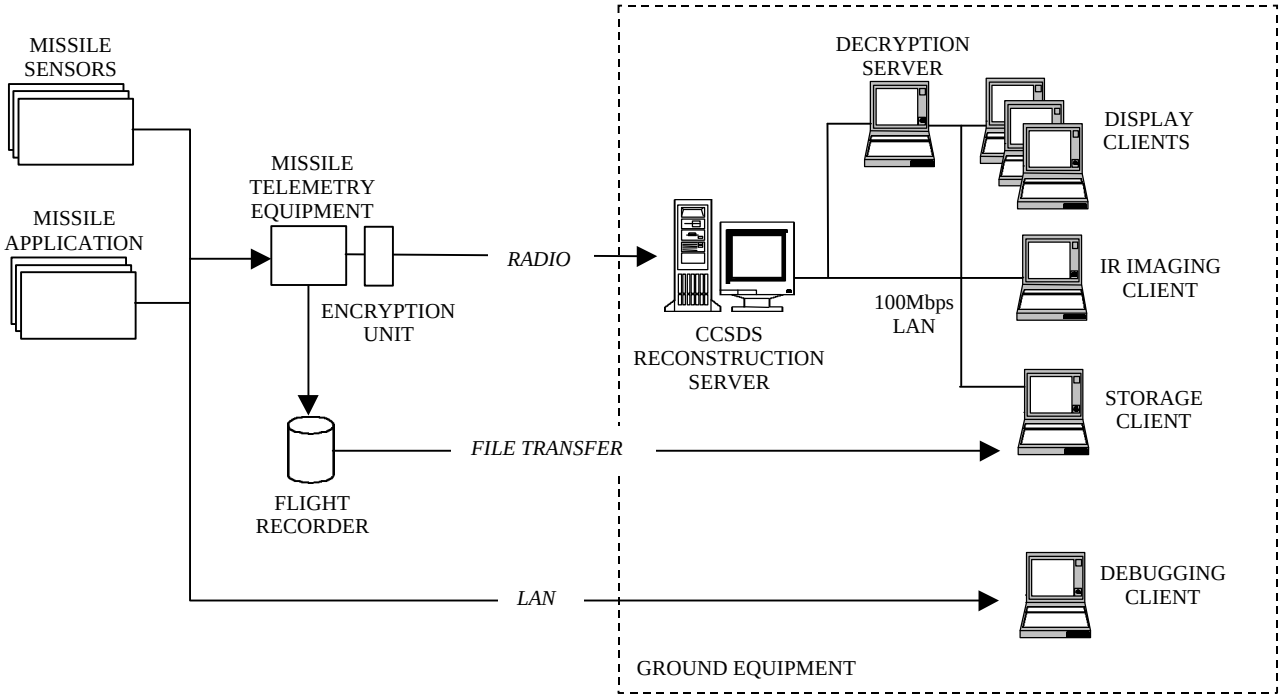

Figure 4: Third and fourth increment.

The NSM log system is designed with as many COTS components as possible, most of the COTS components are located in the ground equipment. The COTS components in the ground equipment are the CCSDS reconstruction server, the decryption server, the storage client and the display client. This log system will be flexible for changes and it will be easy to upgrade the system with new products for future applications.

Test results and system experience will be available before October and a summary will be presented at the ITC 2000 conference.

CONCLUSION

The NSM project has evaluated both the fixed format and the packet telemetry for its log system. It has been important that the NSM log system is easy to reconfigure, since the system shall be used during all phases of development: debugging, lab testing, system testing and test firings. The packet telemetry standard has been selected because the packet telemetry provides dynamics and flexibility for changes, which are not easy to achieve with fixed format.