STAR SYSTEM

DESIGN DOCUMENT

INTERMAP

DOC-1005 Version 1.03
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DOCUMENT HISTORY

Version	Date	Comment/Description of Change	Author(s)
1.01	May 12th, 2003	Include Star3i specific requirements	TRM, WRT
1.03	June 8th, 2004	Reorganized and updated	TRM

TABLE OF CONTENTS

1 INTRODUCTION

1.1 Purpose

This document describes the high-level design and design requirements of the STAR Core Technology. The STAR Core technology provides the basic subsystems required for an interferometric radar system. The system is to be installed in an aircraft with the addition of a radome, pedestal, and antennas.

The STAR Core technology will provide a radar system that is platform independent such that it may be installed in a variety of aircraft.

1.2 Scope

This document the general high-level system design, to be used as a driving factor to the detailed requirements / design of each module.

The document assumes that the reader has a basic understanding of interferometric radar systems, airborne remote sensing platforms, Intermap products and processes and computer systems technology.

1.3 Definitions, Acronyms, and Abbreviations

MTTR ....Mean Time To Repair
STAR ....Global Terrain Mapper
LRU.................................Line Replaceable Units
JBOD................................Just a Bunch Of Disk
TCP/IP..............................Network Communication protocol
MCC.................................Master Control Computer
RCAS ....Radar control and Acquisition System
IMU..................................Inertial Measurement Unit
RCVEX-RCAS ....Receiver Exciter including RCAS
PWRDIST........................Power Distribution Module
ANT ....Antenna and Pedestal Module
NAV ....Navigation Module
WGASS-XTRANS ....Waveguide Assembly and X-band Transmitter

1.4 References

1. STAR System Interface Control Document V1.0
2. Star-3i Availability Analysis – Version 1.0

2 SYSTEM DESIGN

2.1 System Overview

2.1.1 Radar Modules

The STAR Core is a distributed system with independent radar modules with specific functionality. The system will be consist of the following radar modules:

1. A Navigation (NAV) module, which allows communication of navigation data from the GPS and IMU.
2. An Antenna (ANT) module, which provides control of the servomotor in the pedestal. (Optional – depending on the requirement of a rotatable pedestal)
3. A Receiver Exciter and Radar Control Acquisition System (RCVEX-RCAS), which provides control of signal generation and recording.
4. A Wave Guide Assembly and Transmitter module (WGASS-XTRANS), which controls the amplification of the high frequency chirp signal and carries the signal to pedestal through waveguide guide. This module also houses the front end of the receiver function, in that the receiver protection devices and LNA are included.
5. A Power Distribution module (PWRDIST), which provides power to all radar modules.

NOTE: Please see the specific module requirement document(s).

2.1.2 MCC

The system will include a Master Control Computer (MCC), which provides an interface for operation and monitoring of the radar system. The MCC will also retrieve and record raw and status data from the modules.

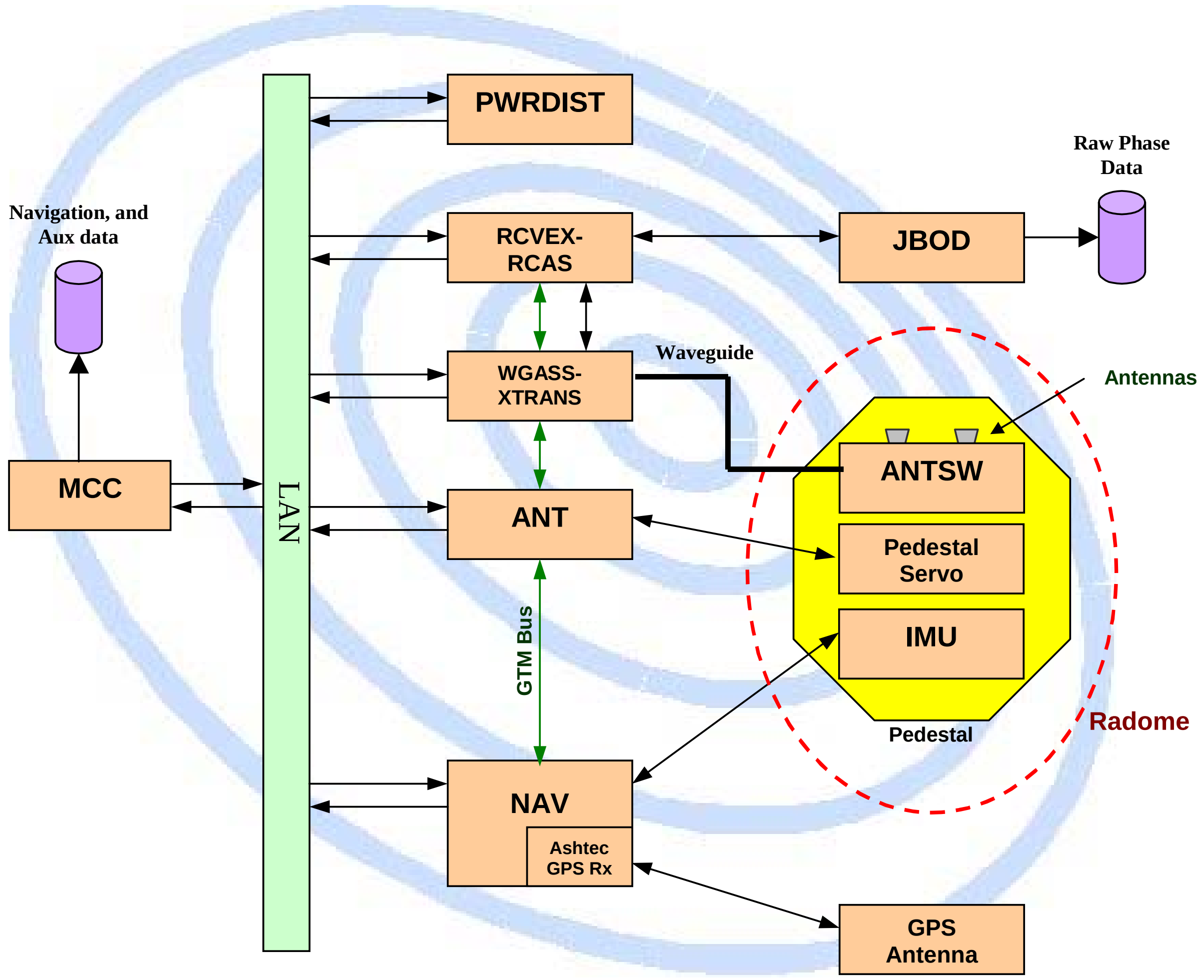


Figure 1 - STAR1 Radar System Overview / Block Diagram

2.2 Radar Module Design

All radar modules must be:

2.2.1 Interchangeability

All radar modules must be interchangeable between platforms, this will be done by creating a standard interface with the following design criteria:

Physical

- The STAR Radar Modules will conform to a common physical interface specification.
- All modules will have a $28V_{DC}$ power input on the rear panel.
- All signal connectors will be located on the front panel of the module
- STAR Radar modules are 19" rack compatible with the existing Star3i and AES-1 radar system.

Software

- The STAR Radar Modules will conform to a software interface specific to each type of module.

Electrical

- Where applicable conform to FAA-AC43-13B standards in mechanical mounting. Where applicable conform to FAA-AC43-13B and Martin - Marietta Workmanship standards.
- All equipment must meet current Federal Air Regulations (FAR-25).
- All radar modules will have an indicator for power and for module fault.

Environmental Requirements

- All radar modules will be able to operate in 0 to +40 degrees Celsius, 95% non-condensing humidity, and 10,000ft pressure level.

Embedded Firmware

Each radar module will have an embedded micro controller. Communication will be through an RJ45 ethernet interface available through the front panel. Additionally an RS232 plug on the front panel will be available for communication to the micro controller.

Internal Data Bus

Each radar modules must provide an internal data bus for reading and writing Calibration information (on EPROM) and reading temperature and other health monitoring sensors. Additionally, some modules will contain an external connection for external devices. Each radar modules must provide internal temperature monitoring.

2.3 Line Replaceable Units

All radar modules will be Line Replaceable. These modules can be removed and replaced by the Radar Operators for quick field replacement and increased availability. The Mean Time To Replace a Line Replaceable unit by a LRU trained technician will be less than 30 minutes.

Each module will have a Physical ICD, Software ICD, and Acceptance Test Procedures that will ensure the module is standardized to be compatible between systems without requiring system or software upgrades.

Each module will have a standard software command interface and a broadcasted status stream as a required interface to the STAR System. Additionally some modules have required non-broadcasting raw data streams, but are module specific and are parsed downstream. For example, regardless of which type of IMU and GPS used, the data stream format between the NAV module and the MCC is the same. The raw IMU and GPS data is parsed on the ground, corresponding to configuration information from the NAV module.

2.4 Calibration / Configuration Tracking

The STAR Core technology provides a mechanism for the tracking and storing of the current system configuration.

2.4.1.1 Configuration Information

Each module will have a configuration file containing a unique ID (model number, serial number and type), software and hardware information, and calibration information. The configuration file will be stored in each module and any applicable subsystem in a non-volatile memory.

2.4.1.2 Accessibility

The configuration information for each module and subsystem will be collected by the MCC at startup and written to a file for use in ground processing and diagnostics as specified in the STAR System ICD. The configuration information will be stored on a EPROM accessible through a 1-wire bus.

2.5 STAR Bus

The STAR Bus provides a common interface for all timing and synchronization signals.

1. The STAR bus will contain the following signals:
    - 10MHz STALO Master clock
    - 1PPS Master clock
    - Pulse Repetition Interval (PRI)
    - 1 or more Spare Twist Pair
2. All modules (excluding PWRDIST) will contain a STAR Bus.
3. Each module will contain a standard STAR bus interface with two connections ports. The STAR bus will have a straight through connection through the two ports so as to allow for daisy chaining from unit to unit. The bus will be terminated at the end.

2.6 Time Tagging

STAR time Tagging of each module will lever Star3i technology. Module time will be stored in hardware using two counters, and updated using the STAR Bus.

A Time Major counter will contain the GPS week and week second, and is incremented directly from the rising edge of the 1Hz PPS (from GPS Receiver) signal via the STAR Bus. The counter may be set by the onboard microcontroller, and implemented on the next PPS.

A Time Minor counter will contain the fraction of a second since the Time Major. The Time Minor counter is incremented directly from the 10MHz clock giving a resolution of a 100ns. The Time Minor count is cleared when the Time Major is updated every 1Hz PPS.

2.7 Time Synchronization

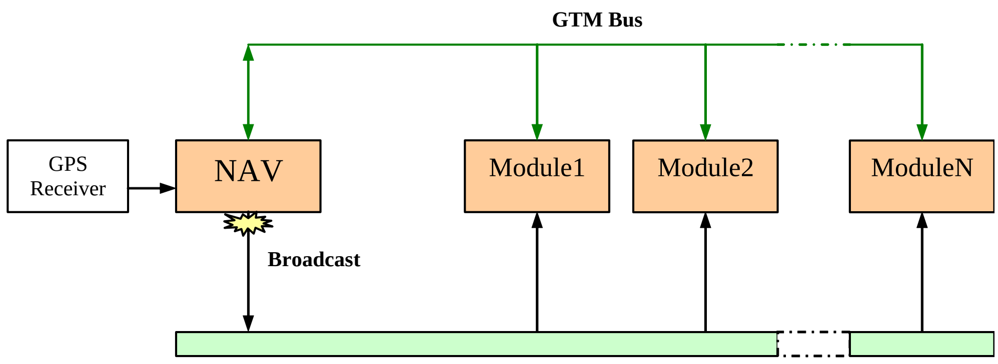
All system modules capable of providing timing information must be synchronized to the GPS 1PPS and the 10MHz STALO of GPS time provided by the NAV module to within 100ns.

The STAR system must be able to:

a. Synchronize all modules to the 1Hz clock and 10MHz clock (excluding PWRDIST).
b. Provide 100% deterministic modules synchronization.
c. Detect any un-synchronization of a module.

In the STAR Design, the MCC is not involved with the time synchronization algorithm. The MCC merely indicates when time needs to be synchronized. This accomplished by using broadcasting algorithm where the time is broadcast to multiple clients in parallel.

The NAV module is the master clock of the system. It's internal clock will be set to the GPS time received from the receiver. On every PPS signal, it will broadcasts out its internal time to all modules. By nature of the broadcast, the last received time by a module will be the most current time. Any missed broadcasts will not arrive, instead of arriving late.



Synchronizing Time

The MCC informs the modules to set the time. When a radar module receives a broadcast, it will set its Time Major clock to that value.

Checking Time Synchronization

Each radar module continually monitors for broadcast packets. When a packet is received, it compares the week second on the packet with the internal week second of the module. If the two differ, than the time on the module has become unsynchronized.