

STR SW CENTRALIZATION: DESIGN AND VALIDATION IMPACTS

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AGENDA

1 - CONTEXT

2 - DESIGN CONCEPT

3 - INDUSTRIAL IMPACT

4 - DEVELOPMENT & ON ORBIT REX

5 - RECOMMENDATIONS FOR STANDARDIZATION

1 - CONTEXT

/// WHY ?

- / COMPETITIVENESS FOR CONSTELLATIONS AND TELECOMMUNICATION COMMERCIAL MARKET
- / EVOLUTION OF THE COMPUTER PERFORMANCES (CPU & MEMORY)
- / SATELLITE DESIGN OPTIMIZATION
- / NON RECURRENT COST AND DEVELOPMENT EFFORT IS BALANCED BY THE COST SAVINGS ON CONSTELLATIONS

/// HOW ?

- / STR DESIGN OPTIMIZATION
- / INDUSTRIAL ORGANIZATION

PROPRIETARY INFORMATION

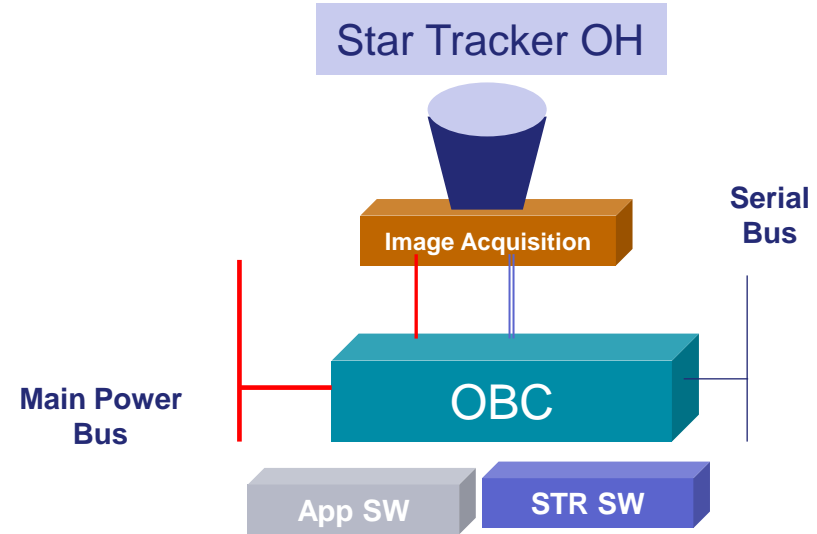
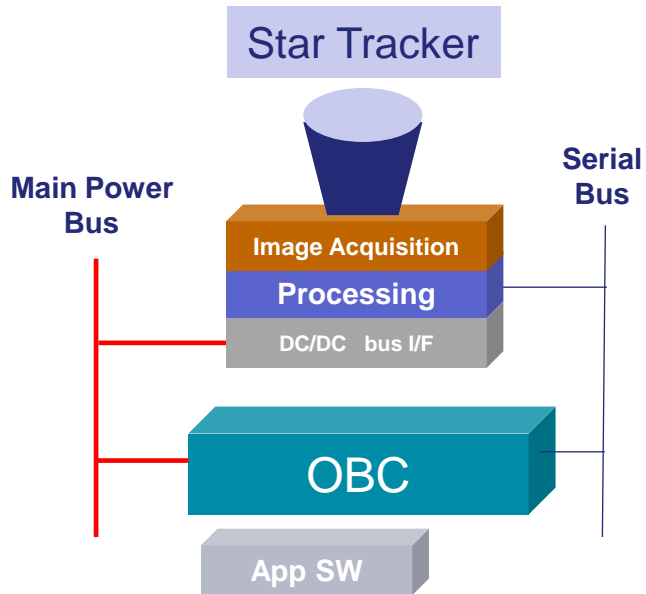
2 - DESIGN CONCEPT

/// Design Optimization

- / STR IMAGE PROCESSING DONE BY THE OBC
- / STR OH POWER SUPPLIED BY THE OBC

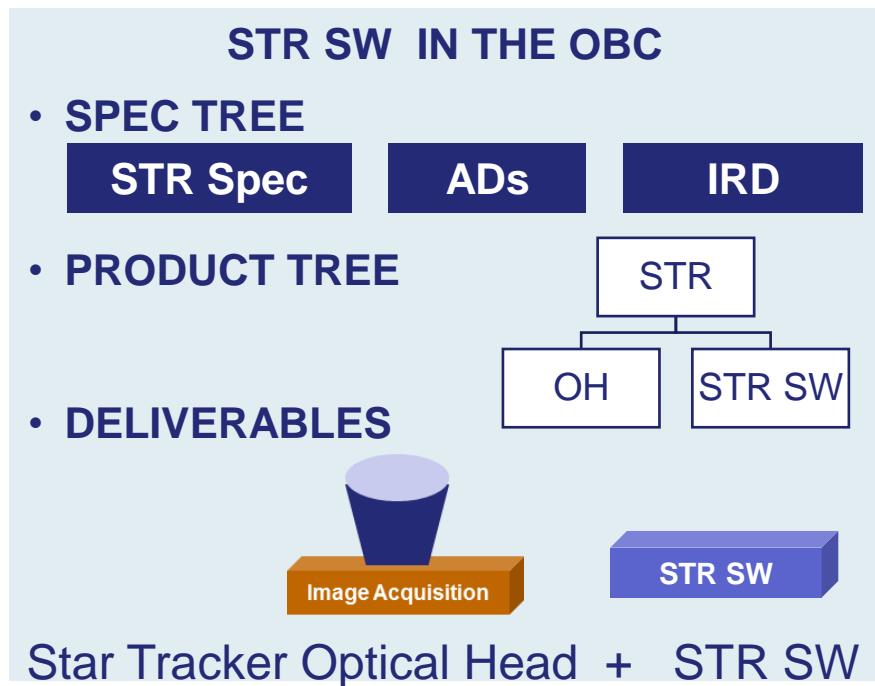
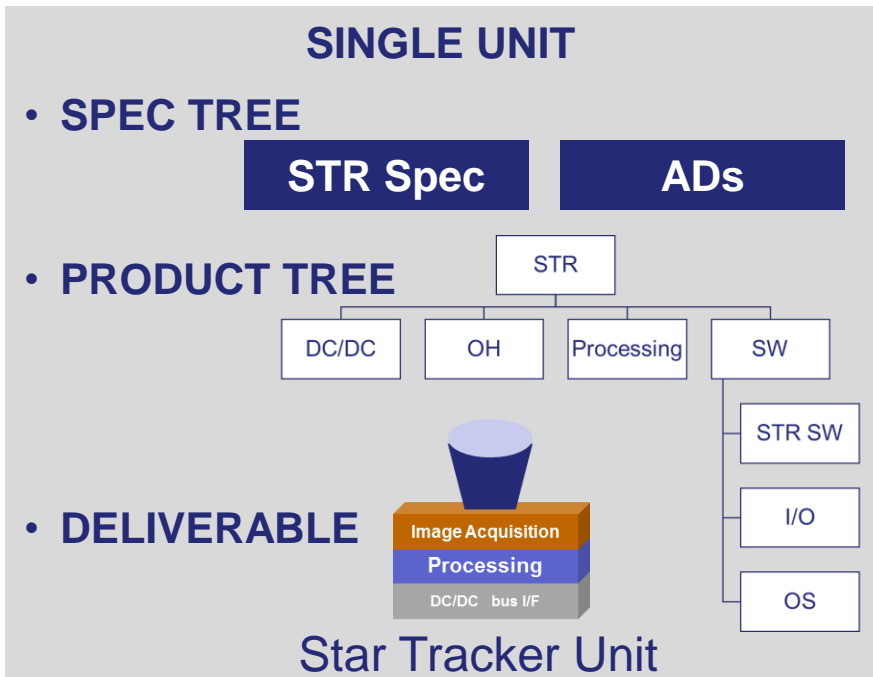
BENEFITS

- Cost
- Mass
- Power
- Reliability
- Simplification of the satellite accommodation



3 - INDUSTRIAL IMPACT

/// IMPACT ON THE STAR TRACKER SPEC AND PRODUCT TREE

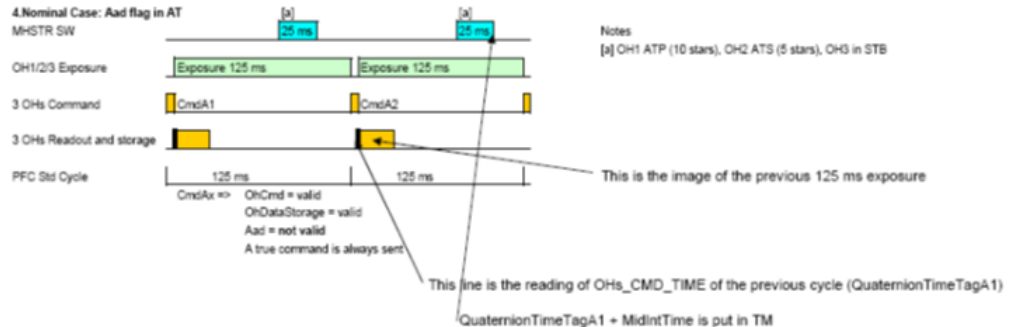


/// IP AND DESIGN ARE PROTECTED : STR SW SOURCE CODE IS NOT DELIVERED

3 - INDUSTRIAL IMPACT

/// OBSW impact

- / OBSW includes all the SW components : low level SW , Operating System, platform services , Satellite application SW and the Star Tracker SW
- / STR SW is delivered as a .OBJ file
- / STR SW is associated to dedicated tasks or partitions supervised by the Operating System that avoid any fault propagation
- / Any STR SW modification request OBS SW impact analysis and regression test



/// STR SW IRD

- / CPU , memory allocation, and synchronisation
- / Communication between Application SW , timing and real time constraints are defined with the STR supplier in a co-engineering phase
- / OBSW real time architecture shall respect On Board Time accuracy and jitters

3 - INDUSTRIAL IMPACT

/// OBC impact and HW IRD

- / OH Power Supply (Voltage and Power Consumption) shall be defined
- / PELTIER control is ensured by the STR SW . Electrical interface, TEC Seebeck voltage and duty cycle shall be defined in the HW IRD and verified at OBC level

/// OBC – OH communication links

- / SpaceWire is used to interface the OH
- / Communication protocol and packet organization shall be defined in the IRD
- / OBC SpaceWire software drivers shall be provided to the STR supplier to optimize development and integration process

/// Integration of the STR OH and OBC is done on the Avio Test Bench and at satellite level

- / STR test scenario shall be defined with the STR supplier

3 - INDUSTRIAL IMPACT

Impact on the Star Tracker IVV

/// Star Tracker SW validation

- / Classical STR SW validation performed on development environment
- / SW performance tests shall be performed on a flight representative processor with respect to SW spec , SW IRD and real time constraints
- / End to End performances are demonstrated by analysis and with dedicated simulation as for a single STR unit

/// **Star Tracker qualification** is focused on OH qualification (ie : mechanical, thermal and EMC environment and straylight tests)

/// **Star Tracker OH Acceptance** is focused on the performance verification, calibration in thermal environment and alignments without need of the STR SW

/// Flight representative Processor used for the STR SW validation shall be defined (processor board, frequency) with the PRIME very early to respect STR supplier development constraints

4 - LESSON LEARNT ON THE DEVELOPMENT & ON ORBIT REX

/// LESSON LEARNT ON THE DEVELOPMENT

- / No available standard or application guideline
- / Strong cooperation with the STR supplier is mandatory to define STR SW interface , converge on timings and memory allocations in order to optimize global CPU and memory budgets and the validation plan
- / Acceptance and qualification plan has to be defined very early
- / End-to-end performance tests performed at avionics level with several OH stimulated by OGSE driven by the satellite environment simulator
- / Acquisition and tracking performances are similar to single units. Fine tuning of the STR SW is done with regard to radiation environment , satellite dynamic and CPU/timing allocations

/// ON ORBIT REX

- / Good behavior observed on a LEO constellation and on the first Spacebus Neo GEO satellite
- / Acquisition and tracking performances are similar to a single unit star tracker.
- / Optical Head management is "transparent" on the Attitude Control.
- / STR SW observability and maintainability is simpler. IN case of investigation, OBSW has a direct access to STR SW parameters (no serial bus limitation)

5 - RECOMMENDATIONS FOR STANDARDIZATION

Several STR solution are available today in Europe

- /// Supplier are now open for the integration of the STR SW in the OBSW taking into consideration the guarantee to preserve Intellectual Property of the STR design and algorithms
- /// Due to the lack of interface standardization, integrated solution is expensive.

Recommendation to analyze the possibility to

- /// propose a standardization of the SW interface to enable a Product line approach and reduce the development cost of a new solution.
- /// propose a generic test plan or guidelines for STR qualification and acceptance