PROFIBUS in a Marine Application

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Agenda

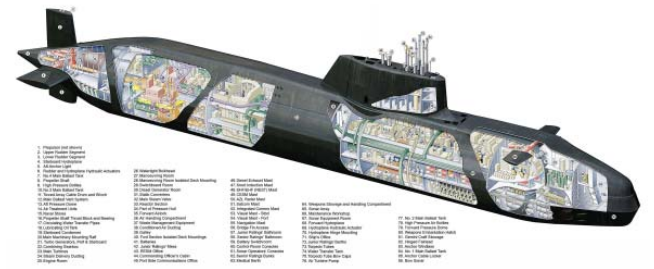
- Introduction
- Reason for Change
- System Overview
- System Requirements
- Application of Profibus
  - *Network Architecture*
  - *Installation*
  - *Safety and System Redundancy*
  - *Realised Benefits*
- Summary
- Any Questions

Introduction

- BAE SYSTEM Maritime are a prime contractor for the Royal Navy's Surface Vessels and Submarines.

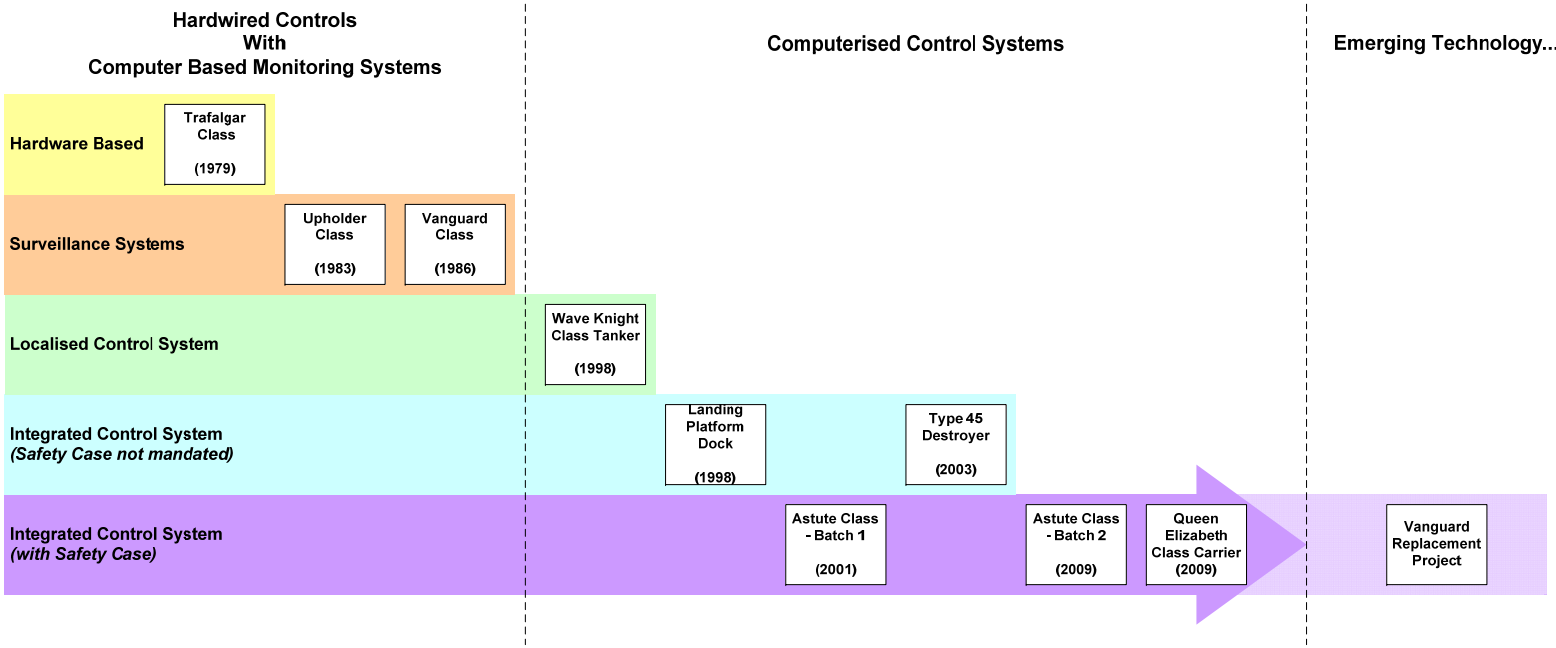
- BAE SYSTEMS Maritime Submarines are currently building the Astute Class Submarines and designing Future Submarines.

- Over the past 20 years the control and instrumentation on-board these vessels has transitioned from hardwired controls to computerised control systems.



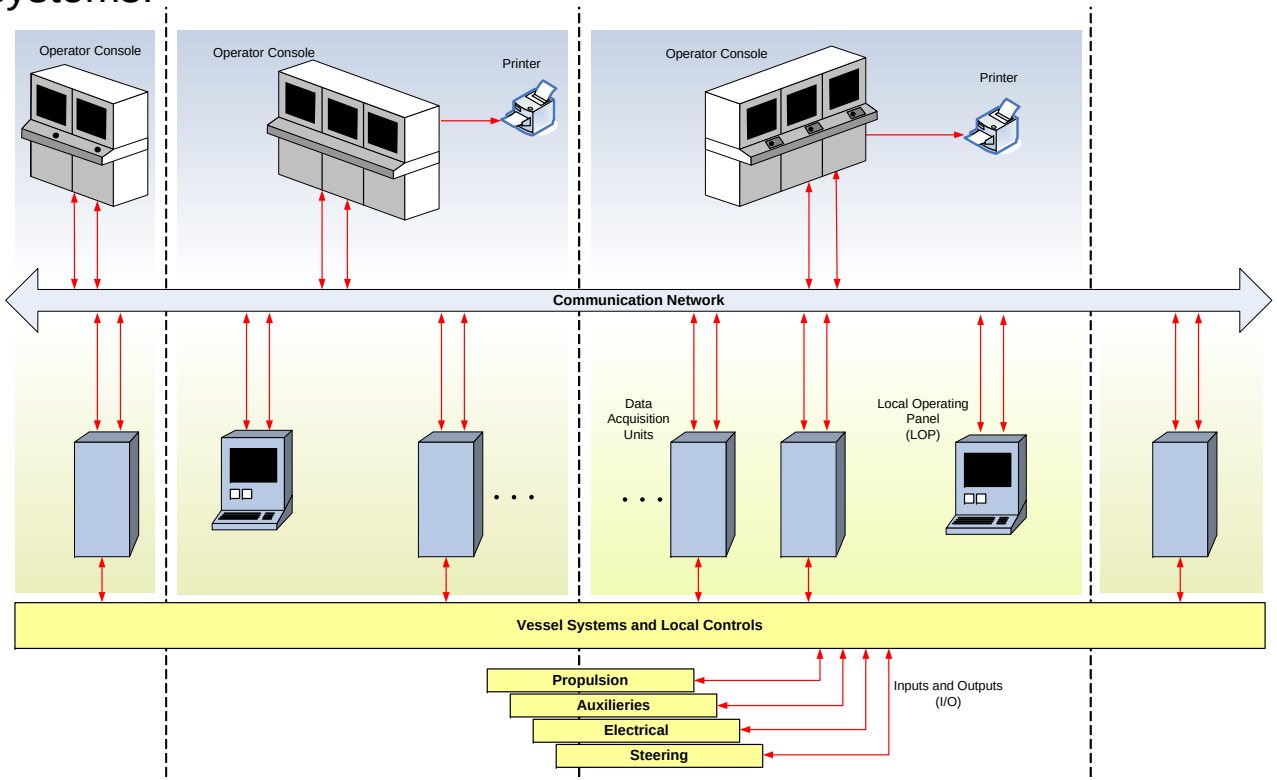
Reason for Change

- Reductions in man-power (the crew).
- Tendency to use well-proven bespoke systems.
- Legacy systems suffering from obsolescence.
- Difficult to maintain, requiring specialist engineering knowledge.
- New more affordable systems, tending towards COTS solutions.



Integrated Platform Management System (IPMS)

- Safety-Related System responsible for the control and monitoring of Propulsion, Electrical, Steering and Auxiliary systems of the vessel.
- Interfaces with thousands of inputs and outputs across the vessel.
- Provides the user interface for the operators and maintainers of the systems.



Safety Justification and Targets:

- Safety Case,
- Safety Integrity Level assessed to be no greater than SIL 2,
- Redundancy and Availability Targets have been set.

Security (Information Assurance):

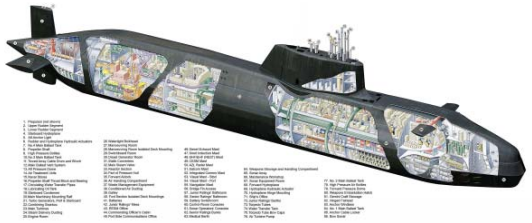
- Protectively Marked Data,
- Physical Security,
- Technical Security, e.g. Passwords and Encryption.

Transverse Engineering:

- Shock & Vibration,
- Temperature,
- EMC,
- Materials Compliance.

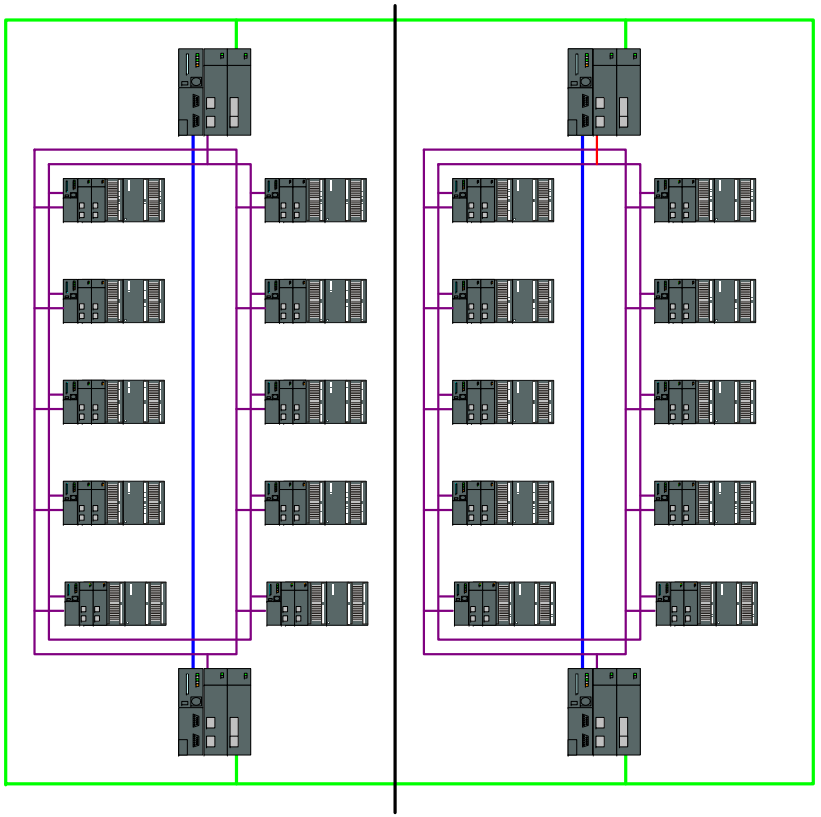
Physical Constraints:

- Data Collection Units size,
- Cable Management and Segregation,
- Integration into the vessel.



Network Architecture

- Dual Redundant Architecture.
- Strategically located data acquisition units.
- Diverse communications paths.
- Backed-up Power Supplies
- Safety Assessments, based on:
  - Signal Allocation,
  - Function Analysis,
  - Zonal Analysis.



Installation

- Data Aquisition Units and Console mounted I/O racks use copper Profibus (Supplier):
  - Remote I/O making use of redundant communication modules.
  - Optical Link Modules used to interconnect the units.
- Units interconnected via dual redundant fibre rings (Shipbuilder).
  - Bulkhead Penetrations/Connectors
  - Shared Network Cables
  - Network Patch Boxes

- Lessons Learnt so far…
  - Fibre Discipline.
  - Education for designers, installers and end-users.
  - Accessibility for modifications and maintenance.

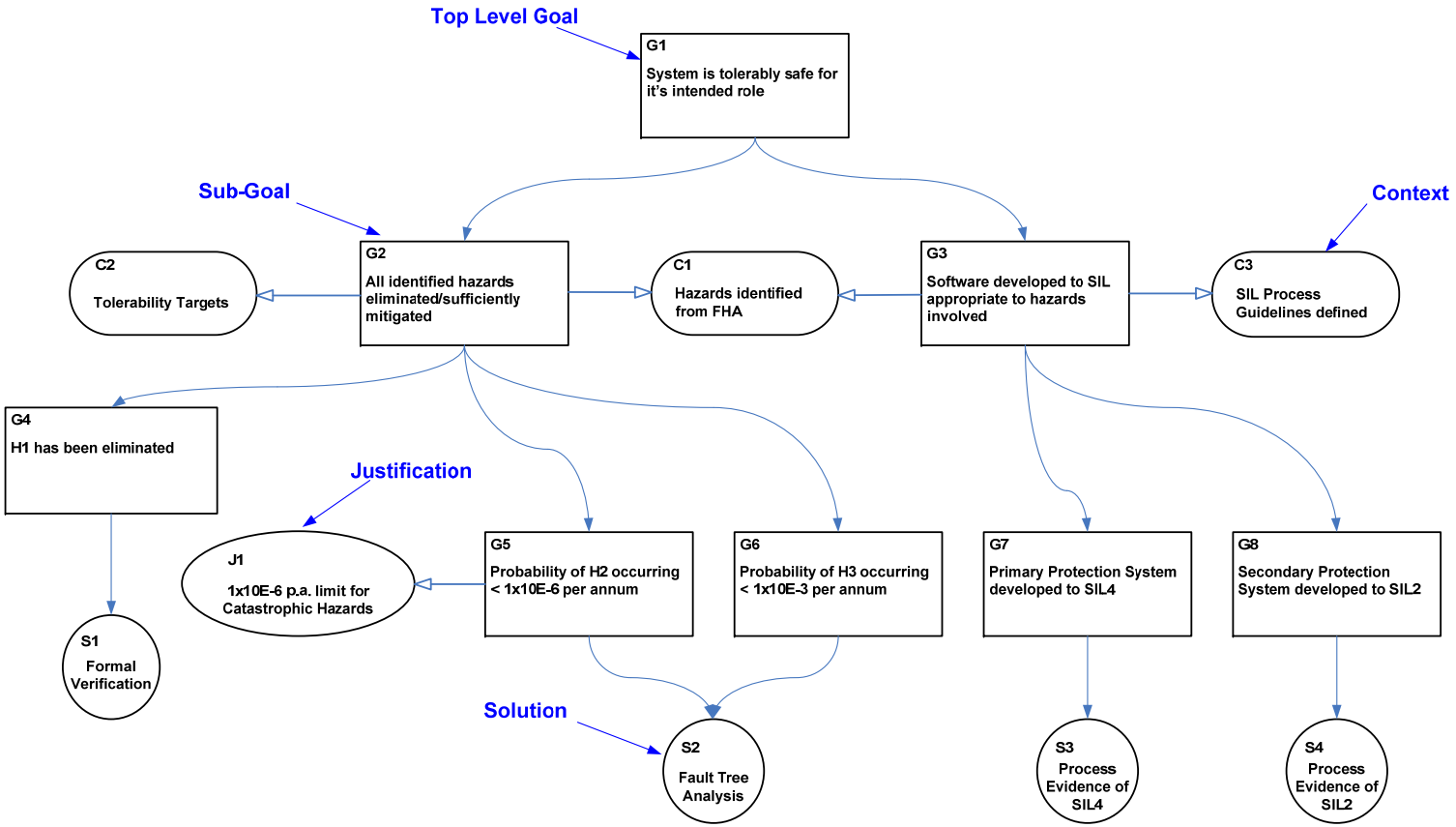
Safety & System Redundancy

- No fail-safe state,
- Continuous Operation – even in degraded conditions,
- Reliance on Operator – Man in the loop,
- System Failure can lead directly to hazard.

Safety Assessments

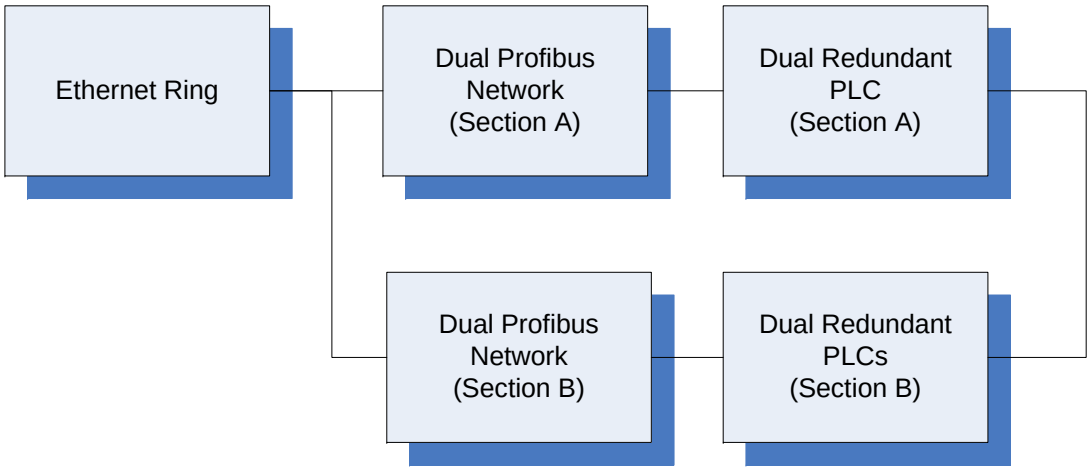
- Safety Argument using GSN “IPMS is tolerably safe...”,
- SIL 2 Development Process (Design, Implementation & Testing),
- Single Point of Failures,
- HAZID and HAZOP,
- RBDs and Fault Trees.

Example Safety Argument using GSN



Example Reliability Block Diagram

- Modular RBD, component parts calculated individually.



- Reliability calculations developed in accordance with Manufacturer’ s Data, MIL-HDBK and IEC 61508.
- Forming part of the SIL 2 Development Process.

Realised Benefits

- Adaptable to change – Easy to integrate additional I/O points.
- Enhanced Diagnostics for Maintainers.
- Reductions in the volume of copper cabling.
- Fibre Optics reduces the impact of Electromagnetic Interference.
- In-service evidence to support safety justifications.
- And finally - Through Life Cost savings.

Summary

- New and innovative system for the shipbuilder – new challenges being addressed.
- Regular training sessions set-up to aid boat installation, commissioning and ultimately operating the system.
- Early commissioning activities have identified a number of advantages of the system, compared to previous systems.
  - Enhanced, easy to access, diagnostics.
  - Flexibility to extend the network and I/O.
- Studies currently been undertaken:
  - Using PROFINET,
  - Smart Instrumentation,
  - Standardising interfaces to equipment.

Questions?

Thank you…

Any Questions?