



connect

2024 AUSTIN





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The life story of a ruggedized PXI based test solution deployed for decades to support front line military aircraft

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Serco

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Serco Group plc

1929

UK division of Radio Corporation of America

1987

Management buyout, renamed Serco, floated on the London stock exchange in 1988

2024

Citizen Services, Defence, Justice, Transport, Community Services, Healthcare, Space, Migration

£4.7 billion revenue 50,000+ employees Global presence

North America

9,000 people
28% group revenue

UK & Europe

31,000 people
50% group revenue

Middle East

4,500 people
5% group revenue

Asia Pacific

12,000 people
17% group revenue



Our Global Presence

UK and Europe

Serco has over 31,000 people in the UK & Europe, working across 220+ government contracts.

Middle East

Serco has over 4,500 people in the Middle East, with operations across the United Arab Emirates, The Kingdom of Saudi Arabia, Qatar and Iraq.

North America

Serco has over 9,000 people in North America, with operations across the U.S. and Canada.

Asia Pacific

Serco has over 12,000 people in the Asia Pacific region, with operations in Australia, New Zealand, and Hong Kong.

We are committed to forming long term partnerships and supporting our customers to deliver on their mission.

Serco Technology Division

The technology hub of Serco UK and Europe, providing high integrity test solutions, through life support, data acquisition/simulation, and technical consultancy.

1988

Design, Integration and Test business founded.
Developing test solutions for military, aeronautical and commercial applications

30+

Years in the NI Alliance Partner Program working closely with the NI sales team, System Engineers and Support

200+

Systems delivered to support MoDs, Armed Forces and OEMs

Capabilities



Test Engineering

Application of hardware, software and systems engineering to automate test. Simplifying the process of test to enable it to be applied consistently by any operator.

Multiple form factor solutions from factory test to deployed and hand-held solutions.

Complete turn-key solutions, test platforms and test application development or simply expert knowledge.



Through Life Support

Tailored solutions empowering our customers to meet their performance goals.

From complete logistic support packages, contracted availability, obsolescence management, refresh or simply repair on demand.

Customised support and life extension for all types of equipment.



Data Acquisition, Simulation and Control

Acquisition of data from digital and physical sources, processing, analysis, presentation and control of automation.

From smart sensors and IoT devices to closed-loop control systems, solutions supporting Industry 4.0.

Customised systems for complex experimental rigs and integration environments including synthetic training environments.



Technical Consultancy

Highly skilled engineers available to help your project succeed; from system design consultancy to process analysis and improvement.

Modelling skills and tools to analyse physical and business systems/processes to allow optimisation and increase efficiency.

Introduction to the program

- Original Requirement
 - Design a general purpose test system to test the Suspension and Release components of Stores Management Systems (SMS) on all UK fixed wing platforms
 - Replace the functionality of multiple in service equipments
 - Develop TPSs for all of the DUTs for these platforms – using variable quality test definition data
 - Make it suitable for use in service bays (home and deployed) and also for deployment on carriers
 - Comply with both commercial and military EMC requirements
 - Make it simple to operate
 - Service life of 10 years
 - Meet all legacy test requirement plus Mil-Std-1760 specific requirements for smart stores

The image shows two men in a workshop environment. The man in the foreground, wearing a black polo shirt and having tattoos on his left arm, is focused on connecting a cable to a piece of electronic equipment. The man in the background, wearing a light blue button-down shirt and glasses, is also working on similar equipment. The background features a poster titled 'PERFECT INTEGRATION' with the 'serco' logo and an 'EXTREME' tagline. The poster includes text about project integration and a diagram of a device. The overall scene is overlaid with a semi-transparent red and blue geometric shape.

Aircraft Stores Management Systems in a nutshell



circa 1916, a flight lieutenant of the Royal Naval Air Service throws a 16-pound high-explosive bomb from the rear cockpit of the gondola of an SSZ (Sea Scout Zero) airship.

By this stage of the war the most common bombs dropped by British aeroplanes were 20, 100 and 112-pounders. Early aerial bomb-aiming techniques were based more on hope than science.



What is a Store?

Anything carried by an aircraft, internally or externally and mounted on suspension and release equipment to support the mission.

Carriage Stores

- Missile Launchers
- Multi Bomb Racks etc

Mission Stores

- Weapons
- Decoys
- Pods
- Fuel Tanks



Suspension & Release Equipment (S&RE)

Any device used for the carriage, suspension, employment and jettison of stores.

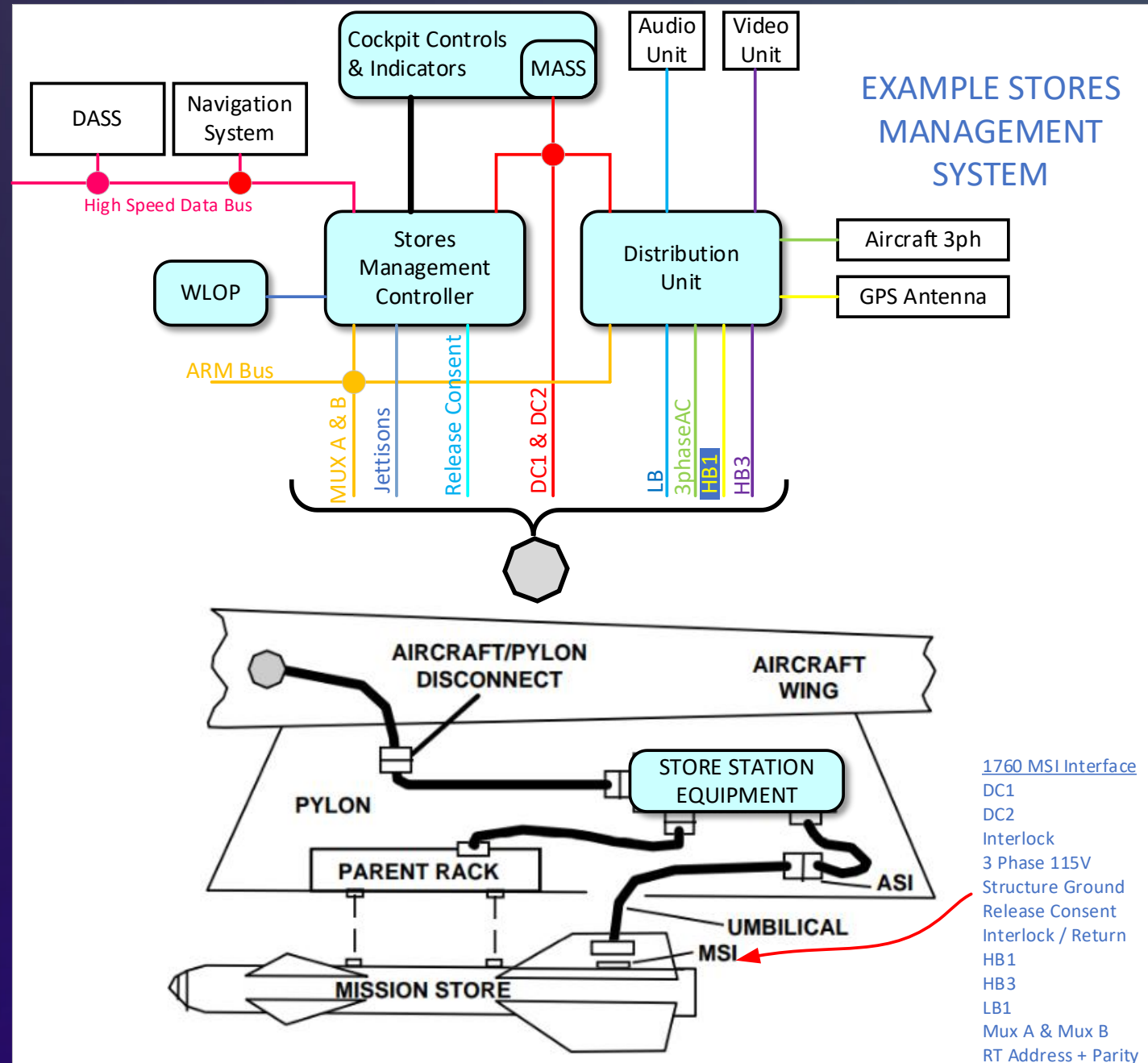
- Pylons
- Adaptors
- Racks (ERUs)
- Launchers
- Dispensers



Stores Management Systems

Military aircraft carry mission stores to support their operations:-

- Must be carried safely, even when flying abnormally – no inadvertent release
- Accurate and predictable release
- Transfer of mission data from aircraft to store and vice versa
- Support for many store types from multiple vendors
- Compliance with standards e.g. Mil-Std-1760C
- Safe behaviour in the event of unexpected responses from stores
- Ability to jettison heavy loads if aircraft needs to modify its mission



Stores Management System In Operation



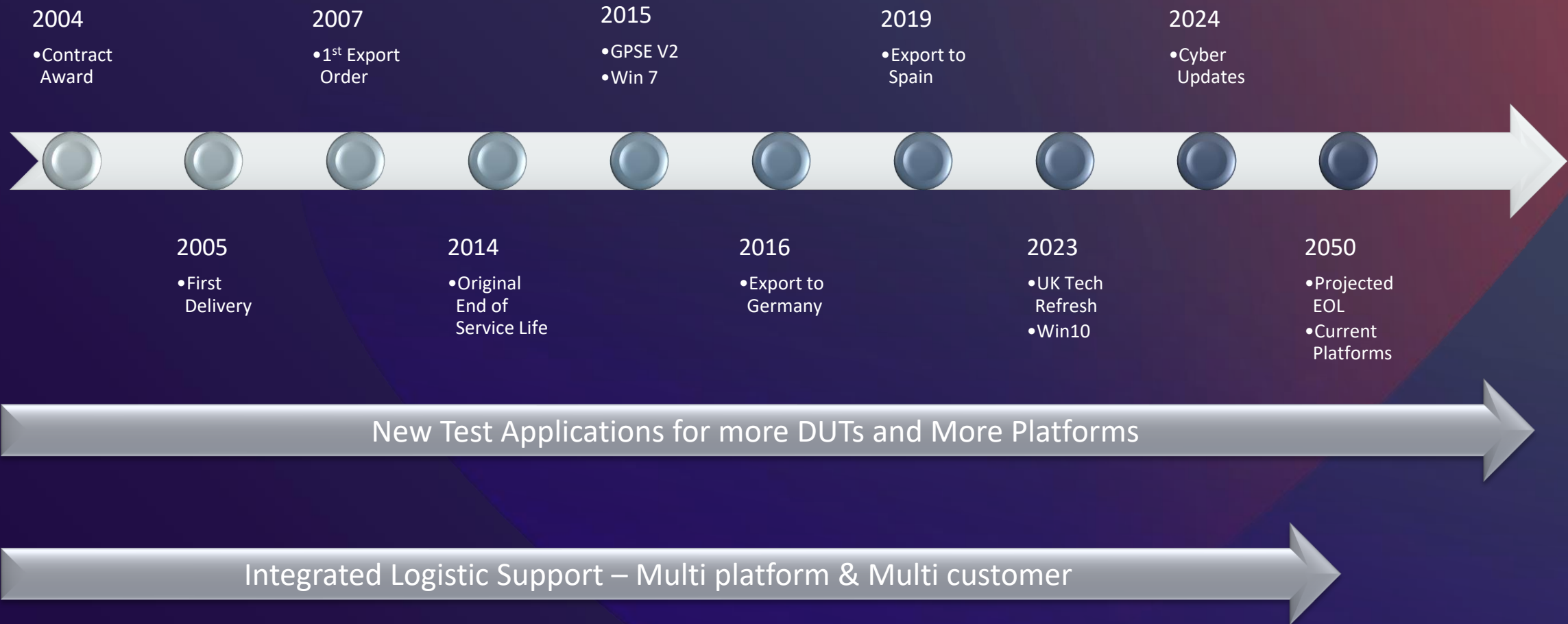
GPSE System Overview



GPSE Overview

- In 2004 the UK MoD sought competitive bids for a new test system to replace the incumbent systems (5 off) used for testing Suspension and Release Equipment on fixed wing platforms (Harrier, Hawk, Tornado GR1/GR4/F3, Nimrod and Typhoon filter testing)
- In collaboration with NI field sales team, Serco proposed a ruggedised PXI based solution using our depth of experience working with integration rigs, simulators, aircraft test and our knowledge of Mil-Std-1760
- The system had to comply with military specifications for environmental and EMC performance whilst also meeting the commercial requirements necessary to allow it to be a CE marked product
- Initial delivery program was for 50 test systems.
- The GPSE was so well received on the Typhoon program that the UK customer extended the requirement to replace a further five incumbent test systems.

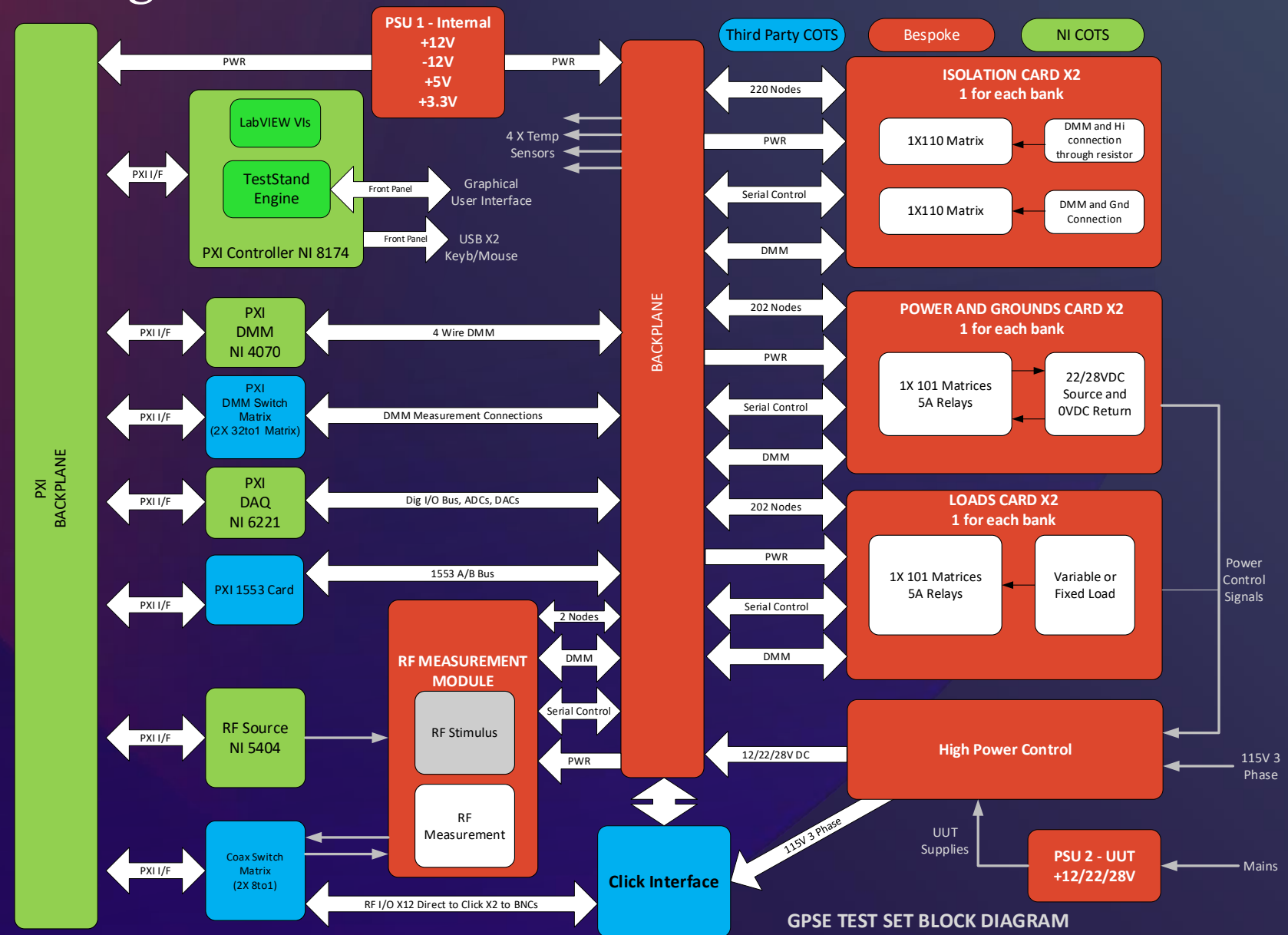
GPSE Timeline



One system to rule them all

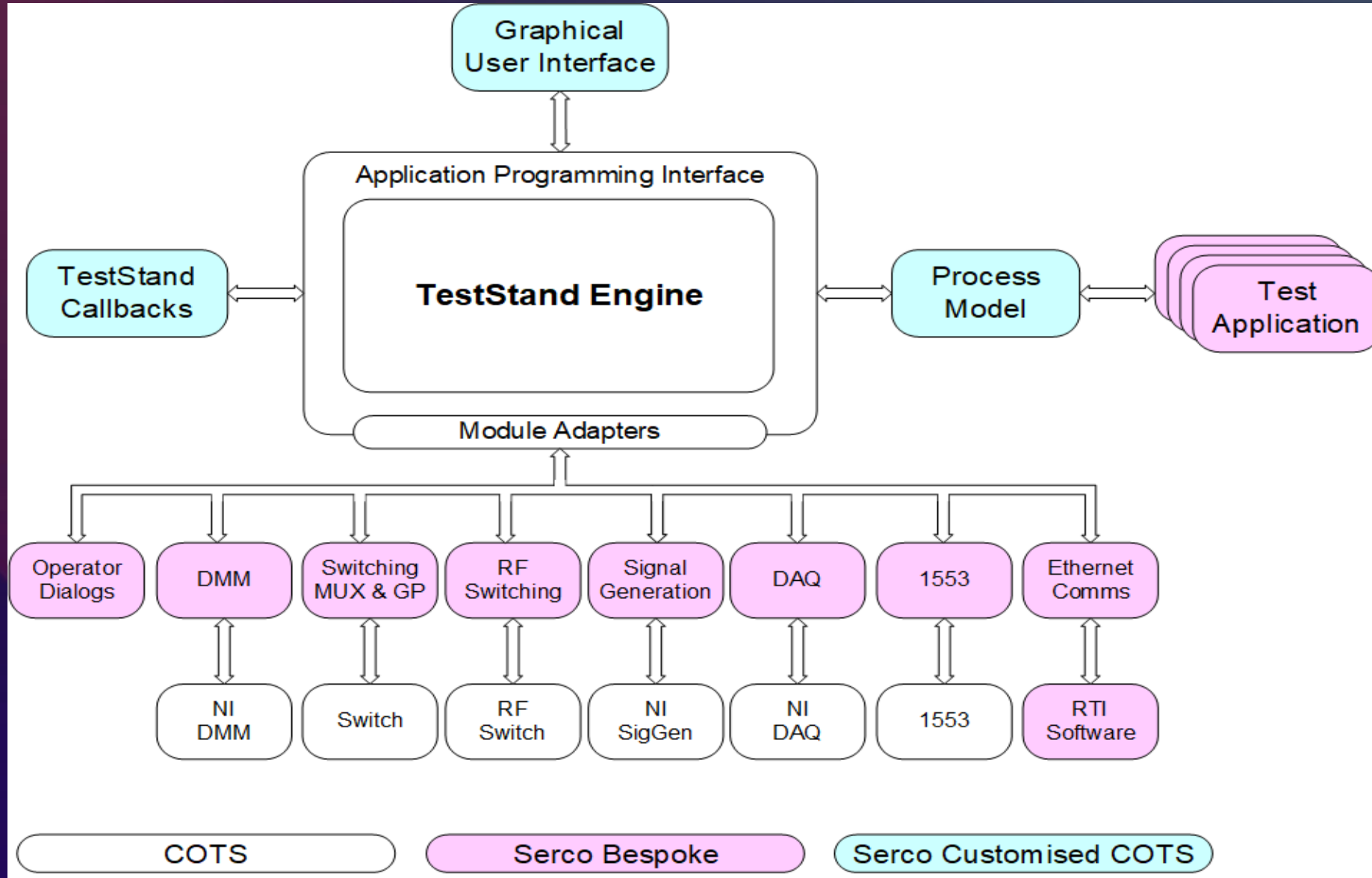
- Introduction of GPSE enabled the UK MoD to retire multiple platform specific assets
 - WE 534
 - WE 2111
 - SSALTS
 - LTF
 - MUFTI
 - AGERD0201
 - AGERD0450
 - AGERD094
 - AGERD097
 - AGERD242
- Fewer Assets.....Less cost (more later)

GPSE System Diagram



GPSE TEST SET BLOCK DIAGRAM

GPSE Software Architecture



Operating System Lockdown and Cyber Security

- Remove bloat
 - Use of Windows IoT to keep OS overhead minimal
 - Removal of superfluous, performance-sapping apps and services
 - Background processes restricted
- Remove access to common ports
 - No user-accessible standard ports
 - Systems knowledge is required to successfully interface with GPSE
- Physical security
 - Physical write-protect on removable storage
 - Use of proprietary connectors
 - No common network connectivity
 - Restricted I/O
- Software and OS-level hardening
 - Application of CIS benchmarks for OS configuration
 - Drive encryption
 - Physical authentication required for system access
 - Restriction to a custom software environment

Environmental Qualification

This contract required compliance with the following standards

- The military environmental and EMC requirements were referenced from DEF-STAN 00-35 and 59-41
 - Climatic conditions A1, A2, A3, B1, B2, B3, C0, C1, C2, M1, M2, M3
 - Electromagnetic Compatibility for Type 1 equipment
- Commercial standards
 - 89/336/EEC EMC Directive using BS EN 61326 for CE marking
 - 73/23/EEC Low Voltage Directive using BS EN 61010 harmonised requirements standard for CE marking.
 - 2002/95/EC Restriction of Hazardous Substance (RoHS) (though not a contractual requirement and GPSE is exempt as a military system, we decided it would be good to comply
- Software standards
 - AQAP 160 Quality Requirements for Software Life Cycle

Design for extreme environments

- Design the protected environment for the instrumentation to handle:
 - The heat generated internally
 - Protect internals from water, humidity, dust
 - Anti-vibration/shock absorbing mounts
- Ensure all components will perform within the modified environment provided by the protective case
- Review all COTS components and add measures to protect them if required
- Model everything
- Test sub-systems and components to incrementally build confidence in final product
- Formal system qualification testing at accredited facilities
- Re-work any areas of failure then re-test

Driving Rain

Def Stan 00-35 Ch 3-27 Test CL27

Storage / Transport Configuration

200mm/hr at 45° to front and rear

Duration: 5 minutes.

GPSE must be operational post-test.



Operational Drip

Def Stan 00-35 Ch 3-28 Test CL28

Operational Configuration

280 litre/m²/hour for 15minutes

GPSE must continue to operate for the duration of the test.



Transportation Salt Fog

Def Stan 00-35 Ch 4-02 Test CN2

Storage / Transport Configuration

Procedure Ka at 35°C

Duration: 28days

GPSE must not have water ingress
and no significant corrosion to
handles or catches.



Non-Operational Lifting

Def Stan 00-35 Ch 2-15 Test M15

Storage / Transport Configuration

Each handle loaded to 3 x GPSE Mass

Duration: 5 minutes per handle

GPSE handles and supporting panels must be undamaged.



Storage Stacking

Def Stan 00-35 Ch 2-16 Test M16

Storage / Transport Configuration

Load 11 x GPSE mass

Duration: 24hours

GPSE case must be undamaged.



High Temperature & Solar Radiation

Def Stan 00-35 Ch 3-02 Test CL2

Storage / Transport Configuration

Procedure A, A1

Duration: Three 24hour cycles

GPSE must be operational post-test.



Wheeled Vehicle Transportation Bounce

Def Stan 00-35 Ch 2-11 Test M11

Storage / Transport Configuration

Duration: 20minutes

GPSE must be operational post-test.



Transportation Vibration & Shock

Def Stan 00-35 Ch 2-11 Test M1

Storage / Transport Configuration

Fixed Wing Propeller aircraft

Duration: 2hours/axis

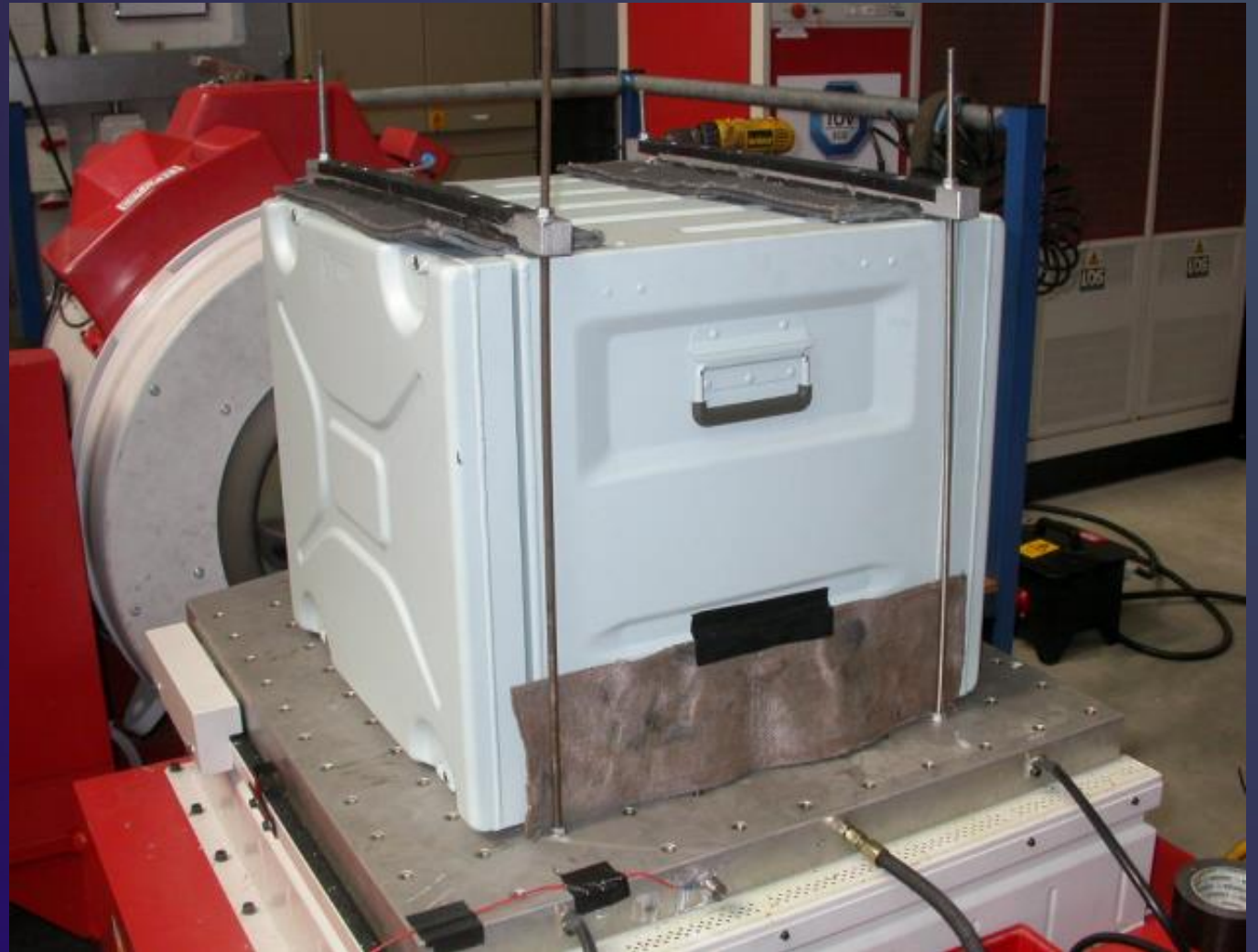
GPSE must be operational post-test.

Def Stan 00-35 Ch 2-11 Test M3

Storage / Transport Configuration

2 x 15g half sine 11ms pulse per side

GPSE must be operational post-test.



Operational Drop Test

Def Stan 00-35 Ch 2-05 Test M5

Operational Configuration

2 x 0.75m drops on base to concrete.

GPSE must be operational post test.

Operational Impact Test
Touchscreen
0.75m Drop 1

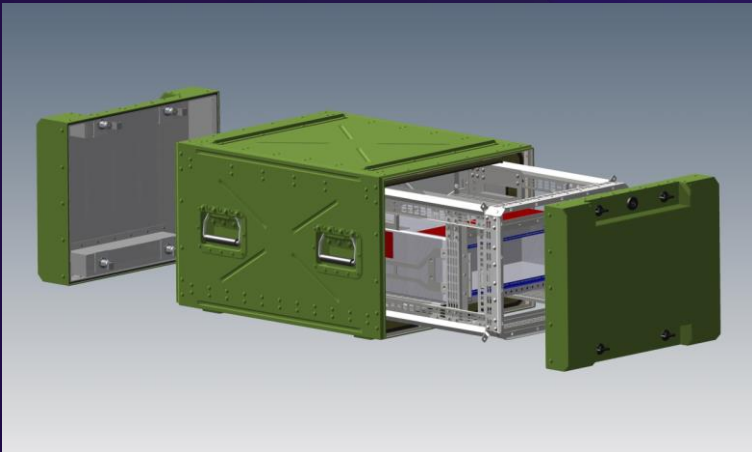
Waterproof Touchscreen

Informal test for engineering amusement



Ruggedised Solutions

- We have a long history of designing ruggedised systems to enable commercial technology to be deployed into extreme environments
 - RF test system – PXIe-1085 in military hardened enclosure
 - Also solutions for PXIe-1062Q and PXIe-1095
 - VXI – big iron ATE
 - Custom solutions – just ask



A large fighter jet is parked inside a hangar. Two workers wearing yellow protective suits and hoods are standing near the aircraft. The jet's cockpit area is covered with white plastic. A large red and purple circular graphic is overlaid on the right side of the image.

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Long term support

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Surface Finish

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Long Term Support – What have we learned

- Initial contract required life of 10 years minimum (19 years ago)
- Current projected service life until 2050 and beyond
- Periodic obsolescence review to component level where possible
 - Identify / test / check impact on system certifications (EMC, safety) of alternative and update design standard.
 - Discuss with customer current availability with view to potential life-time-buy to support current fleet.
 - Upgrade the OS before it becomes un-upgradable with the current hardware.
- NI Hardware Lifecycle status reviewed so Serco aware long in advance of a product reaching 'end of life'.
- In extreme circumstances (no alternative product), NI Hardware Service Agreements have been employed to maintain product repairability and longevity.
- System test results periodically retrieved and reviewed with system failures investigated. Failure trend analysis employed to identify symptoms of circuits that are starting to degrade giving the ability to pre-empt failures and take corrective action, which may or may not be component replacement.
- Test results stored in an off-customer site repository.

The background of the slide is a dense, overlapping pile of US dollar bills. The bills are primarily \$100 bills, with some \$1 and \$2 bills visible. They are arranged in a way that creates a sense of depth and abundance. A semi-transparent, multi-colored diagonal band (shades of purple, blue, and red) runs from the bottom left towards the top right, partially obscuring the bills.

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Reducing Total Cost of Ownership and Driving Efficiency

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Standards Compliance

- CE
- Def Stans
- Mil Standards
- Creates a common understanding of the performance of the system and helps customers in their adoption of it
- Mil-Std-1760C – That defines the interface of the aircraft/store interface
 - Creation of a general purpose test system allows it to be used on any platform (subject to approvals)
 - This can be difficult for some customers as the special to type (STTE) test equipment provided by (or authorised by) the aircraft design authority is an easier road
- Industry standard sequencer (NI TestStand)
 - Supports ATML reporting and input tools

Efficiencies of a common approach

- One general purpose system to control instead of many special to type (STTE)
 - The logistical burden of controlling and calibrating multiple pieces of equipment is higher than for one system
 - Calibration
 - Support/repair
 - Documentation Maintenance
 - Asset storage
 - Common core test systems can allow swapping between service lines to give higher overall availability
- Embracing unified test
 - With multiple operators of a platform all using the same common support solution we have more knowledge that can drive test sequence evolution
 - New features
 - Improved flow and limit refinement
- Common support
 - We operate support programs for multiple customers
 - Common spares pooling
- Mobility – visiting air forces can use common familiar equipment at bases when on missions

Key take aways

- Design for the environment specified
- Engage with NI early (even at the bid stage)
- Think about cyber security and have a plan
- Design in modularity in hardware and software to reduce impact of obsolescence and change
- Think general purpose – what standards can I conform to
- Test early if possible so rework has less impact
- Work with a partner (we are a friendly bunch 😊)

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Questions