Science & Technology Facilities Council

National Satellite Test Facility (NSTF)

Dynamic Test Data Acquisition System Requirements Specification

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Document **Prepared By:**	Mike Shepherd NSTF Facility Project Manager	**Signature and Date:**	Digitally signed by Mike Shepherd Date: 2019.03.20 11:10:10 Z
Document **Approved By:**	Nigel Morris NSTF Project Manager	**Signature and Date:**	Digitally signed by Nigel Morris DN: cn=Nigel Morris, o=STFC, ou=RAL Space, email=nigel.morris@stfc.ac.uk, c=GB Date: 2019.03.20 11:26:48 Z

RAL Space

CHANGE RECORD

Issue	Date	Section(s) Affected	Description of Change/Change Request Reference/Remarks
Draft	03/12/17		First draft – for user's group review
1	22/08/18		First Issue, high level requirements only
2	07/03/19	All	Second issue. Compete re-write with detailed requirements
2 Rev 1	13/03/19	P1, 11,12	Minor revision – fully signed off & minor text corrections
2 Rev 2	20/03/19	P5	Minor revision – "(except for section 2.8a)" added to table introduction, and units conflict in table corrected (all now kHz).

TABLE OF CONTENTS

1. PREAMBLE

1.1 SCOPE

The National Satellite Test Facility (NSTF) is a new facility for the environmental testing of complete satellites and large sub-assemblies. It is being funded by the UK Government, developed and operated by RAL Space, and will provide comprehensive space AIV/AIT facilities for both new and existing space companies.

This document identifies the requirements for the National Satellite Test Facility (NSTF) dynamic test data acquisition system.

1.2 PURPOSE

The System will be the primary method of acquiring data for all satellite and sub-assembly vibration, acoustic and shock tests in the NSTF. In responding to these requirements potential suppliers will be able to demonstrate that their solutions will give a robust, accurate, high quality system with long term support.

1.3 REFERENCE DOCUMENTS

RD #	REFERENCE DOCUMENT TITLE	DOCUMENT ID	ISSUE / DATE
1	NSTF Data Acquisition System Price Schedule Template	UK SBS PR19002	(see bid)
2			
3			

2. REQUIREMENTS

2.1 GENERAL INFORMATION

Data acquisition is a critical part of the satellite testing process. Suppliers are encouraged to describe the use of their systems at similar facilities.

The system is only intended to be operated within the NSTF. See the Schematics (sections 3 and 4) for the operating environments of the different elements.

RAL Space will be responsible for delivering appropriate PCs/servers and display screen hardware for all NSTF systems. All computers will be supplied with a bare operating system with an administration account for suppliers to customise.

The preferred system for Control/Measurement is “Windows Server 2016 x64” (using Dell Server hardware – PowerEdge R640). Alternatively “Windows 10 Enterprise x64” (using Dell CAD hardware – Precision R7920) may be used. Standard tasks will be run on “Windows 10 Enterprise x64” (using Dell Desktop hardware - Optiplex 7060).

Maintenance and support access to the system will be via a Secure Remote Desktop Gateway Service.

For the purpose of this tender the following large satellite test requirements should be assumed (except for section 2.8a):

Test Type	No. of Channels	Sample rate kHz	Duration mins	No. of Test Axes	Runs per axis
Sine vibe	500	≥5	3	3	5
Acoustic	500	≥25	1	1	4
Pyroshock	250	100	0.5	1	10

2.2 HARDWARE CONFIGURATION – MANDATORY

a) The system shall be modular, reconfigurable and expandable

b) The system shall be capable of operation as two independent assemblies (Schematic 1), or combined into one large assembly (Schematic 2).

Schematic 1 shall be used for delivery.

c) The main control and storage hardware will be located in the NSTF vibration test facility control room. RAL Space will provide suitable (Cat-6/6a) Ethernet cables between the control room and the test areas. All other cables, network switches, etc. are the responsibility of the supplier. Cat6/Cat6A Ethernet cables shall be used for all local connectivity within the system; the NSTF colour code for these cables is grey.

d) A facility UPS will be supplied by the RAL Space. The supplier shall define the UPS requirements for all elements of the data acquisition system.

e) Storage and processing shall take place in the control room.

f) The supplier shall state compliance of their system setup (Software Application(s) and Hardware requirements) with Windows Server 2016 x64 and/or Windows 10 Enterprise x64 (Non-compliances can be considered on a case by case basis.)

g) The supplier is to state the minimum and preferred high-end PC or Server, video card, display screen and storage requirements for the main control and data storage. RAL Space expects to maintain a redundant PC or Server for this system.

h) The supplier is to state the minimum and preferred PC, video card and display screen requirements for the two local controllers, used for set-up, instrumentation checking and remote test control. RAL Space intends that these two computers provide redundancy to each other in the event of failure.

i) RAL Space will provide a one Gb/s network connection to connect the system to the NSTF network for distribution, long-term storage, backup and maintenance purposes. This shall not be used for internal rack or inter-rack communications.

j) The system shall support up to four display screens within the control room. The supplier shall define the requirements for the display screens.

k) The A/D hardware shall be mounted in mobile 19” racks or similar, provided by the supplier. Each rack shall be no more than 2300mm tall (including wheels), and shall be able to pass through a 1000mm wide door opening. Easy access to the modules is required for system reconfiguration. Locking wheels are required. All external surfaces shall be cleanable with Isopropyl Alcohol.

l) The Analogue to Digital converter (A/D) hardware may be subjected to high noise environments of up to 130 dB (reference: 0 dB = 2 x 10–5 Pa) during acoustic testing.

m) Each mobile rack shall be self-contained in its power distribution and internal networking, and shall be powered through BS1363 three pin electrical plug(s).

n) The system shall support remote and independent viewing of the data in near real-time from other areas of the facility via the NSTF LAN.

o) The system will include sufficient software licences for the simultaneous operation of two systems, including remote viewing at 2 stations.

2.3 HARDWARE DELIVERY - MANDATORY

a) Delivery is required before Friday 13th December 2019.

2.4 SENSORS TO BE SUPPORTED – MANDATORY

a) The system shall be capable of acquiring a minimum of 500 channels simultaneously, comprising of different combinations of the sensor types identified below:

   i. 400 IEPE TEDS Accelerometer channels. The system shall supply 20-30V, 2 to 20mA input for the integrated pre-amplifiers.
   ii. 36 force sensor charge amplifier outputs ±10V. (see derived channels requirement for force and moment calculations)
   iii. 100 Strain Gauges (¼, ½ and full bridge)
   iv. 30 IEPE TEDS Microphone channels. The system shall supply 20-30V, 2 to 20mA input for the Integrated pre-amplifiers

b) The data acquisition current supply for IEPE sensors must be selectable on a channel by channel basis as any of these channels may be shared with the vibration controller.

2.5 SENSOR INTERFACES – MANDATORY

a) The accelerometer connectors shall be BNC Female

b) A visual status indication shall be given when connecting integrated pre-amplifier sensors that the circuit is complete & nominal current is being drawn.

c) Indication shall be given either at the connector interface and/or within the software displays of the local rack PC.

d) The system shall be able to carry out open loop and short circuit checks for all types of sensors and cables.

e) An interface for IEEE 1451 Transducer Electronic Data Sheet (TEDS) Class 1 shall permit the automatic loading of instrumentation calibration data into the system when using these sensors.

f) The system shall be capable of being set up in advance off-line and stored and retrieved as required.

g) The system shall be able to record TEDS sensor, A/D channel and module identification and calibration data with each set of test data

h) The system shall be synchronised to the NSTF facility GNSS time synchronisation signal. RAL Space will distribute this signal throughout the facility from a central antenna and receiver via coaxial cable.

2.6 SENSOR INTERFACES - SCORED

a) The supplier shall describe how the Data Acquisition system can use TEDS data when it is not providing the current source for these sensors. (required when sensors are shared with a control system)

b) The supplier shall describe how the system could be adapted to acquire data from other sensor types including microphones, piezo-electric (charge) accelerometers and miscellaneous voltages ±10V.

c) The supplier shall state whether the following Strain Gauges resistances can be supported: 120Ω, 350Ω and 1000Ω. And also if shunt calibration or similar techniques are included in the hardware.

d) Overload protection shall be ≥40V.

2.7 DIGITISATION – MANDATORY

a) The system shall be capable of acquiring time histories at a sample rate of 100 kHz. This capability is required to meet 10x oversampling requirements for Pyroshock recording.

b) The A/D is expected to have ≥24 bit converters and have a useable dynamic range suitable for IEPE accelerometers and microphones.

c) The system shall be able to remove any DC offset to less than 0.1% of the measurement range for each type of A/D used.

d) The supplier shall provide a measurement uncertainty budget for the measurement and processing chain, not including the sensors.

2.8 DIGITISATION - SCORED

a) The supplier shall state if all 500 channels can be acquired simultaneously at a sample rate of 100 kHz, and if the dynamic range (or other parameters) is reduced by this mode of operation.

b) The supplier shall provide details of the design and performance of their A/D hardware, including amplitude precision and phase matching between all channels in an assembly up to 2000 Hz.

c) The supplier shall describe their anti-aliasing techniques.

d) The supplier shall state if an integrated signal source(s) is included as standard or supply options for adding this capability.

e) Options should be presented for analogue and digital alarm outputs.

2.9 DATA PROCESSING – MANDATORY

a) As delivered, the system shall be capable of basic capture & review of data. Software licences for Sine Reduction, Random Reduction and Shock Capture shall be included. These licences shall permit the system to operate as one large assembly or two independent assemblies.

b) The system shall be capable of generating alarm and abort outputs.

c) Low-pass, Band-pass and High-pass filters shall be available. The original time series data must not be changed by these operations.

d) Acoustic data shall be presented in Octave, 1/3 Octave and narrow band formats.

e) The system shall be able to capture, display in real time and replay both frequency and time domain data from DC to 10 kHz.

f) The system shall be able to capture, display in real time and replay transient test data with the highest sample rate (100 kHz). Other parameters may be post-processed.

g) The system shall be able to calculate and display derived channels in real time for sine (5-150 Hz) and random (5-2000 Hz

h)) testing. E.g. To monitor loads and moments applied to a satellite in three axes, 3 sets of 12 load link inputs will have summed or multiplied by a factor and summed.

i) The data storage format shall be readable by other software without further licenses being required.

j) The data shall be exportable in standard non-proprietary formats. UFF is required, in particular UNV58. Compatibility with other data formats and management systems such as Intespace DynaWorks neutral file output (.NT), ASAM ODS, HDF5, etc. shall be stated.

2.10 DATA PROCESSING - SCORED

a) Options for additional licenses for post processing data should be proposed. This should include
   i. The use of the existing software system by additional users, both short term and long term
   ii. The supply of more advanced analysis software modules, both short term and long term

2.11 OPERATIONAL SUPPORT- MANDATORY

a) A minimum hardware and software warranty of 36 months is required. The warranty shall include repair and/or replacement of all supplied component parts and software, and technical support as defined below.

b) The supplier shall supply phone, email and remote access support during normal working hours.

c) The supplier shall provide onsite support when both parties agree an issue cannot be resolved by phone, email or remote access support. This onsite support must not be available any later than 96 hours once agreement is made it is required. Earlier response time is of benefit to the Contracting Authority.

d) The support and maintenance identified in c) and d) above must be for a minimum of 36 months, included in the contract price. Price options for further extensions to this should be provided as part of the AW5.2 Price Schedule template return [RD1], under section 'Additional/Optional Costs'.

e) The supplier shall ensure availability of onsite technical specialist support during the NSTF development and critical tests. If this will incur any additional cost, this should be provided as part of the AW5.2 Price Schedule template return [RD1], under section 'Additional/Optional Costs'.

f) The supplier shall provide indicative costs for the rental of extra data acquisition modules as part of the AW5.2 Price Schedule template return [RD1], under section 'Additional/Optional Costs'.

2.12 OPERATION SUPPORT - SCORED

a) The supplier shall provide a commissioning and training plan. Training shall take place at RAL Space premises after commissioning of the system for up to 6 staff.

b) The supplier shall state the available service level for issues that cannot be resolved by routine phone/email/remote access.

c) The supplier shall propose a calibration contract for 3 years. This should include details of calibration methodologies and traceability, e.g. UKAS, ISO 17025.

d) The supplier shall describe their approach to software updates, upgrades and assurance, including minor and major revisions of applications.

e) The supplier shall describe their licence policy, detailing how the licences work with regard to flexibility of use, allocation to machines or users, operator or viewer functionality, and seamless transfer to a spare redundant PC or Server in the event of failure.

f) The supplier shall confirm their intention to providing technical support to the product line for 10 years.

2.13 PATCH PANEL OPTION – FOR INFORMATION ONLY

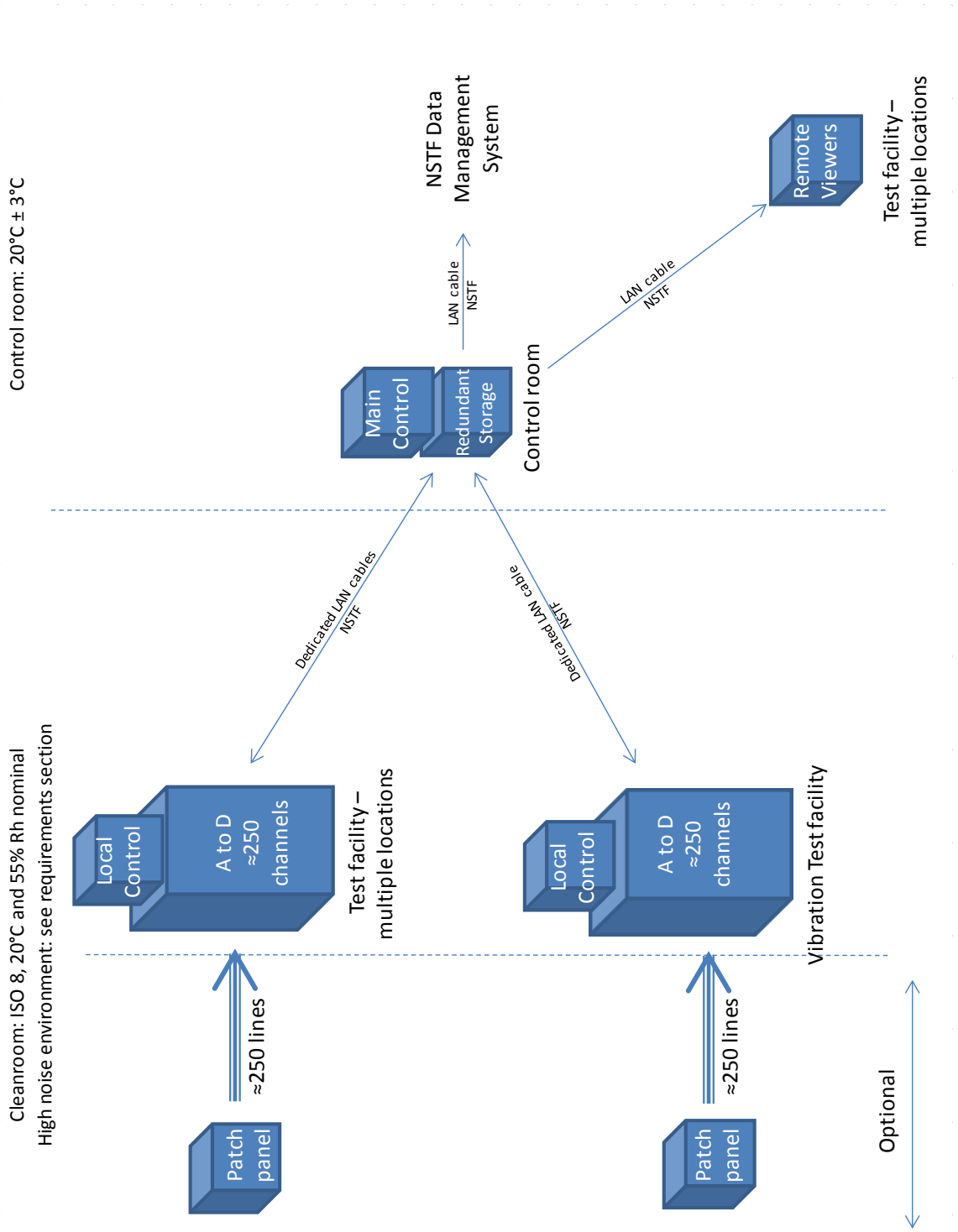
a) The purpose of the patch panels is to allow satellite instrumentation to proceed independently of the data acquisition system, potentially off-site.

b) Suppliers may quote for 2-off 250 channel Patch panels, 19" rack compatible or similar, with 10m cables.

c) The supplier should state if the patch panel provides an indication of sensor status.

d) The supplier should state if the use of the patch panels changes the interface to D/A modules.

3. SCHEMATIC 1: TWO INDEPENDENT RACKS



4. SCHEMATIC 2: LARGE ASSEMBLY