SCIENTIFIC RESEARCH INSTITUTE OF SYSTEM ANALYSIS (SRISA)

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NATIONAL RESEARCH NUCLEAR UNIVERSITY "MEPhI"

Status of the scientific data acquisition system for the GAMMA-400 space telescope mission

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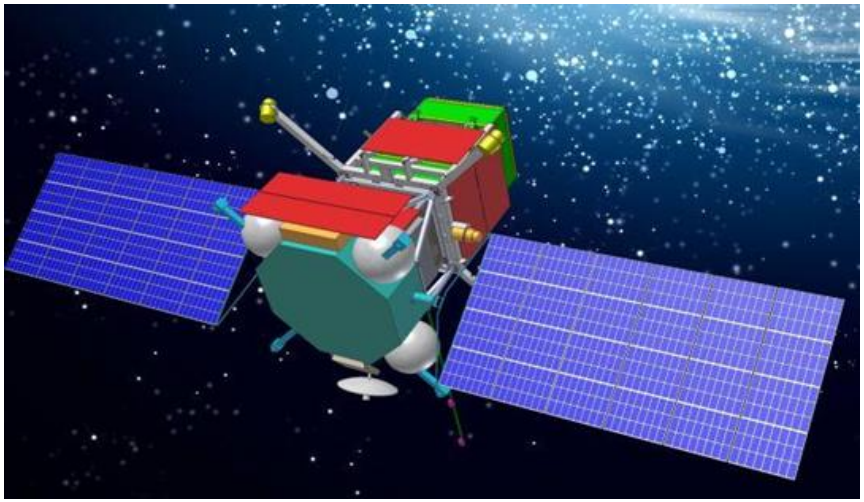
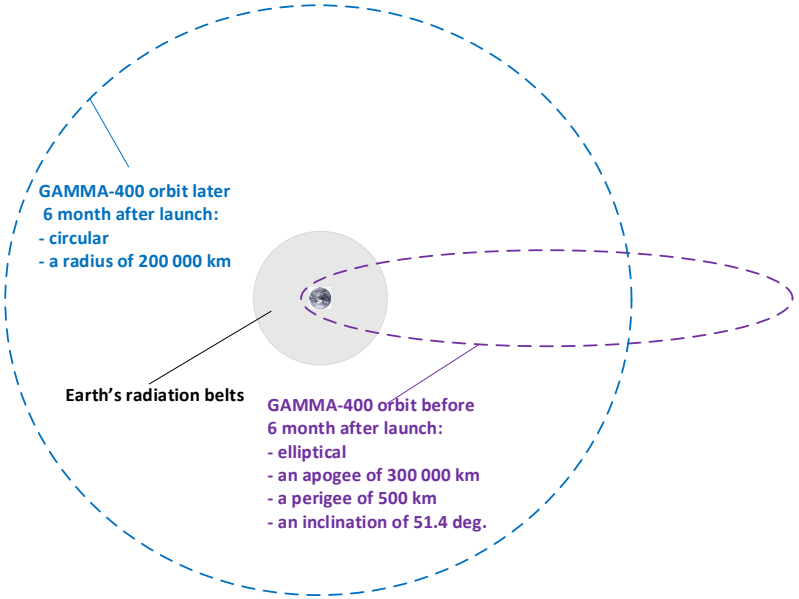
GAMMA-400 space telescope mission

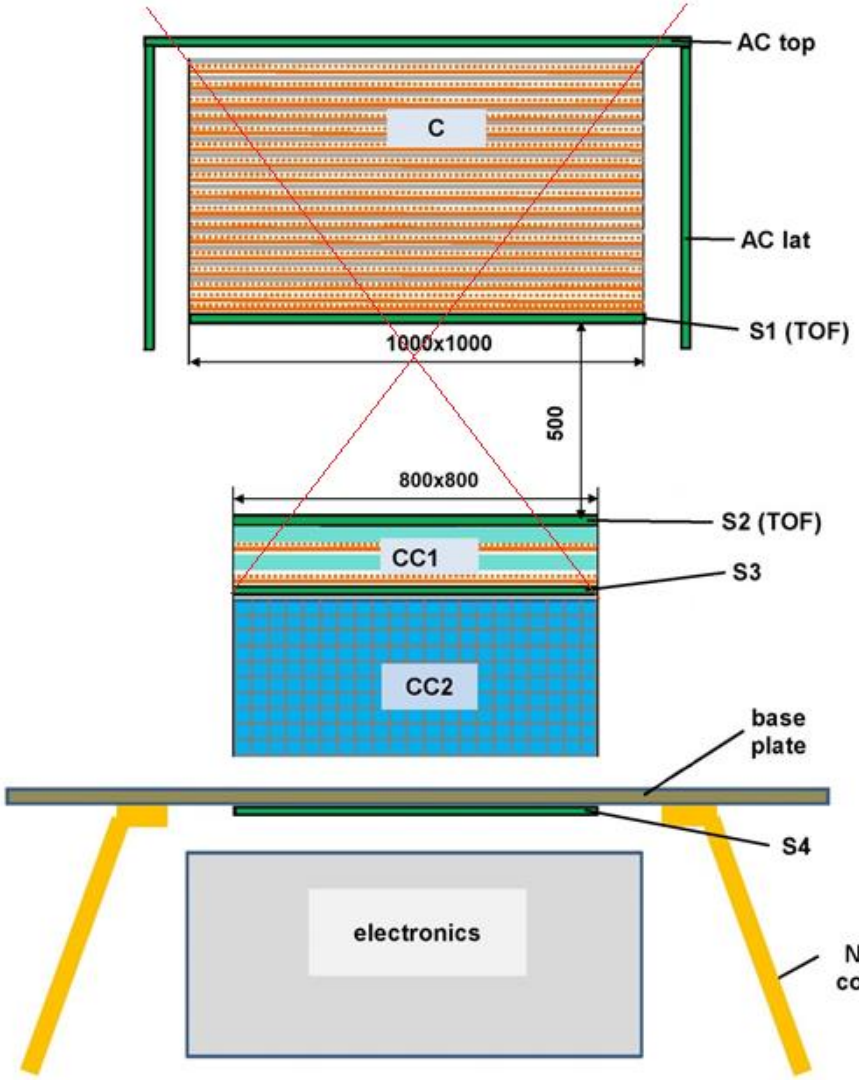




- **The GAMMA-400 main scientific goals:**
  - ***Dark matter searching by means of gamma-ray astronomy***
  - ***Precise investigation of extended and point gamma-ray sources and diffuse gamma rays***

- **Gamma-400 telescope will be installed on the Navigator space platform**
- **Scientific payload 2600 kg**
- **Power budget 2 kW**
- **Expected lifetime >7 years**

GAMMA-400 physical scheme



AC - anticoincidence detectors (AC top, AC lat)

C - Converter-Tracker - total 0.9 Xo
20 layers Si (x,y) (pitch 0.1mm) + W 0.025 Xo
2 layers Si (x,y) (pitch 0.1mm) no W

S1, S2 - TOF detectors

S3, S4 calorimeter scintillator detectors

CC1 - imaging calorimeter (2Xo)
2 layers: CsI(Tl) 1Xo + Si(x,y) (pitch 0.1 mm)

CC2 - electromagnetic calorimeter 19 Xo
CsI(Tl) 3.6x3.6x3.6 cm^3 - 22 x 22 x 10 = 4840 crystals

Convertor-Tracker (C) consists of four parts:
C1, C2, C3, C4

The main functions of the scientific data acquisition system (SDAQ)

- The information acquisition from the sub-systems of the scientific complex.
- Preliminary processing of scientific information and storage it in non-volatile memory.
- Data transfer into high-speed (320 Mbit/s) scientific radio line for its transmission to the data acquisition ground stations.
- Control information reception from the satellite onboard control system (OCS) via MIL-STD-1553B interface, its decoding and transfer to telescope sub-systems. Acquisition of housekeeping data and their transmission to OCS.
- Receiving signals from onboard time and frequency standard system and onboard control system and generating high-stable reference synchronization signals and onboard time code for precise timing of scientific data.

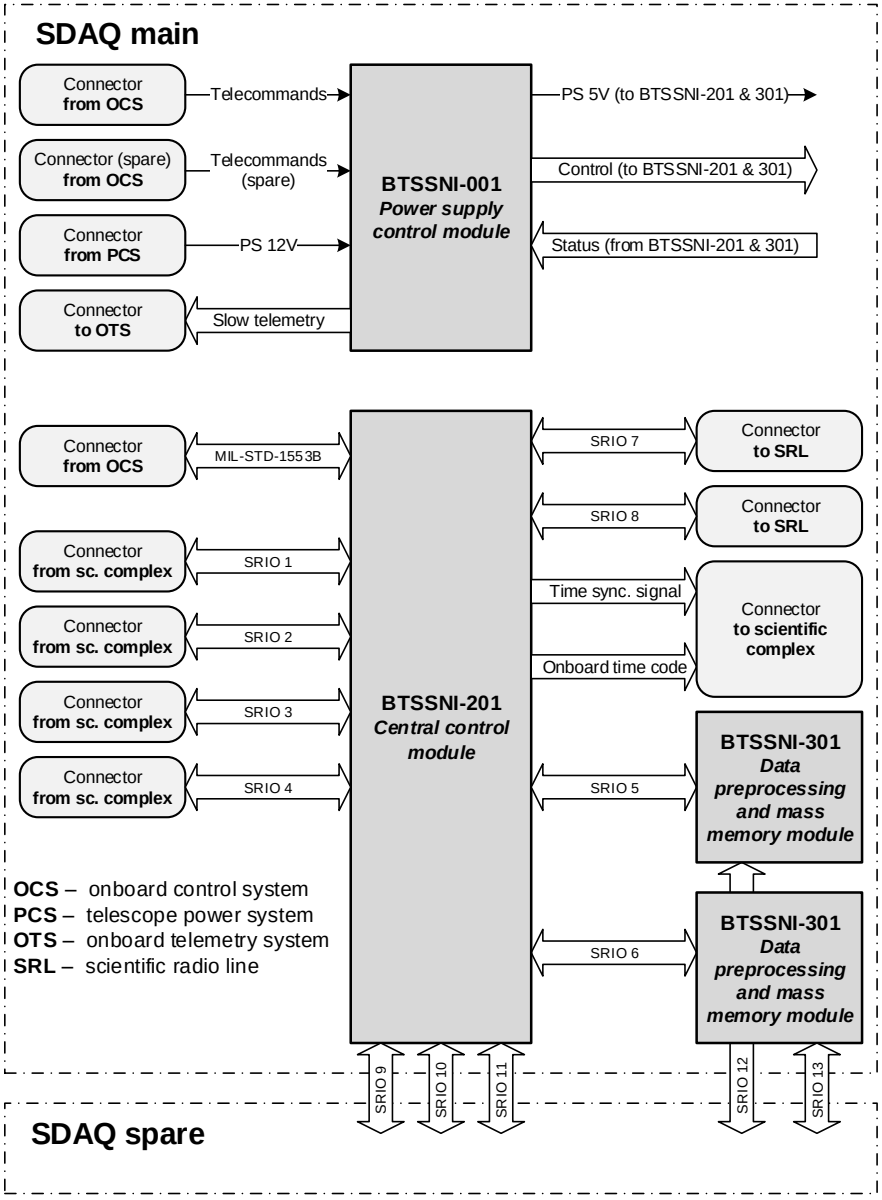
Scientific data structure and volume

- The structure of data from telescope subsystems for detected event:

Telescope subsystem	Maximum data volume, Bytes
Anticoincidence subsystem (AC)	128
Converter-tracker part 1 subsystem (C1)	276 480
Converter-tracker part 2 subsystem (C2)	276 480
Converter-tracker part 3 subsystem (C3)	276 480
Converter-tracker part 4 subsystem (C4)	276 480
Imaging calorimeter subsystem (CC1)	80 000
Electromagnetic calorimeter subsystem (CC2)	17 632
Time of flight detector subsystem (S1, S2)	256
Calorimeter scintillator detector subsystem (S3, S4)	128
Trigger subsystem	128
Total:	1 204 192

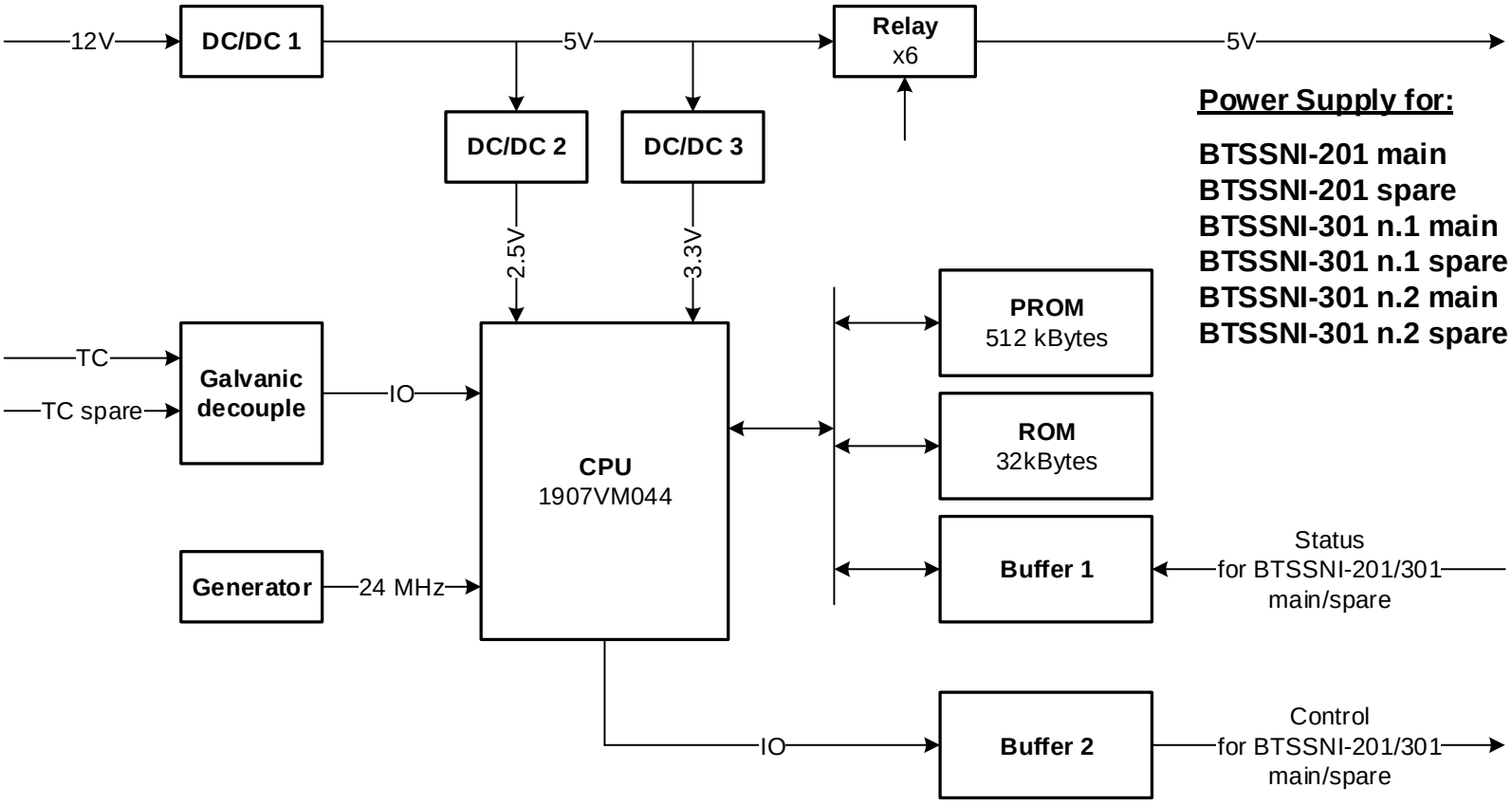
- The estimated maximum volume of scientific information collected per day is about 100 GByte

SDAQ Block Diagram

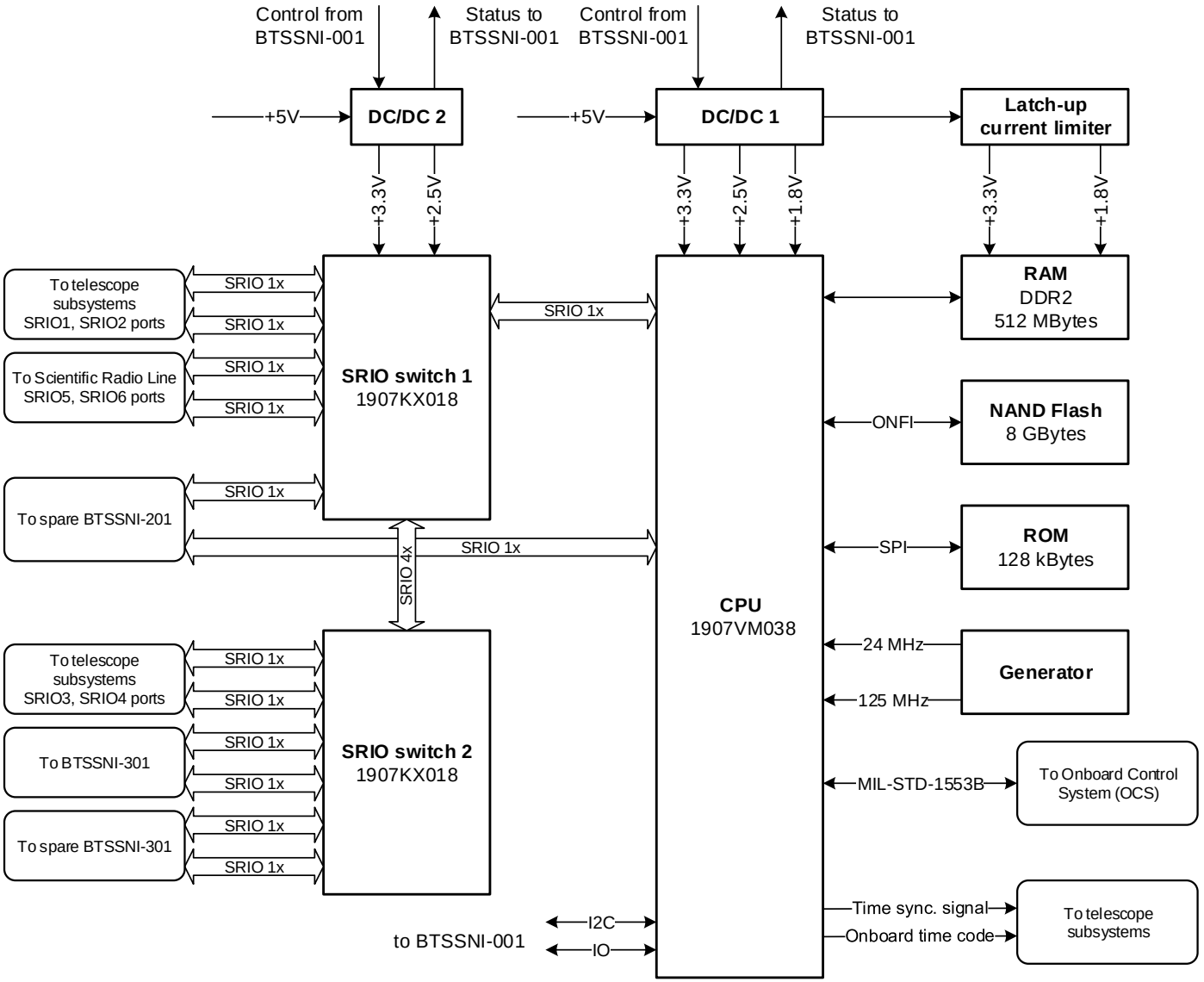


- **BTSSNI-001 (power supply control module) main functions:**
  - DC/DC convertor
  - Power supply distribution to BTSSNI-201 & 301
  - Monitoring of SDAQ status and power supply quality
- **BTSSNI-201 (central control module) main functions:**
  - Control information reception from the satellite onboard control system (OCS) via MIL-STD-1553B interface, its decoding and transfer to telescope subsystems
  - Acquisition of telescope subsystem housekeeping data and their transmission to OCS
  - Generating of the high-stable reference synchronization signals and onboard time code for scientific complex
  - Control of the SDAQ functioning
- **BTSSNI-301 (data preprocessing and mass memory module) main functions:**
  - Preliminary processing of scientific information
  - Scientific information storage in non-volatile mass memory

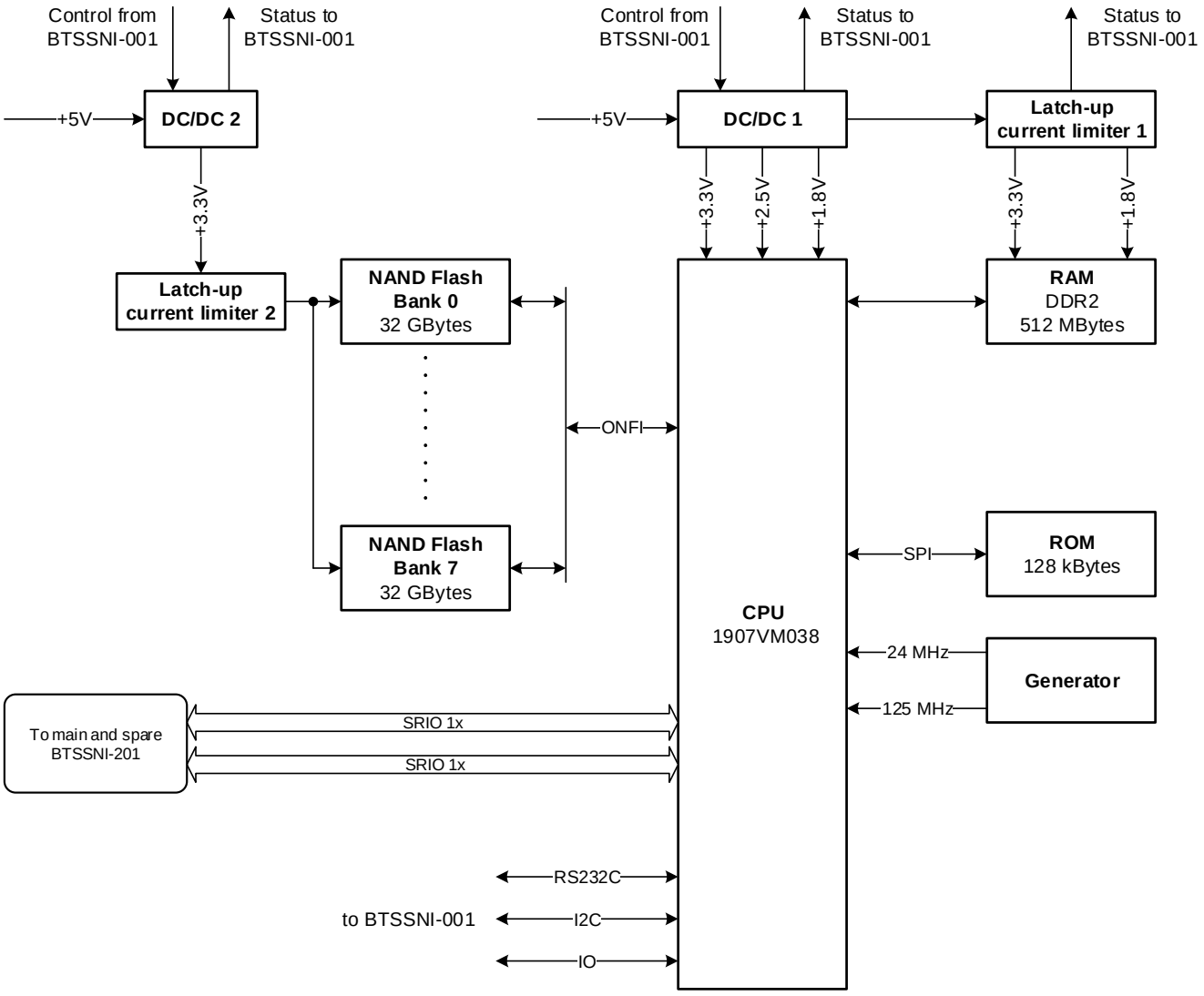
BTSSNI-001 Functional Diagram



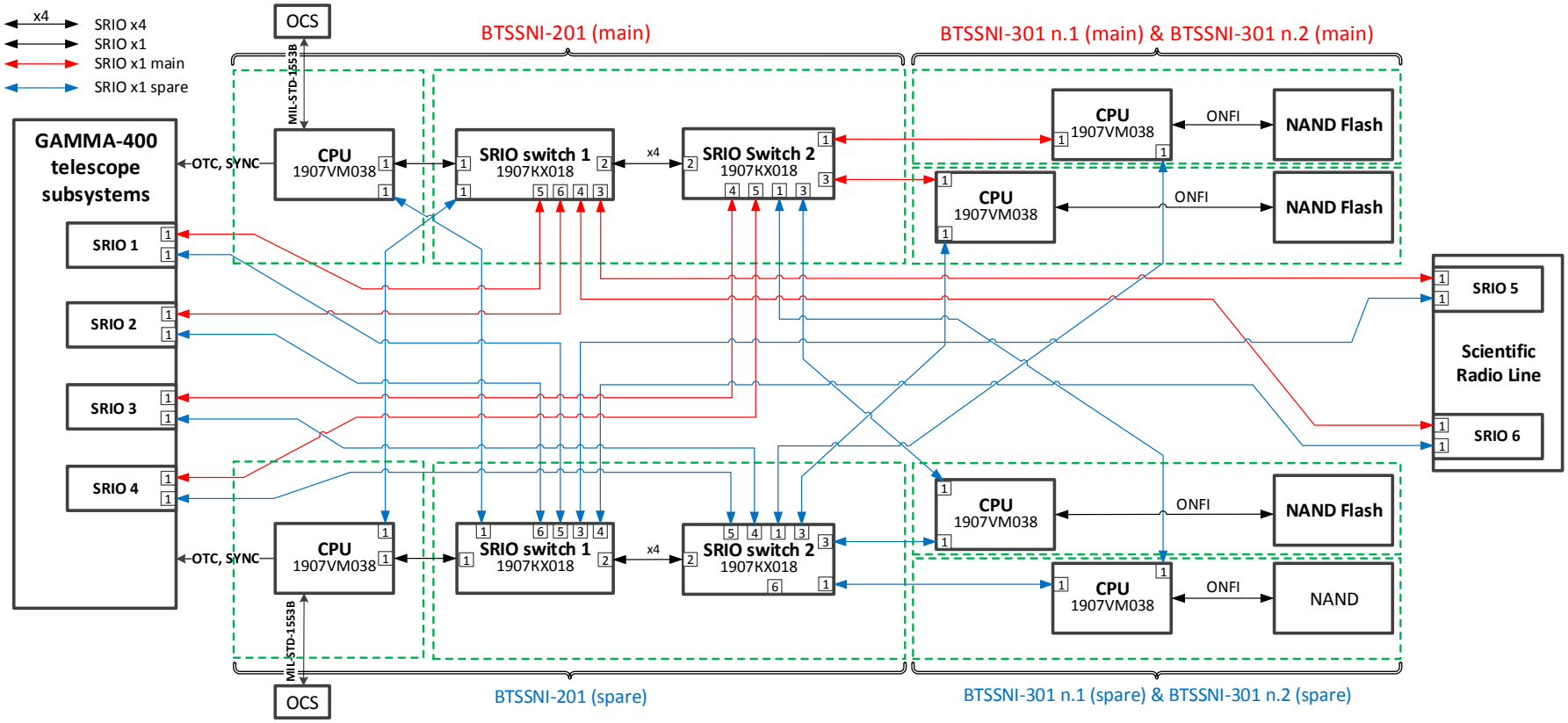
BTSSNI-201 Functional Diagram



BTSSNI-301 Functional Diagram



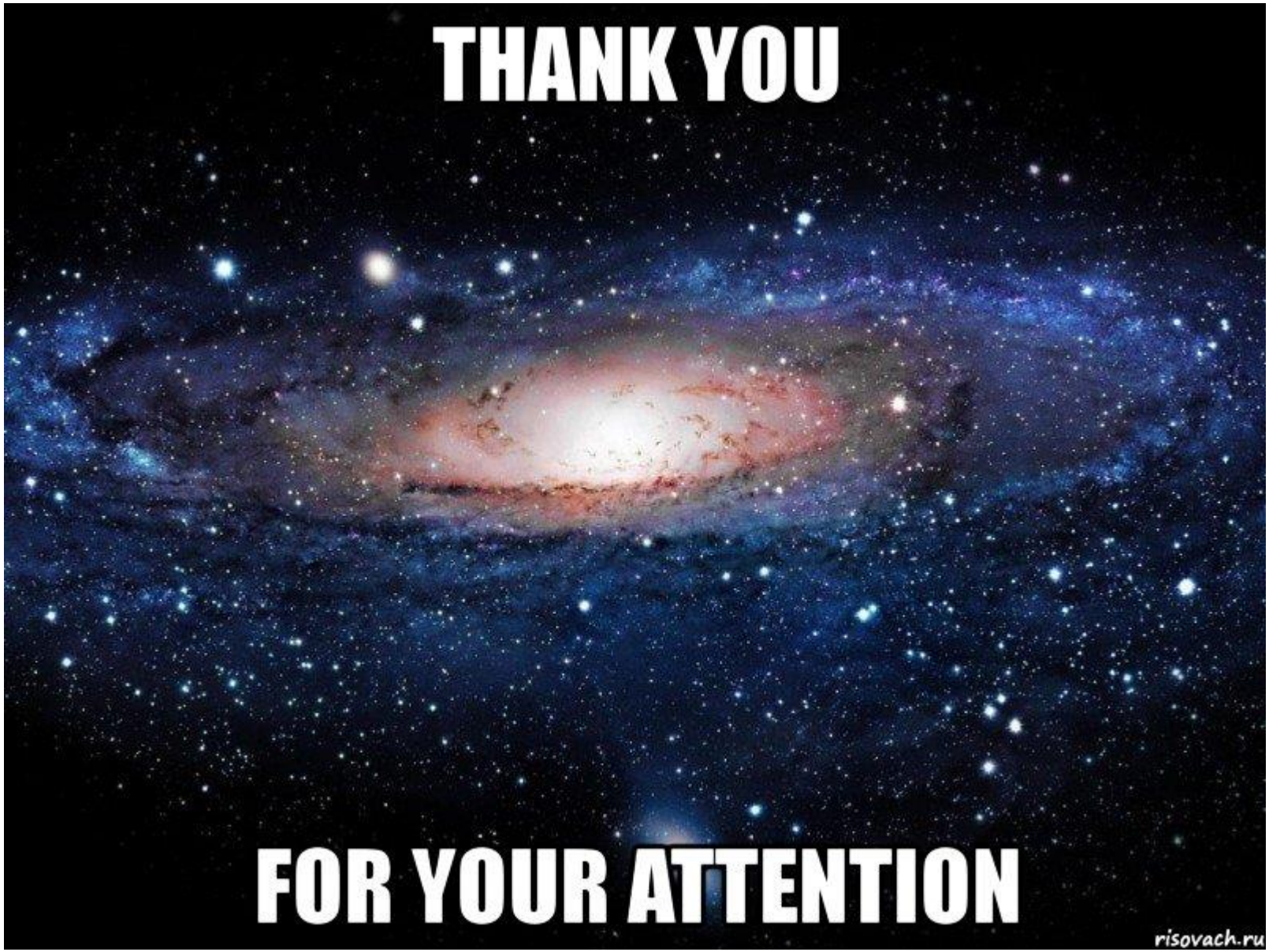
SDAQ Serial Rapid Input-Output (SRIO) interface configuration



The total number of SDAQ operating configurations with BTSSNI-001 main and spare modules is 32

SDAQ technical characteristics

Parameter	Value
Maximum time for receiving and recording of the data for single detected event	21 ms
Maximum total throughput of SRIO1-SRIO4 interfaces	70 MByte/s
Mass memory total (main+spare) volume	1024 GByte
Maximum data flow transmitting to Scientific Radio Line via SRIO 5 & 6	40 MByte/s
Number of external main and spare SRIO interfaces	12
Number of main and spare MIL-STD1553B interfaces	2
Number of main and spare time synchronization interfaces	2
Number of output slow telemetry signals: - Temperature detectors - Dry contacts	 16 20
Number of input main and spare pulse telecommands	20
Maximum power consumption	80 W
Outline dimensions	398x244x234 mm
Mass	not more then 25 kg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