SPACEMAN 2: TOWARDS MULTI-PROTOCOL NETWORK MANAGEMENT

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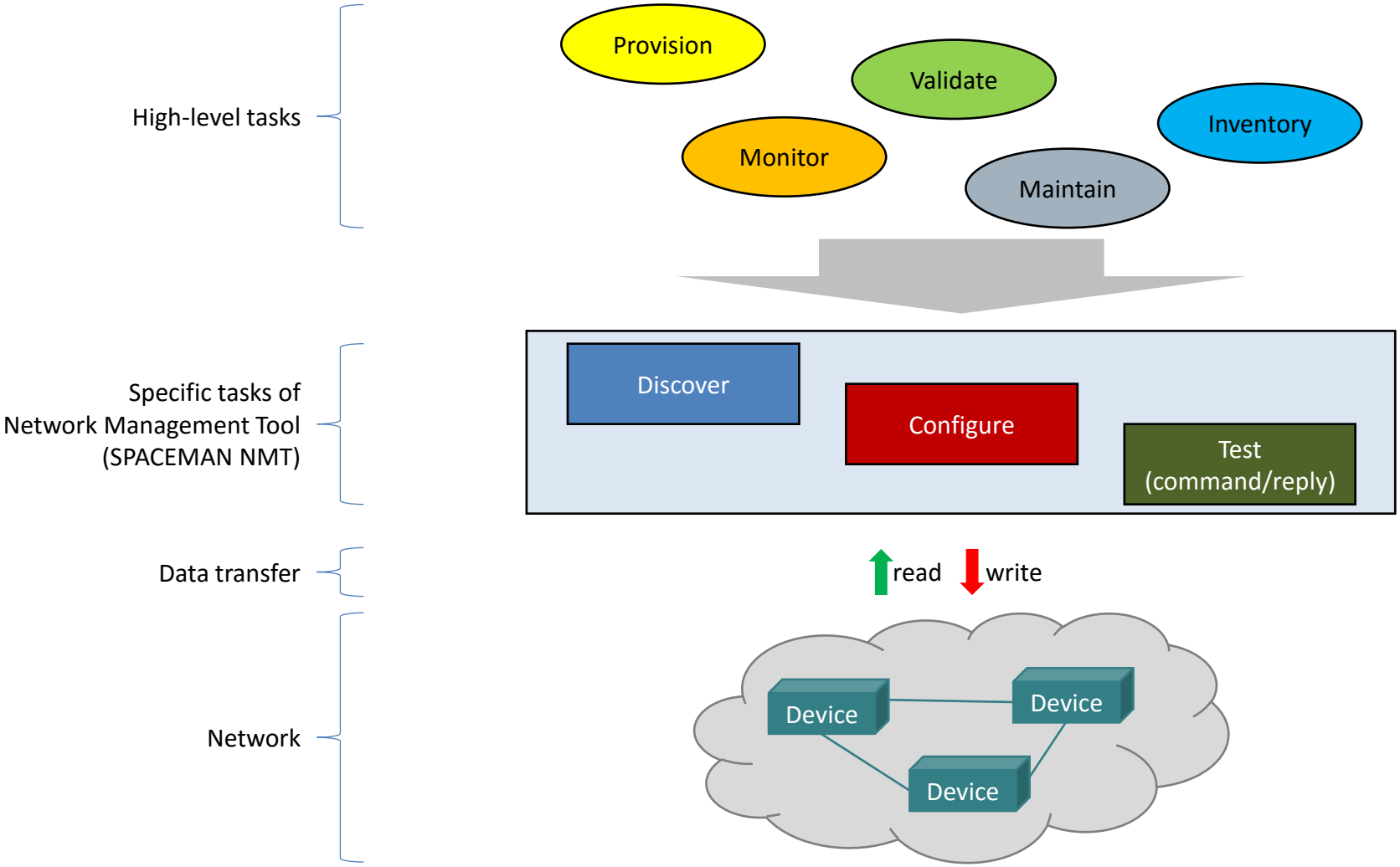
OUTLINE

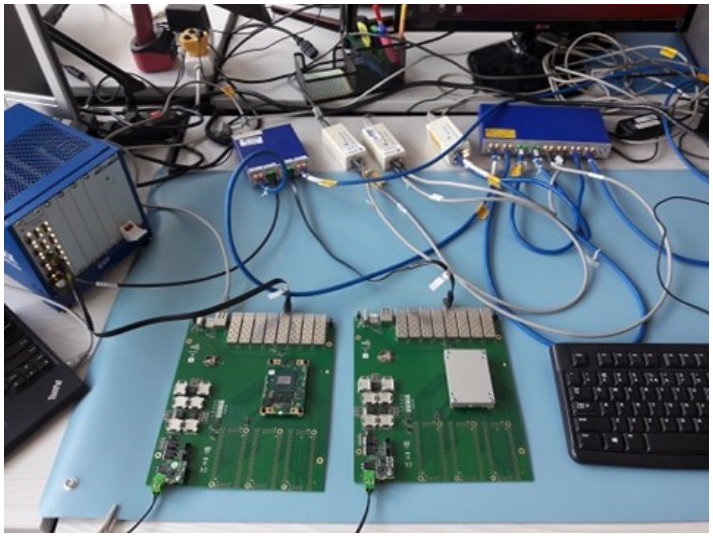
- Network management and SPACEMAN
- Device support
- Other new SPACEMAN features
- Beyond SpaceWire/SpaceFibre
- Conclusion

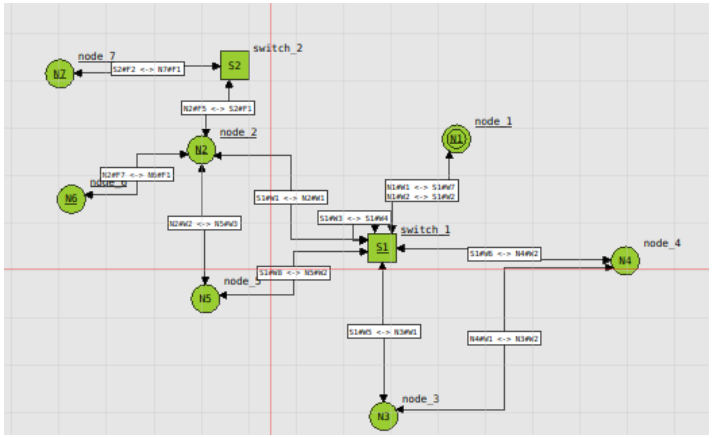
SPACEMAN AND NETWORK MANAGEMENT TASKS



SPACEMAN NMT BASELINE FEATURES

- Manage SpaceWire and SpaceFibre networks, employing NDCP and RMAP
- Automatic device discovery and network topology detection and monitoring
- Read/write/save/restore/compare network configurations
- Generate/edit/export/import XML network models
- Send/receive test packets, packet sequences, and transactions



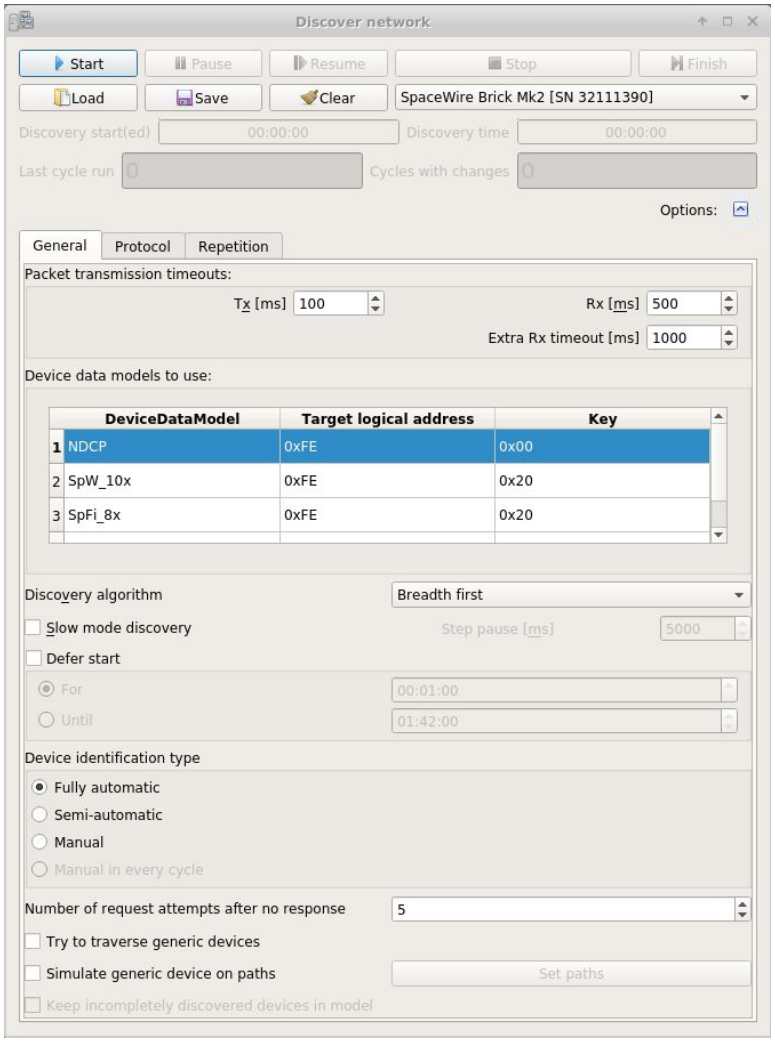


TOWARDS SUPPORT OF MORE DEVICE MODELS

- NDCP provides standardized addressing and contents of its fields.
- RMAP is standardized as to frame format and command-reply semantics only.
- Different device models can have different organization of memory responsible for configuration:
  - register contents: meaning, types, units, ranges, reset and default values,
  - register size and number,
  - memory address maps,
  - addressing modes (e.g. byte- vs. word-oriented),
  - byte order (most-significant-first vs. least-significant-first),
  - RMAP command types implemented (e.g. single address vs. incrementing address types).
- Thus there is no single RMAP support method for all devices.
- SPACEMAN NMT initially supported NDCP, and SpW-10X implementation of RMAP as an “exception”.
- Now it has introduced support of *Device Data Models*

DEVICE DATA MODELS

- A Device Data Model is a code module for supporting memory organization of a specific device model:
  - NDCP (the original version),
  - NDCP v.2 (proposed in a companion paper),
  - RMAP for different device models – in a table shown further.
- A prioritized list of Device Data Models can be manipulated by the user.
- Selection of Device Data Models can be:
  - automatic (by SPACEMAN),
  - semi-automatic,
  - manual (by the user),
  - manual in every cycle of continuous discovery

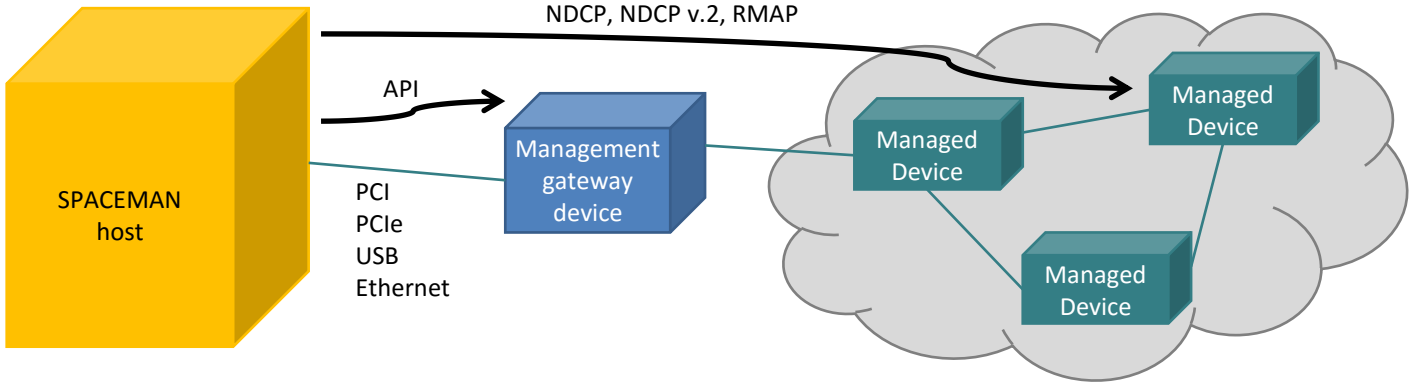


DEVICE DATA MODEL USAGE

- There are predefined *device signatures* – data patterns in replies to particular RMAP ‘read’ commands that are characteristic for specific device models.
  - SPACEMAN uses the device signatures for confirming the model of a device if it receives the reply.
  - Since there is no standardization as to the characteristic data, this approach is not guaranteed to succeed.
- Modes of selection of Device Data Models:
  - fully automatic:
    - SPACEMAN tries each of the models on the list in priority order, until there is a correct reply or the list is exhausted.
    - If exhausted, the device (which is detected as present because of a running SpaceWire link) is marked ‘Generic’. Such a device can optionally be traversed in topology discovery, assuming there is a chance that the device is a switch with more devices connected behind.
  - semi-automatic:
    - Like the fully automatic mode unless the list is exhausted.
    - If exhausted, the user can manually select the model to use for this device (assuming there are models to try that are not present on the current list and hence not tried automatically).
  - manual:
    - No automatic model selection.
    - The user selects the model to use for each of the devices as they are encountered by SPACEMAN. The selections are remembered for the current operation.
  - manual in every cycle (relevant only in continuous discovery)
    - Like the manual mode, but the selections are not remembered across the discovery cycles.

DEVICE SUPPORT

- Support for several device models have been added to SPACEMAN, of SpaceWire as well as SpaceFibre type.
- There are two aspects of device support:
  - **As managed devices**
    Managed devices can be discovered and configured as peripheral devices – elements of the managed network.
    This support depends on implementation of a management protocol (NDCP, RMAP) in the device;
    in the case of RMAP – also on full information on the memory organization and addressing.
  - **As management gateway devices**
    Management gateway devices are devices used by SPACEMAN for connecting to the managed network.
    This support depends on the interface implemented between the device and the SPACEMAN-hosting computer, including any API if needed.
    A management gateway device may be in some cases also a managed device at the same time.



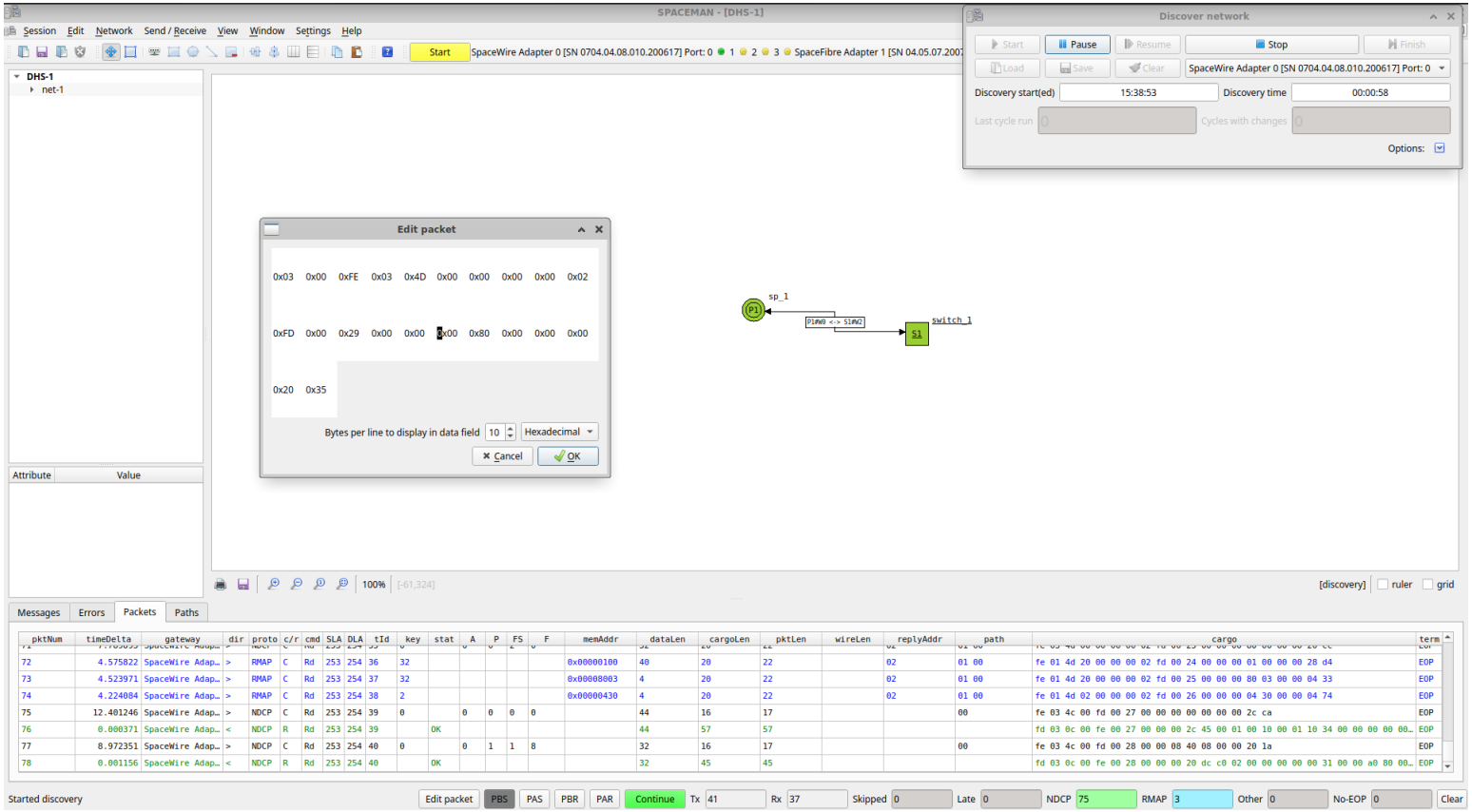
DEVICES CURRENTLY SUPPORTED BY SPACEMAN

Device	Discoverable and manageable as a network peripheral device?		Capable of the management gateway functionality?
	NDCP	RMAP	
STAR-Dundee SpW NDCP-aware devices of the original NDCP (PnP) project	Y	Y	Y
STAR-Dundee SpW and SpFi devices with STAR System API (versions 3.10, 4.0, 5.01)	via a USB- or PCI/PCIe-connected PC-based emulator	Y	Y
STAR-Dundee SpW-USB Brick Mk1	N	Y	N
STAR-Dundee SpFi and SpW Router Breadboard	N	Y	N
SpW-10X switch	N	Y	N
TELETEL iSAFT SpW and SpFi PCIe boards	N	N	Y
Shimafuji GPWGB0012 switch	N	Y	Y
ITTI Zynq-based SpW node	Y	Y	Y
ITTI Zynq-based SpFi node	Y	N	N
Cobham Gaisler GR718B switch	SPACEMAN development	SPACEMAN development	N
Thales Alenia Space MOST-X simulator	SPACEMAN development	Y	SPACEMAN development

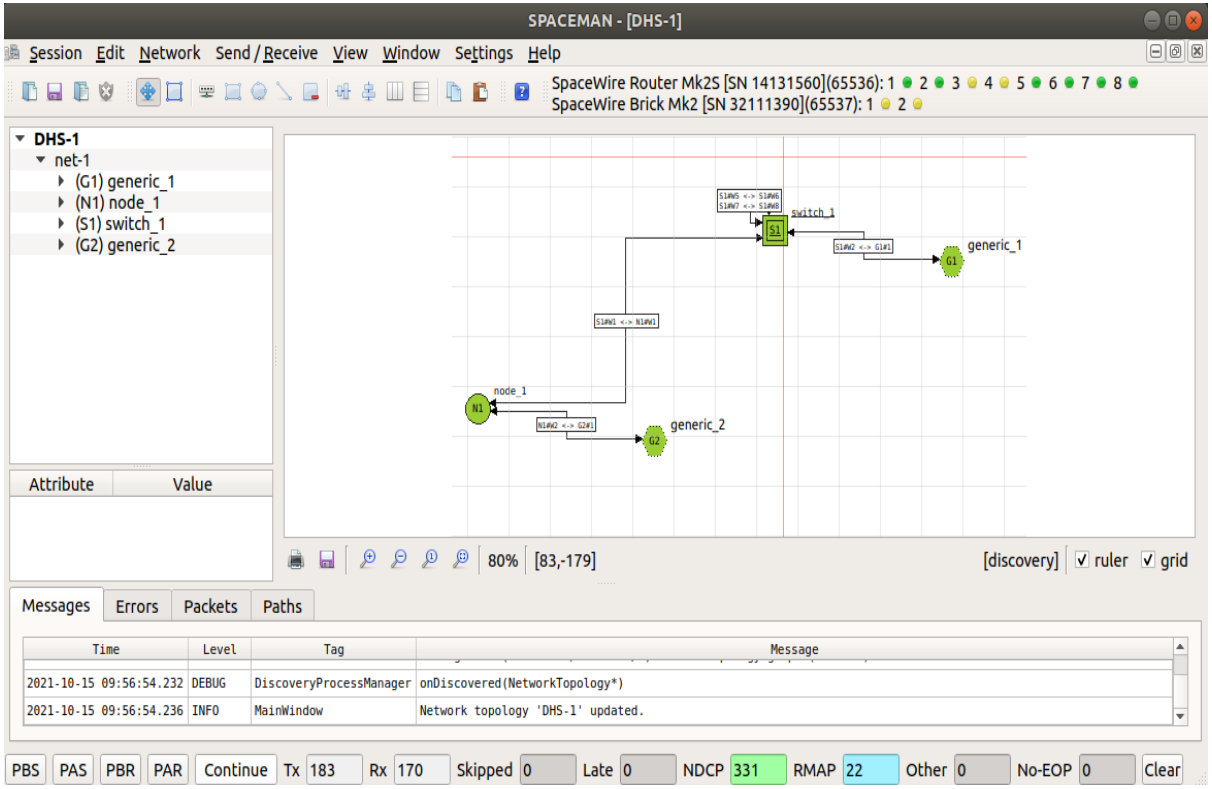
OTHER NEW FEATURES

- Embedded network model server: a TCP server in SPACEMAN for transferring network models in text XML format, similar to an FTP server
  - Network models downloaded from SPACEMAN can be used by the external application that received them.
  - Network models uploaded to SPACEMAN appear in the current working memory of SPACEMAN as if discovered or imported from a file and can be used immediately in comparisons, configurations, editing, etc.
- Remote operation
  - SPACEMAN can manage remote networks (over a LAN or the Internet) via a separate software application called the *Connector*.
  - *Connector* is installed at a remote site where the managed network is operated and connected to the network (in the same way as SPACEMAN in regular local operation).
  - *Connector* appears as another management gateway for SPACEMAN.
- Timed operation
  - Operations involving packet sending (network discovery, configuration, or sending individual test packets of raw SpaceWire, RMAP, or NDCP type) can be timed: started after a specified delay or at specified time or when SPACEMAN detects active connection of the management gateway device to the network, and repeated a specified number of times or for a specified period or until a specified time.
- More support for testing and debugging
  - Breakpoints can be set for just before and after sending or receiving packets by SPACEMAN. While at the breakpoint, the current packet can be edited; when transmission is resumed, the modified packet is processed.

SPACEMAN PACKET DEBUGGING



SPACEMAN APPLICATION WINDOW



BEYOND SPACEWIRE/SPACEFIBRE

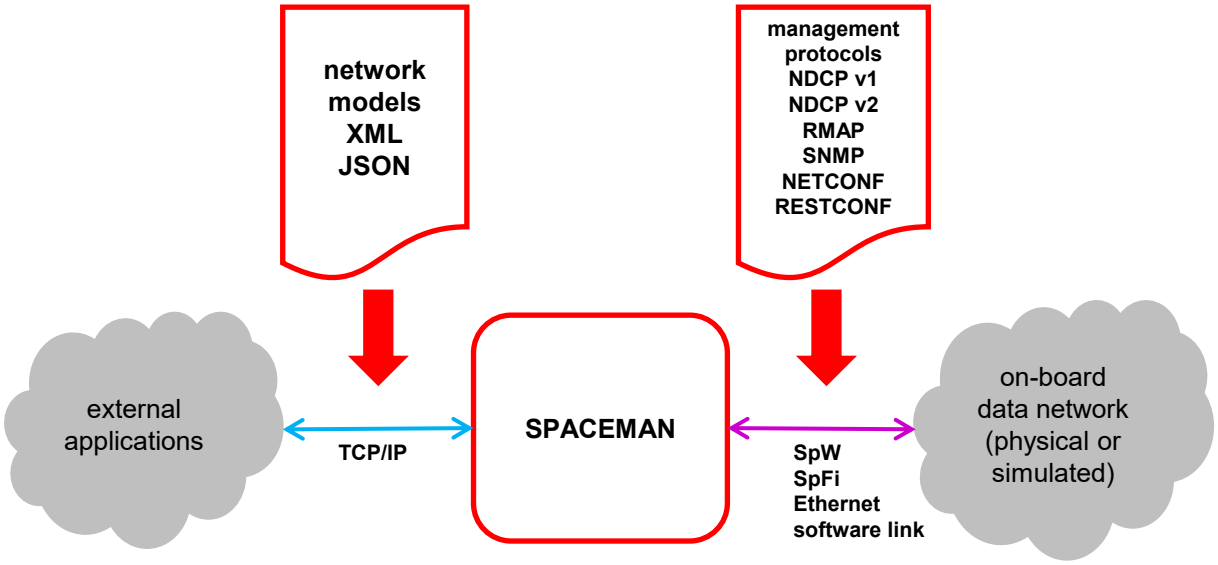
- An activity is being prepared for extending SPACEMAN's domain of application to Time-Sensitive Networking technology.
  - Ethernet-based networks with protocols of the IEEE 802.1Q family, targeting the TSN profile for aerospace/space being developed by the P802.1DP / SAE AS6675 joint project, with the following relevant protocols:
    - IEEE 802.1AS (Timing and Synchronisation)
    - IEEE 802.1Qci (Per-Stream Filtering and Policing)
    - IEEE 802.1CB (Frame Replication and Elimination)
    - IEEE 802.1Qbv (Scheduled Traffic)
    - IEEE 802.1Qav (Credit Based Shaper)
    - IEEE 802.1Qcc (Time Sensitive Network Configuration)
    - IEEE 802.1Qbu (Frame Pre-emption)
    - IEEE 802.3br (Interspersing Express Traffic)
    - IEEE 802.3 (Ethernet)
  - Management protocols and modelling languages:
    - RFC 1157, RFC 1901, RFC 3410 and related (Simple Network Management Protocol)
    - RFC 6241 and related (NETCONF protocol)
    - RFC 8040 and related (RESTCONF protocol)
    - RFC 6020 and related (YANG data modelling language)
  - Of the above standards and protocols a subset will be covered, depending on selected use cases and available hardware devices.

TSN NETWORK MANAGEMENT CHALLENGES

- Entirely different network addressing concept
  - All devices except unmanaged switches are supposed to have permanent unique addresses (MAC)
- New network protocols
- New logic of network discovery and configuration
  - Functionality of Centralized Network Configuration (CNC) and Centralized User Configuration (CUC) of IEEE 802.1Qcc
- Support of new managed devices and management gateways
- New or updated format for network models
- Expansion into the area of network design: data stream schedule calculation tasks (possibly in interaction with external applications)

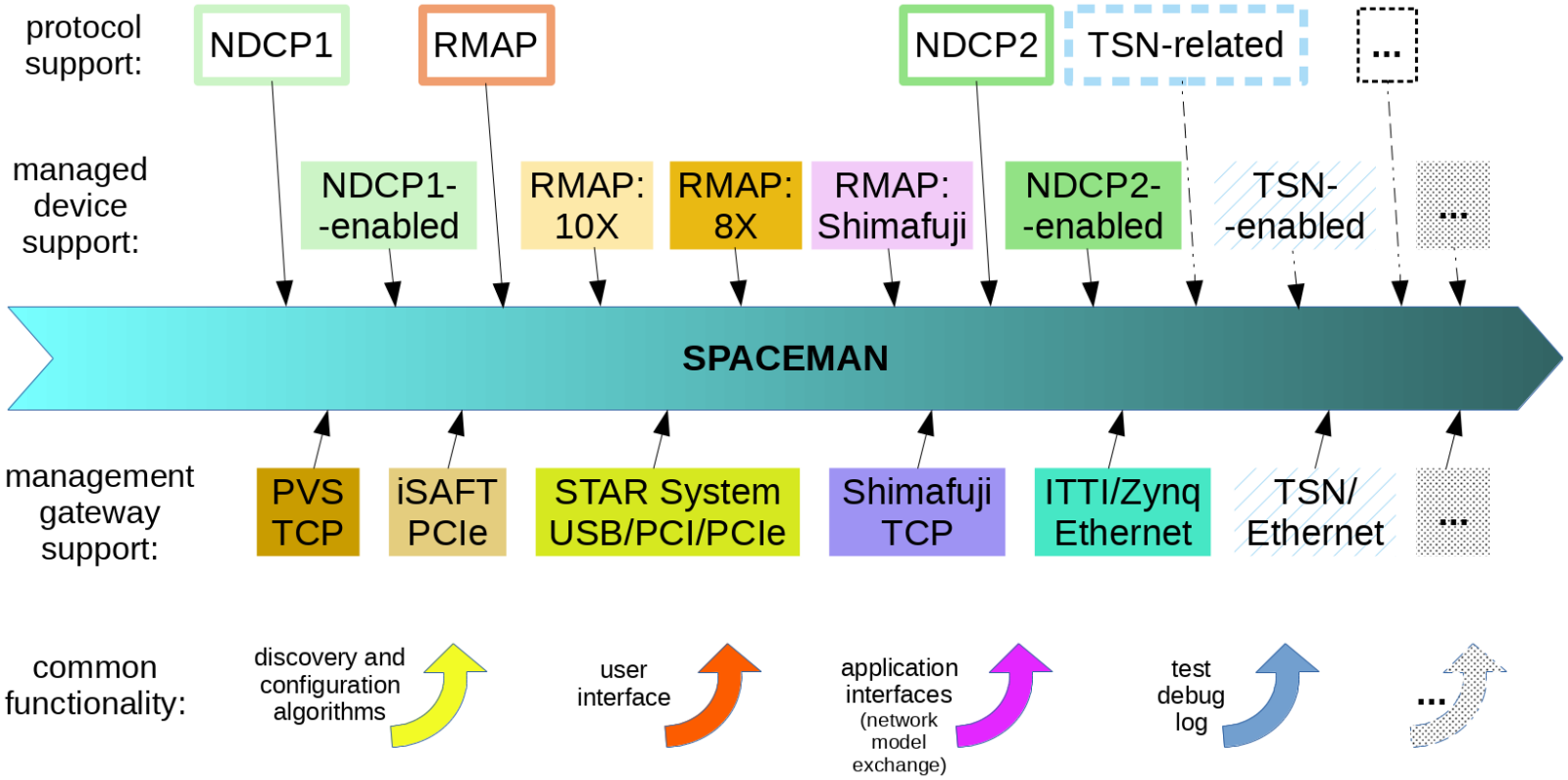
CONCLUSION

- Although NDCP standardizes the network management protocol and data, much more devices support currently RMAP, each in its own way.
  - Response: development of SPACEMAN – extending the list of Device Data Models with more RMAP-supporting device models
- Growing interest in applying TSN technology to onboard data handling
  - Response: evolution of SPACEMAN towards supporting TSN protocols and devices
- Goal: SPACEMAN as a multiprotocol network management tool



SPACEMAN in a broader context

SPACEMAN NMT DEVELOPMENT LINE



THANK YOU FOR YOUR ATTENTION

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