IP Monitoring
Based on NMOS Open Specification

aka "Minimal status Reporting"

Stefan Ledergerber

Simplexity / Swiss Radio and Television (SRF)

stefan.ledergerber@simplexity.ch

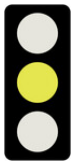
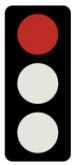
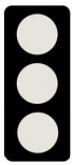
History and Motivation

1. Swiss Radio and Television SRF all-IP building on-air since 2020
2. Installation working, but lacking practical monitoring for users
3. After discussion with key vendors: Publication of White Paper "Standardized Status Monitoring on NMOS Systems"
4. Many positive reactions by broadcasters
5. AMWA: Development of specification family BCP-008 "Minimal Status Reporting"

Goals

1. Monitoring of key elements of IP connections (reporting domains) without device-specific drivers
2. Unleash flexible IP setups, without manual configuration
3. Practical rules, close to user (interface).
   Don't assume large intelligent monitoring system.
4. Avoid unnecessary messages to user
5. Low implementation effort for vendors
   ➔ specify where to put already existing status information & its behavior. Don't overload requirements for new functionality.
6. Broad technological focus :
   SMTPE ST 2110, AES67, IPMX, SRT, RIST, NDI,… and more

Traffic Light approach (1/2)

	Healthy	Services ok, no irregularities
	Partially Healthy	Services ok, some irregularities detected
	Unhealthy	Service not ok
		Inactive or not applicable

Traffic Light approach (2/2)

- Move some intelligence into edge devices
  ➔ reduce overall system complexity
  ➔ allow straight mapping to user interfaces
- Active notifications about state changes (no ”polling” needed)
  ➔ reduce network traffic
  ➔ reduce (monitoring) system load
- Mapping of states strictly to receivers and senders
  ➔ focus on signal connections
  ➔ close to user
- Send the right message:
  - Reporting delay: 3 sec before returning to healthier state
    ➔ address “flapping” conditions
  - At start and stop of a connection, don’t indicate bad states
    ➔ avoid false alarms

Good to know

- Redundancy scenarios taken into account (e.g. SMPTE ST 2022-7)
- Message field for generic information
  (reason for current state, sync source, …)
- Counters allows rough assessment of issue (state “history”)
- Possibility to tweak reporting behavior of devices
  (e.g. automatic reset of counters upon connecting)
- Vendors are free to fine-tune traffic light conditions, if specified intentions of a health state are met. (e.g. green/yellow/red specs)
- Vendors are free to add more of their own status traffic lights.

Reporting domains

1. Connectivity — All data arriving?
   - Physical link
   - Packet level
2. Synchronization — Expected synchronization present?
3. Stream Validation — RX: Decoding possible?
TX: Essense(Baseband signal) ok?

Overall Status — Receiver / Sender ok?

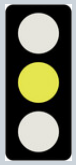
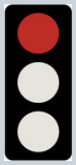
➔ Overall Status…

… can be directly indicated in user interface

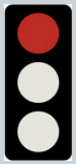
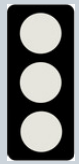
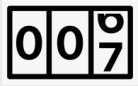
… simplifies configuration of large monitoring systems

… can take vendor-specific statuses into account

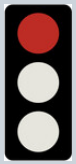
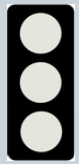
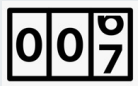
Reporting domains: Connectivity RX&TX

Physical Link			
			
All links ok	Some links down	All needed links down	
Optional Message: Reason for current status (e.g. which interfaces are down?)			
History: State transitions			

Reporting domains: Connectivity RX

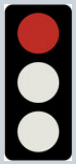
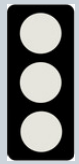
Packets			
			
Receiving all packets	Packets missing Recovery in action	Packets missing Recovery not possible	Receiver not active
Optional Message: Reason for current status			
History: - Lost & Late Packets - State transitions			

Reporting domains: Connectivity TX

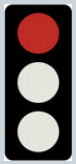
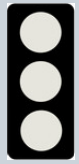
Packets			
			
No Transmission errors	Recoverable errors detected	Unrecoverable transmission errors detected	Sender not active
Optional Message: Reason for current status			
History: - Transmission Errors - State transitions			

Intended use cases:
TCP, RIST, SRT connections (detectable transmission errors)

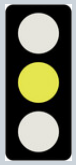
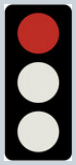
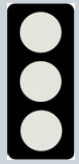
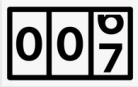
Reporting domains: Synchronisation RX&TX

External synchronization			
			
External sync expected and all ok	Multiple external sync expected, but some missing	External sync expected, but none present	No external sync expected (e.g. internal clock or asynchronous mode)
Optional Message: Reason for current status, incl. previous sync source with interface			
Info: Current Sync source (e.g. PTP GMID, Baseband Input, “internal”)			
History: - State transitions 			

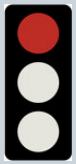
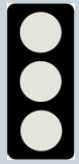
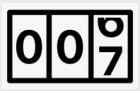
Reporting domains: Stream validation RX

Stream Status			
			
Decoding possible and consistent	Decoding possible, but not matching expectations	Not able to decode stream	Receiver not active
Optional Message: Reason for current status (e.g. “Unknown stream format”)			
History: State transitions			

Reporting domains: Stream validation TX

Essence Status			
			
Valid essence for transmission	Valid essence for tranmission, but validity errors detected	No essence detected or essence not good for transmission	Sender not active
Optional Message: Reason for current status (e.g. “Stream parameter x does not match expectations”)			
History: State transitions			

Reporting domains: Overall Status (Summary)

Connection working?			
			
Connection ok	Connection ok, some domains "yellow", none "red"	Connection disturbed, some domains "red"	Receiver/Sender not active
Optional Message: Reason for current status (Message of worst domain)			
History: State transitions			

Counters ≈ “History”

- Logging not in focus of BCP-008
- Counters of state transitions = useful insight about nature of problem
- Default behavior:
  Counters reset whenever a new connection is established
- Changeable behavior for observing long-term behavior:
  Counter reset manually

Traffic Lights ➔ Current state

Counters ➔ “History”

Technical prerequisites

Implementation of NMOS documents

- IS-12 Control Protocol
- MS-05-02 Control Framework
- (INFO-06 Implementation guide)

Potential for vendors:

IS-12 allows generic parameter control with active notifications

https://specs.amwa.tv/nmos/

Practical examples

	Overall	Connection	Link	Ext. sync.	Stream
Cable disconnect, aging SFP / dirty optical connectors				?	?
Traffic overload on network (e.g. file copy / internet)				?	?
Network config error: Incorrect packet forwarding in network (e.g. IGMP, PIM config mistakes)					?
Multi-use of same multicast address					?
PTP Leader degraded or lost		?			?
User error: Wrong PTP settings (e.g. profile, domain)		?			?
User error: Link Offset (latency) in receiver set too low					?
User error: Incompatible stream settings on new device					

Benefits of BCP-008-001/2

- "driverless" monitoring of most important AVoIP statuses
- In-line with NMOS: Plug'n play through IS-04 registration
- Focused on users:
  - Allows to react effectively / call respective experts
  - Shed light into "black box" of networking
  - Message overflow avoided: Overall status can be shown directly in GUI
  - Current state by traffic light and "history" by counters
- Covers wide range of systems:
  - Small (no monitoring system present)
  - Large (simplifies setup of custom monitoring systems)
- Minimal effort
  - Implementation: Minimal, once IS-12/MS-05-02 is implemented
  - Setup: Rules standardized and shifted into edge devices
- Open for expansion
  - More status reporting possible while staying compliant to "Minimal Status Reporting"
  - IS-12 = generic control interface suitable to control more device parameters
  - Not restricted to SMPTE ST 2110, also useful for IPMX etc.

Current state of discussion

- Receiver & Sender specifications settled and publicly available
- Pending activities
  - Automated test suite development
  - Controller specs

- Feedback welcome

Thanks…

…to the volunteers of this activity:

- Cristian Recoseanu (Pebble) – Technical Lead
- Alain Bouchard (Matrox)
- Pete Cordell (Sony/Nevion)
- Jonathan Thorpe (Sony)
- Markus Wohlgemuth (Vizrt)

Documents

NMOS Specifications

- https://specs.amwa.tv/nmos/

NMOS Specifications about “Minimal Status Reporting”

- Receiver: https://specs.amwa.tv/bcp-008-01/
- Sender: https://specs.amwa.tv/bcp-008-02/

SRF Whitepaper “Standardized Status Monitoring on NMOS Systems”

- https://bit.ly/IP-Status

Developer Resources

- https://github.com/sony/nmos-cpp
  Node implementation SDK/library, supporting IS-12
  (BCP-008-01/02 in progress)

- https://github.com/AMWA-TV/nmos-device-control-mock
  NMOS control mock device supporting IS-12 and BCP-008-01/02

- https://specs.amwa.tv/nmos-testing/
  NMOS testing framework supporting IS-12
  (BCP-008-01/02 in progress)

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