PRE-DRAFT IEEE 802 Nendica Report: Network Stream and Flow Interworking

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Scope

The scope of this report is the characterization, from a unified perspective, of network streams and flows in IEEE 802 networks, and in some networks that are typically connected to IEEE 802 networks, including an assessment of the process of interworking flows and streams across network boundaries and the feasibility and value of such interworking in achieving end-to-end flow management and QoS. Standardization implications are identified.

Purpose

By taking a unified perspective toward the assessment of network streams and flows, this document is intended to encourage a common understanding of concepts that are largely considered from a unique perspective in each network technology. That unified perspective is intended to motivate efforts to consider procedures to interwork streams and flows across network boundaries, so that QoS characteristics that are managed within a single network by stream and flow control can be joined across network boundaries, allowing a level of end-to-end QoS control. The intention is not to specify interworking protocols but ideally to identify particular network pairs that can benefit from stream and flow interworking, assess the feasibility of such interworking in those cases, identify gaps preventing interworking, and identify standardization activities that would promote successful interworking.

Introduction

This document has been developed within the IEEE 802 IEEE 802 "Network Enhancements for the Next Decade" Industry Connections Activity (Nendica) in accordance with the Nendica Work Item on "Network Stream and Flow Interworking" **Error! Reference source not found.**[1]).

Network Streams and Flows

Network traffic is increasingly managed as a set of streams or flows rather than series of frames or packets. IEEE 802 networks have developed and utilized flow concepts; e.g.:

- IEEE 802.11 Parameterized Traffic Streams (TSs)
- IEEE 802.1 TSN Streams for time-sensitive networking (various standards)
- IEEE Std 1722 Audio/Video Transport Protocol (AVTP) streams
- IEEE 802.1Qcz Congestion isolation
- IEEE 802.16 Service Flows for all traffic
- IEEE 802.15.4 use of Guaranteed Time Slots

Non-802 networks have developed and utilized flow concepts:

- MEF Carrier Ethernet Virtual Connections
- IETF DetNet
- IETF RAW
- Software-Defined Networking, including OpenFlow
- DOCSIS Service Flows
- 3GPP Bearers
- IP flows (DSCP; IPV6 flow identifier)
- other

While these network streams and flows can be characterized by various parameters and are qualitatively different concepts in different networks, some characteristics are common. Here we attempt to generalize the concept of a stream or flow into a definition suitable for use in this report…

[1]Information on references can be found at the end of the document in the Citations section.

Uses for Stream and Flow identification

Stream and flows can be used for:

Stream and Flow Characterization

Stream and flows can be characterized by parameters including:

- Specification document
- Network architecture
- Conditions
- Addressing
- End station
- Control
- Flow-sensitive elements
- Flow name
- Flow identification
- Flow quantity
- Flow descriptor
- Flow addition process
- Flow deletion process
- Flow change process
- Flow QoS properties
- Frame classification
- Request/grant system and polling services
- Admission control
- Interworking

Characteristics of Stream and Flow Concepts in Specific Networks

IEEE 802.11 Traffic Streams

Characteristic	IEEE 802.11 Traffic Streams	notes
Specification document	IEEE Std 802.11	
Sub-specification	HCCA	
Network architecture	Shared medium Point-to-Multipoint	HCCA is centralized
Conditions	Operates under CSMA/CA	Scheduling is by an AP within its BSS; not guaranteed in the presence of non-HCCA devices, or another HCCA BSS
Addressing	802 unicast	
End station	Non-AP STA	
Control	Access point (AP) scheduler	
Flow-sensitive elements	AP	
Flow name	parameterized traffic stream (TS)	
Flow identification	traffic stream identifier (TSID)	
Flow quantity	8 (3 bits)	per connection (AP+STA), per direction
Flow descriptor	traffic specification (TSPEC)	
Flow addition process	add traffic stream (ADDTS)	
Flow deletion process	delete traffic stream (DELTS)	
Flow change process	[none]	
Flow QoS properties	Nominal MSDU Size, Maximum MSDU Size, Minimum Service Interval, Maximum Service Interval, Inactivity Interval, Suspension Interval, Service Start Time, Minimum Data Rate, Mean Data Rate, Peak Data Rate, Burst Size, Delay Bound, Minimum PHY Rate, Surplus Bandwidth Allowance, Medium Time	9.4.2.29
Frame classification	stream classification service (SCS)?	11.26
Request/grant system and polling services	Polled TXOP Buffer status report (BSR) [P802.11ax]	10.23.3.3
Admission control	yes	
Interworking	R.3 QoS mapping guidelines for interworking with external networks	

MEF Carrier Ethernet – Ethernet Virtual Connections

Characteristic	MEF Carrier Ethernet	notes
Specification document	MEF 6.3	and other MEF specs
Sub-specification	EVC: Ethernet Virtual Private Line (EVPL) Ethernet Virtual Private LAN (EVP-LAN) Ethernet Virtual Private Tree (EVP-Tree)	port-based services are not included here
Network architecture	Shared medium EVC Type: Point-to-Point, Multipoint-to-Multipoint, or Rooted-Multipoint	
Conditions		
Addressing	IEEE 802 48-bit address	
End station	Ethernet connected at port (UNI)	
Control		
Flow-sensitive elements	bridges or other operator elements	
Flow name	service	
Flow identification	Customer-Edge VLAN ID	
Flow quantity	4094 (12 bits)	
Flow descriptor	Service attributes	
Flow addition process	manual (historically)	may be automated per MEF Lifecycle Service Orchestration (LSO)
Flow deletion process	manual (historically)	may be automated per MEF Lifecycle Service Orchestration (LSO)
Flow change process	manual (historically)	may be automated per MEF Lifecycle Service Orchestration (LSO)
Flow QoS properties	many	
Frame classification	unspecified	
Request/grant system and polling services	None; full-duplex system, reservation-based	
Admission control	Yes	
Interworking	unspecified	

DOCSIS Service Flows

Characteristic	DOCSIS	notes
Specification document	DOCSIS 4.0 MAC and Upper Layer Protocols Interface Specification	key features date to DOCSIS 1.1
Sub-specification		
Network architecture	point-to-multipoint	
Conditions		
Addressing	IEEE 802 48-bit address	
End station	cable modem (CM)	
Control	cable modem termination system (CMTS)	
Flow-sensitive elements	CMTS and CM	
Flow name	service flow	unidirectional
Flow identification	service identifier (SID)	Service flows are identified by SFID and described by QoS parameters. Active service flows are assigned an SID.
Flow quantity	SID 14 bits	SFID is 32 bits
Flow descriptor	QoS Parameter Set	
Flow addition process	Dynamic Service Addition	
Flow deletion process	Dynamic Service Deletion	
Flow change process	Dynamic Service Change	
Flow QoS properties	Traffic Priority, Maximum Sustained Traffic Rate, Maximum Traffic Burst, Minimum Reserved Traffic Rate, etc.	
Frame classification	Upstream and Downstream Classifiers; Payload Header Suppression Rules;	
Request/grant system and polling services	Upstream Service Flow Scheduling Services, including Unsolicited Grant Service (UGS), Real-Time Polling Service (rtPS), Unsolicited Grant Service with Activity Detection (UGS-AD), Non-Real-Time Polling Service (nrtPS) and Best Effort (BE) service	
Admission control	yes	
Interworking		

Interworking of Streams and Flows

1. Value of interworking
2. Feasibility of interworking
3. Network combinations of practical interest

Standardization Implications

Suggestions for standardization

Conclusion

Conclusions regarding network stream and flow interworking

Citations

[1] "IEEE 802 Nendica Work Item Proposal: Network Stream and Flow Interworking," 2020-02-20 https://mentor.ieee.org/802.1/dcn/1-20-0004-04-ICne.pdf

[2] Marks, Roger; de la Oliva, Antonio; and Wuesteney, Lukas, "Deterministic WLAN: A problem of scheduling and identifiers" 2019-11-11 https://mentor.ieee.org/802.1/dcn/1Parta

[3] Marks, Roger, "Examples of Stream and Flow Characterization" 2020-04-23 https://mentor.ieee.org/802.1/dcn/1-20-0028-01-ICne.docx

[4] IEEE 802.1 Time-Sensitive Networking (TSN) Task Group webpage, https://1.ieee802.org/tsn/

[5] P802.11ax ("Enhancements for High Efficiency WLAN", draft) https://standards.ieee.org/project/802_11ax.html

[6] P802.11be ("Enhancements for Extremely High Throughput", pre-draft) https://standards.ieee.org/project/802_11be.html

[7] IEEE Std 802.1Q-2018 (Revision of IEEE Std 802.1Q-2011), IEEE Standard for Local and metropolitan area networks—Bridges and Bridged Networks, July 2019, https://ieeexplore.ieee.org/document/8686439/

[8] IEEE Std 802.1CF-2019, IEEE Recommended Practice for Network Reference Model and Functional Description of IEEE 802® Access Network, May 2019, https://ieeexplore.ieee.org/document/8726453.