A First Qualitative Comparison of the Admission Control in FTT-SE, HaRTES and AVB

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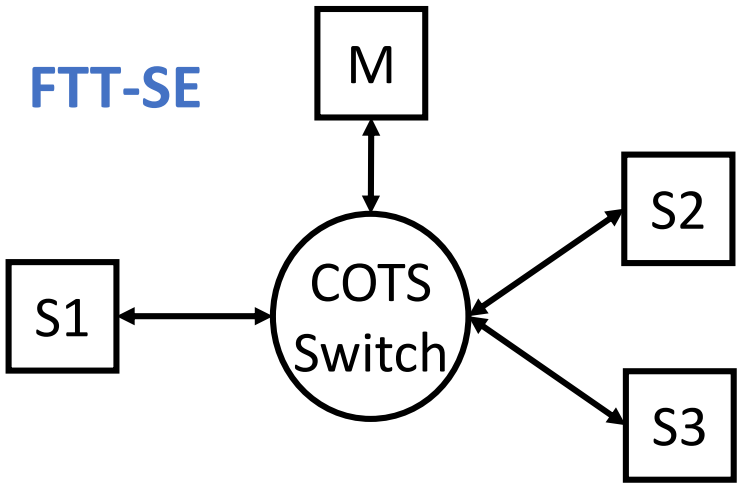
Introduction

- Ethernet is gaining importance in automation, avionics and automotive.
- Multimedia & control traffic coexistence.
- Diversity in size, intensity and timing of the traffic.
- Ethernet lacks for real-time and adaptivity.
- Flexible Time-Triggered and Audio Video Bridging.
- Admission control is provides adaptivity.

In this paper we compare FTT and AVB Admission Control mechanisms in mono-hop networks.

Flexible Time-Triggered

- **Time-triggered** (synchronous) and **event-triggered** (asynchronous) traffic.
- Master/multi-slave architecture.
- Communication done through **streams**.
- Any slave can request the creation of streams.



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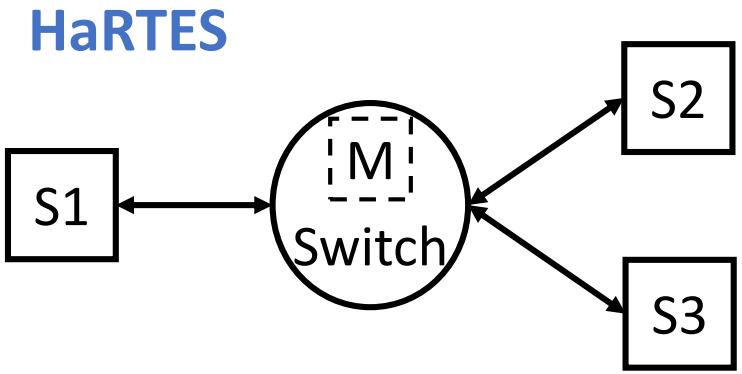
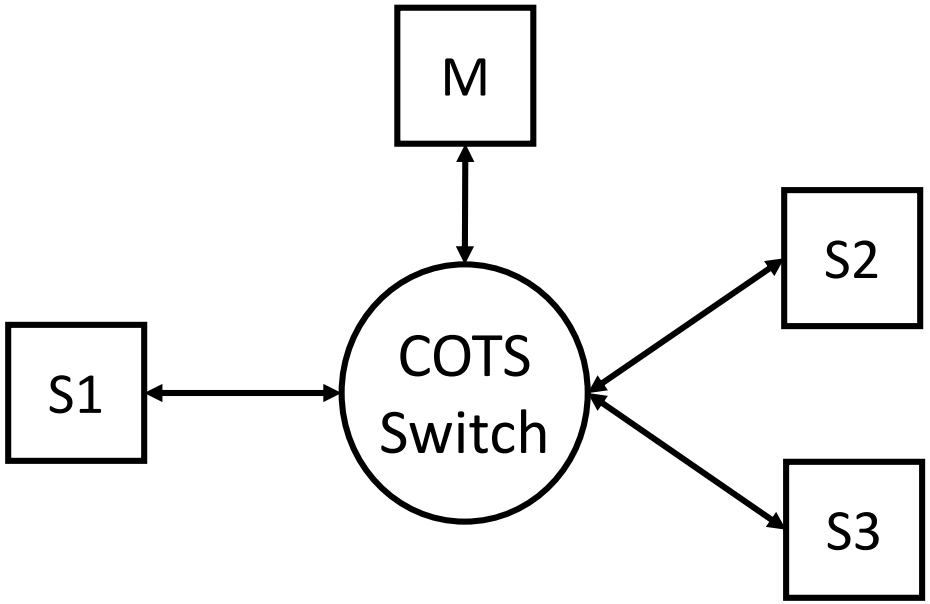


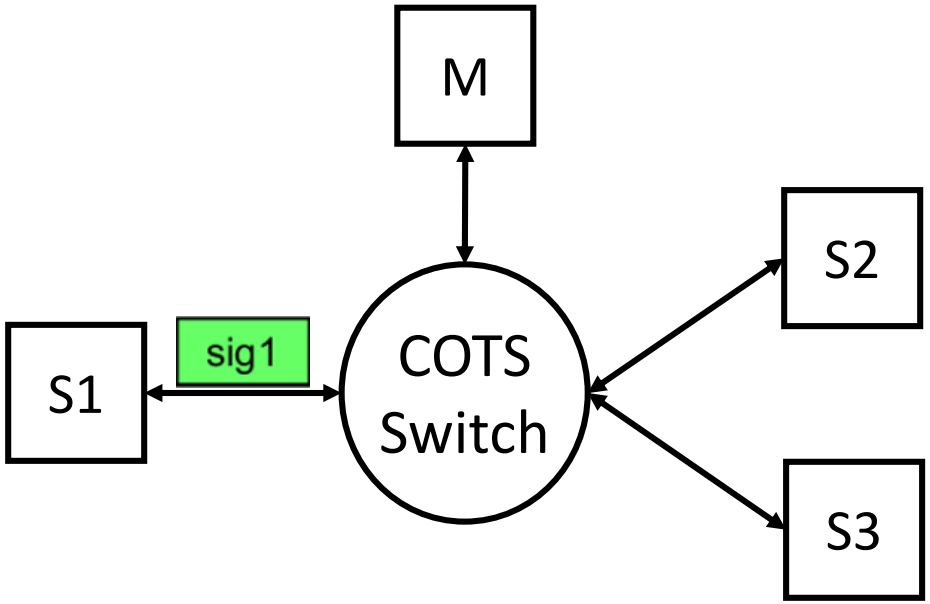
FTT - Switched Ethernet

Master and slaves connected though a COTS switch.



FTT - Switched Ethernet

Admission control: signalling of requests.



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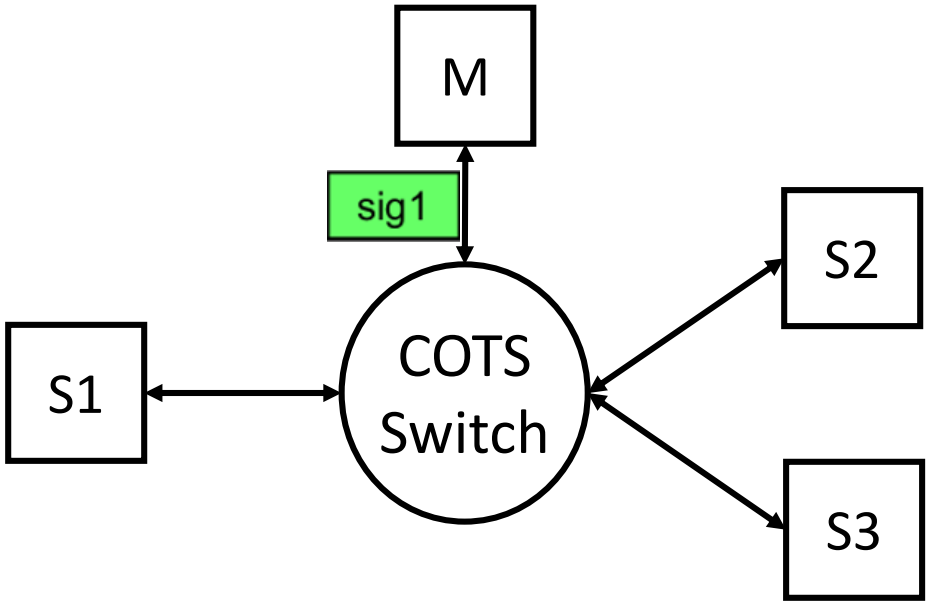
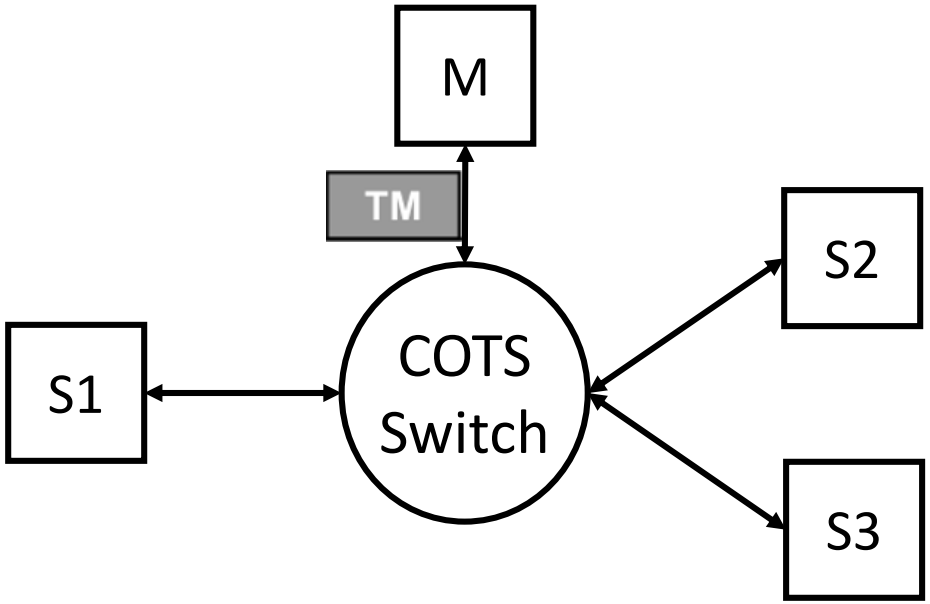


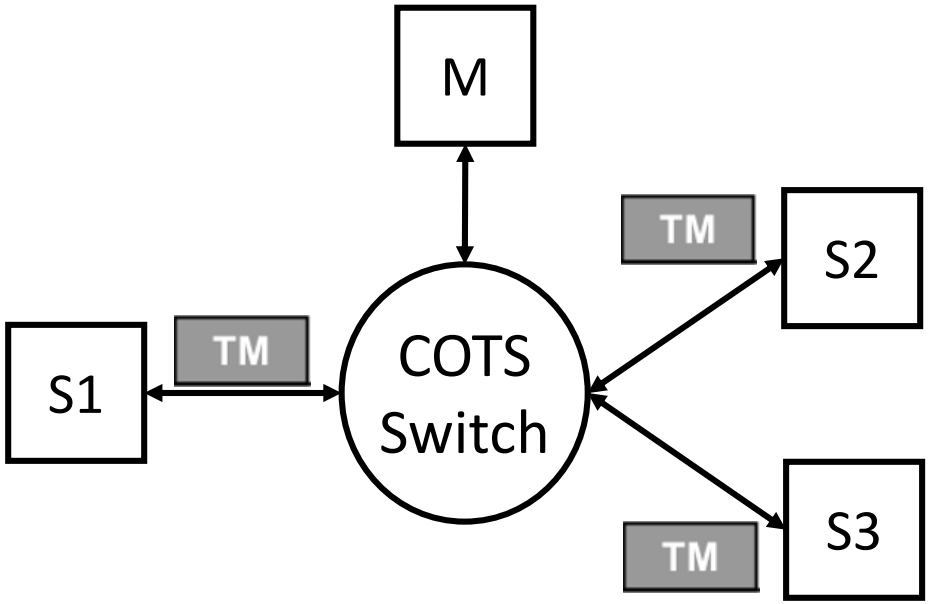
FTT - Switched Ethernet

Admission control: transmission of schedule



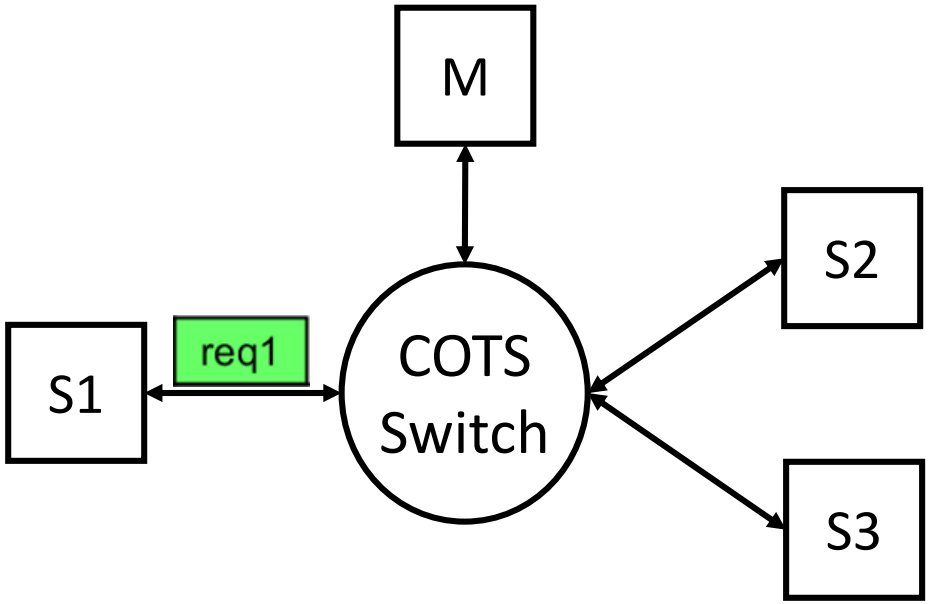
FTT - Switched Ethernet

Admission control: transmission of schedule



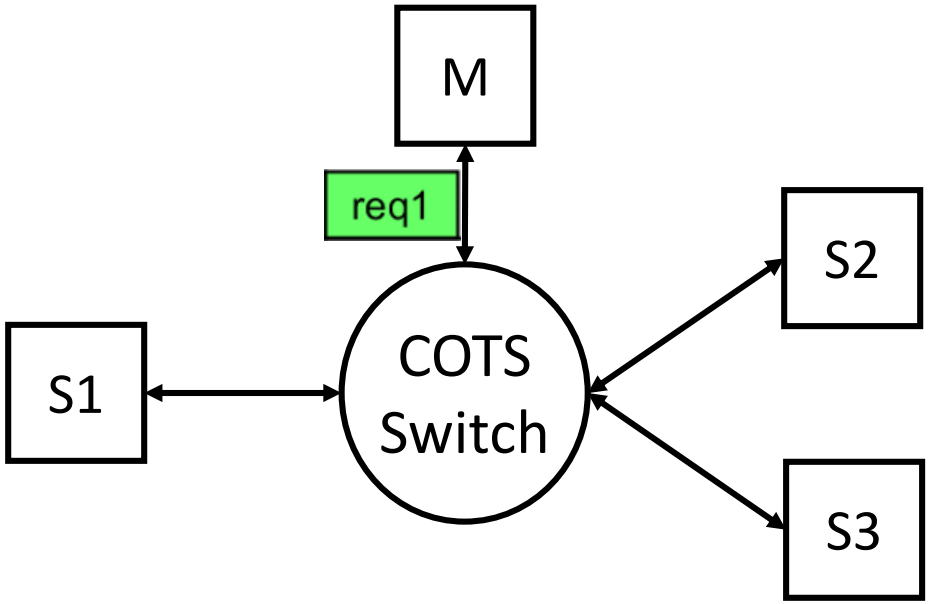
FTT - Switched Ethernet

Admission control: slave request



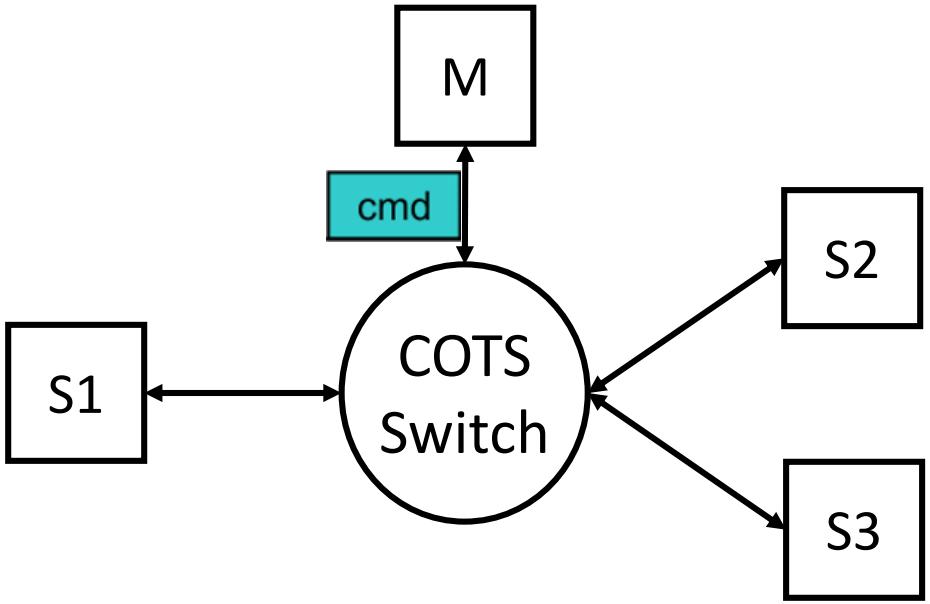
FTT - Switched Ethernet

Admission control : slave request



FTT - Switched Ethernet

Admission control: master command



FTT - Switched Ethernet

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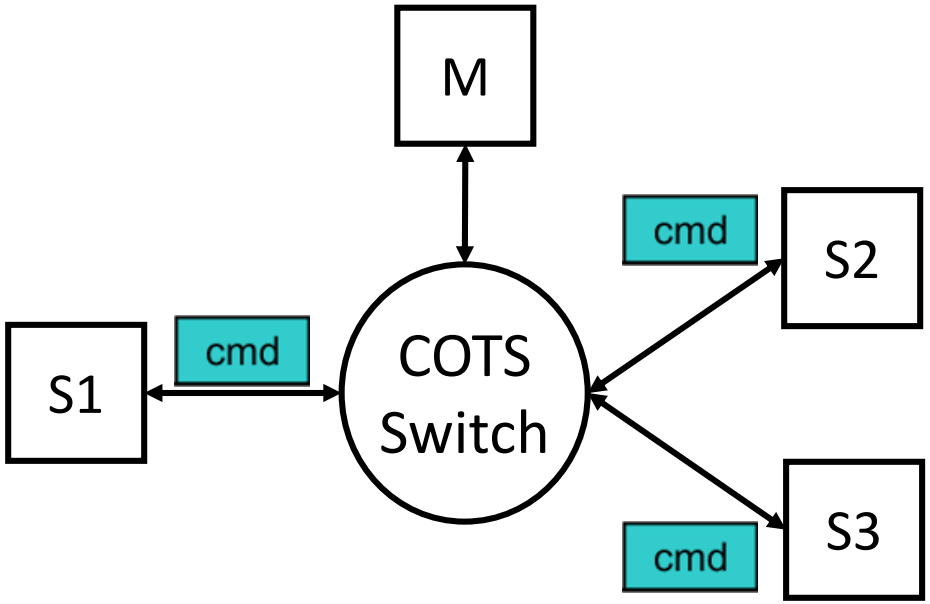
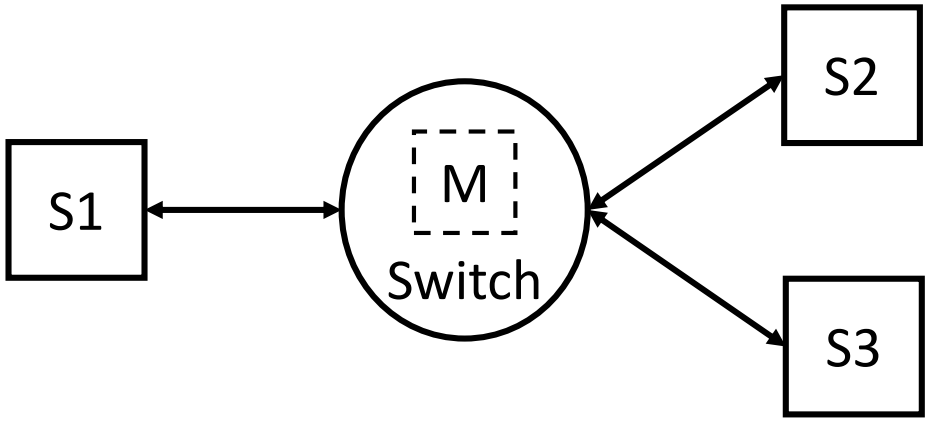


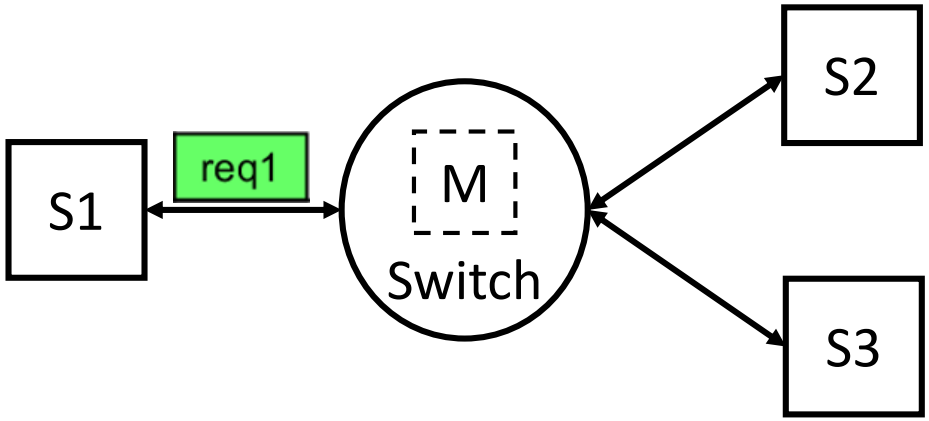
HaRTES

Master embedded in the switch.



Hard Real Time Ethernet Switching

Admission control: slave request



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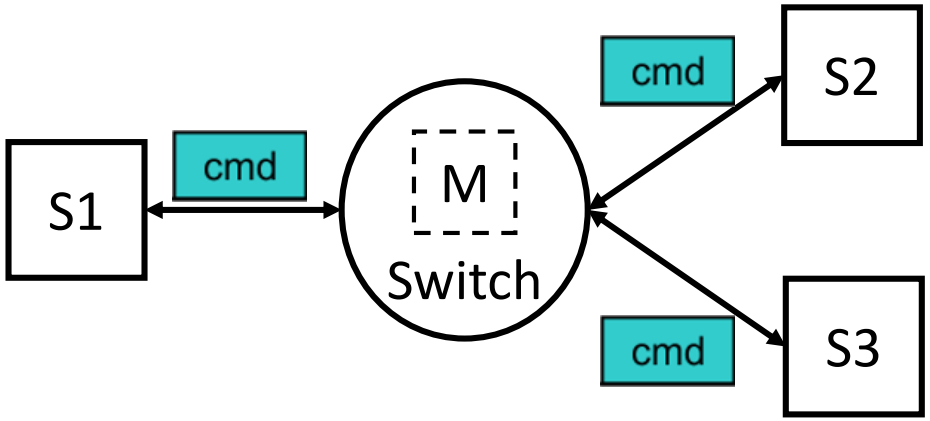
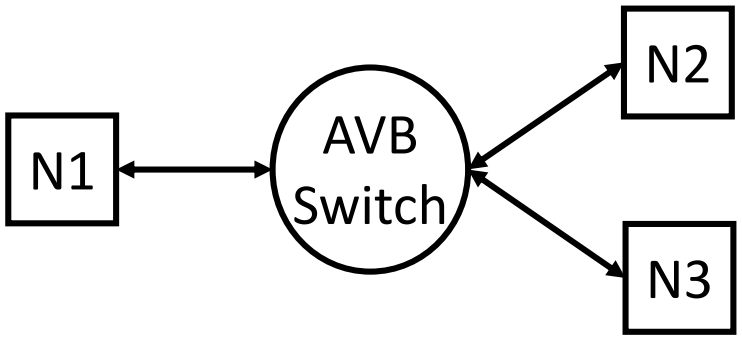
Admission control: master command



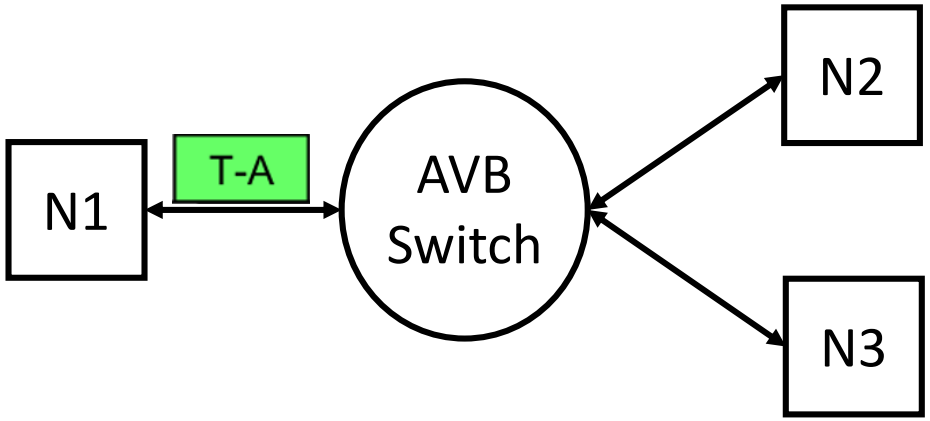
Audio Video Bridging

- **Set of standards** that, among other things, provide **admission control**.
- Communication also done through **streams**.
- Stream Reservation Protocol for Admission Control.
- Creation of streams triggered only by the publisher.
- The **reservation of resources** is done by the **switch**.



Audio Video Bridging

Admission control: announcement of publisher



Audio Video Bridging

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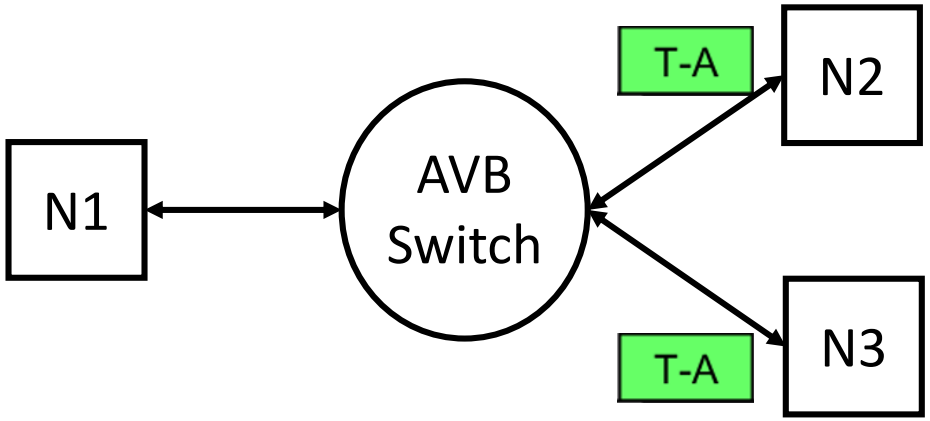
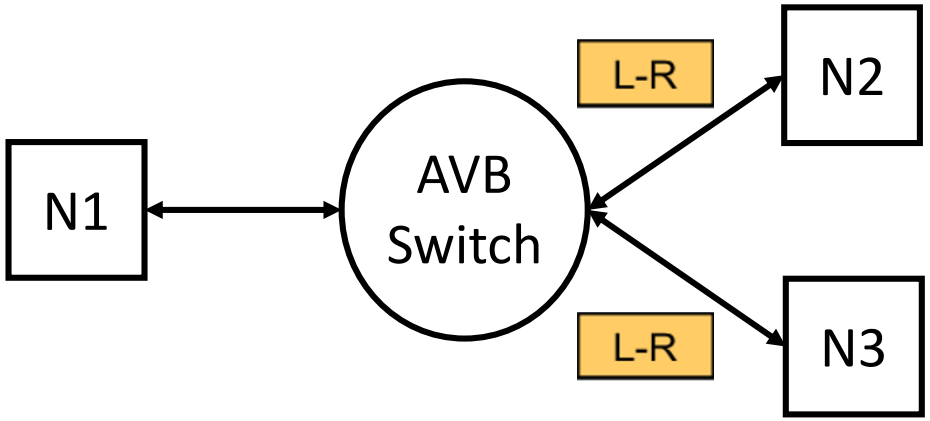


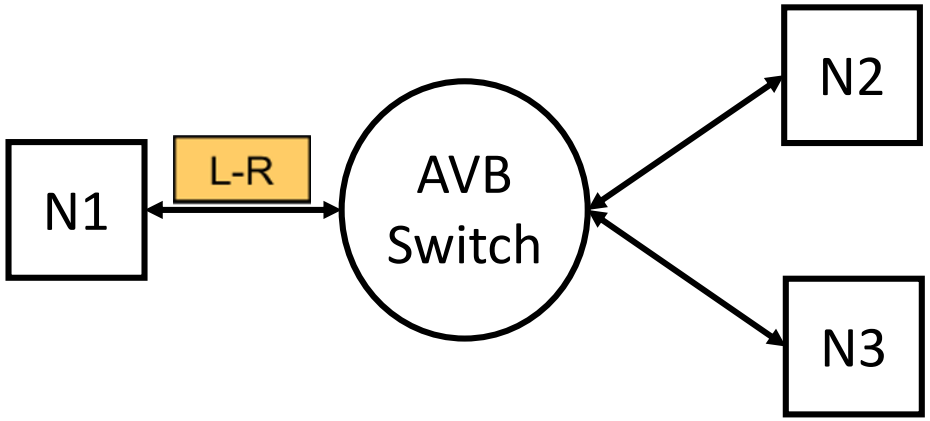
Audio Video Bridging

Admission control: announcement of subscriber



Audio Video Bridging

Admission control: announcement of subscriber



Comparison

Compare reliability, flexibility and performance.

	Reliability		Flexibility			Performance
	Trans. Faults	Perm. Faults	QoS change	Class change	Legacy nodes	# messages
FTT-SE	✗	✗	✓	✗	✓	12
HaRTES	✗	✓	✓	✗	✓	4
AVB	✗	✗	✗	✗	✗	4

Questions?

Please meet me at the poster!

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Abstract

Ethernet is gaining importance in fields such as **automation, avionics and automotive**. In these fields novel multimedia-based applications must coexist with traditional control systems, which leads to **high diversity in size, intensity and timing requirements of the traffic traversing the channel**.

Multimedia traffic is characterised by having large size, low intensity and soft real-time requirements, while **control traffic** usually conveys small amounts of information with a high intensity and hard real-time requirements. Moreover, many modern applications must **support on-line connection and disconnection of participants**.

Since **Ethernet** was designed as a general purpose data network protocol it **lacks** appropriate support for **real-time communications** and **dynamic quality of service management**. Several protocols were proposed to cope with these drawbacks, including **Flexible Time-Triggered Switched Ethernet** and, more recently, **Audio Video Bridging**.

In this paper we discuss the importance of the admission control and make a comparison of the implementations carried out in the aforementioned protocols.

Audio Video Bridging

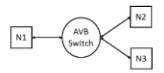
AVB is a **set of standards** that provide Ethernet with synchronisation, frame forwarding and **admission control**.

The communication is done through virtual channels called **streams**, to which nodes can attach as **talker** or **listeners**.

The creation of a stream is triggered by the talker and is completed when the talker receives the confirmation of at least one listener.

The **reservation of resources** is done by the **switch**.

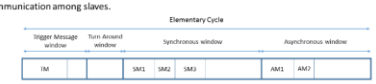
Mono-hop Architecture



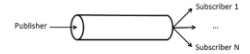
Messages exchanged in Admission Control

Flexible Time-Triggered

Flexible Time-Triggered supports **event** and **time-triggered traffic** in a **flexible** manner. Follows a **master/multi-slave architecture**. The master organises the communication in slots of fixed duration called **Elementary Cycles**, by sending the so called **Trigger Message** to synchronise and trigger the communication among slaves.

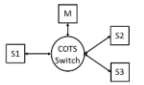


The communication is carried out through virtual communication channels called **message streams**. First slaves **ask for the creation** of the stream and afterwards ask to **attach as publisher or subscribers**.



FTT-SE

Mono-hop Architecture

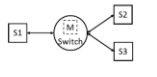


Messages exchanged in Admission Control

- The slave **informs** the master about the **pending requests**.
- When allowed, the slave **requests** the **creation** or **attachment** to a stream.
- The **master** performs the **admission control** and sends the result to all slaves.

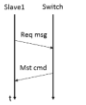
HaRTES

Mono-hop Architecture



Messages exchanged in Admission Control

- The slave **requests** to the master the **creation** and **attachment** to a stream.
- The **master checks the availability of resources** and sends the result to all slaves.

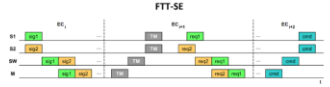


Analysis of the performance, flexibility and reliability of the admission control

Performance

Number of messages needed for the creation of a stream with a transmitter and a receiver

FTT-SE



AVB: 4 messages.
- N1 → SW → N2 (TA)
- N2 → SW → N1 (LR)

HaRTES: 4 messages.
- S1, S2 → SW (req)
- SW → S1,S2 (cmd)

FTT-SE: 12 messages.
- S1, S2 → SW (sig)
- S1, S2 → SW (req)
- SW → S1, S2 (cmd)

HaRTES

AVB

Flexibility

Functionalities provided by the admission control

FTT-SE
- Several classes of traffic: Hard and soft real-time.
- On-line connection and disconnection of participants.
- Changing QoS requirements of a stream on-line.
- Legacy nodes: use of non-FTT-aware applications.

HaRTES
- Several classes of traffic: Hard and soft real-time.
- On-line connection and disconnection of participants.
- Changing QoS requirements of a stream on-line.
- Legacy nodes: use of non-FTT-aware applications.

AVB
- Several classes of traffic: Class A and B, soft real-time with different timing guarantees.
- On-line connection and disconnection of participants.

Reliability

Level of tolerance to errors affecting the admission control

FTT-SE | **HaRTES** | **AVB**

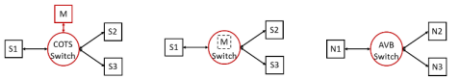
Temporary faults affecting the channel

Signalling message: delay AC
Request message: prevent AC
Command message: missed resources + inconsistency

Request message: prevent AC
Command message: missed resources + inconsistency

Talker advertise: prevent AC
Listener ready: prevent communication.

Permanent faults → single points of failure in the architecture



Conclusions and Future Work

Reliability: **none** of the protocols provide adequate services to face **transient faults**; **HaRTES** is currently the only one **handling permanent faults; IEEE is developing a new set of standards** to overcome some of these problems.

Flexibility: **FTT** allows to dynamically **change the QoS** of the streams and the use of **legacy nodes**, conversely to AVB.

Performance: **FTT-SE** introduces a **significant overhead** in the communication channel when compared to HaRTES and AVB.

	Reliability		Flexibility			Performance
	Transient Faults	Permanent Faults	QoS change	Class change	Legacy nodes	Overhead*
FTT-SE	✗	✗	✓	✓	✓	12
HaRTES	✗	✓	✓	✗	✓	4
AVB	✗	✗	✗	✗	✗	4

*Minimum number of messages exchanged during the admission control.

We are **currently** working on extending this comparison and carrying out a quantitative one, through **simulation in OMNeT++**.

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