

# **AES67, ST2110, RAVENNA**

**Standards, Interoperabilité, futur...**

# Nicolas Sturm

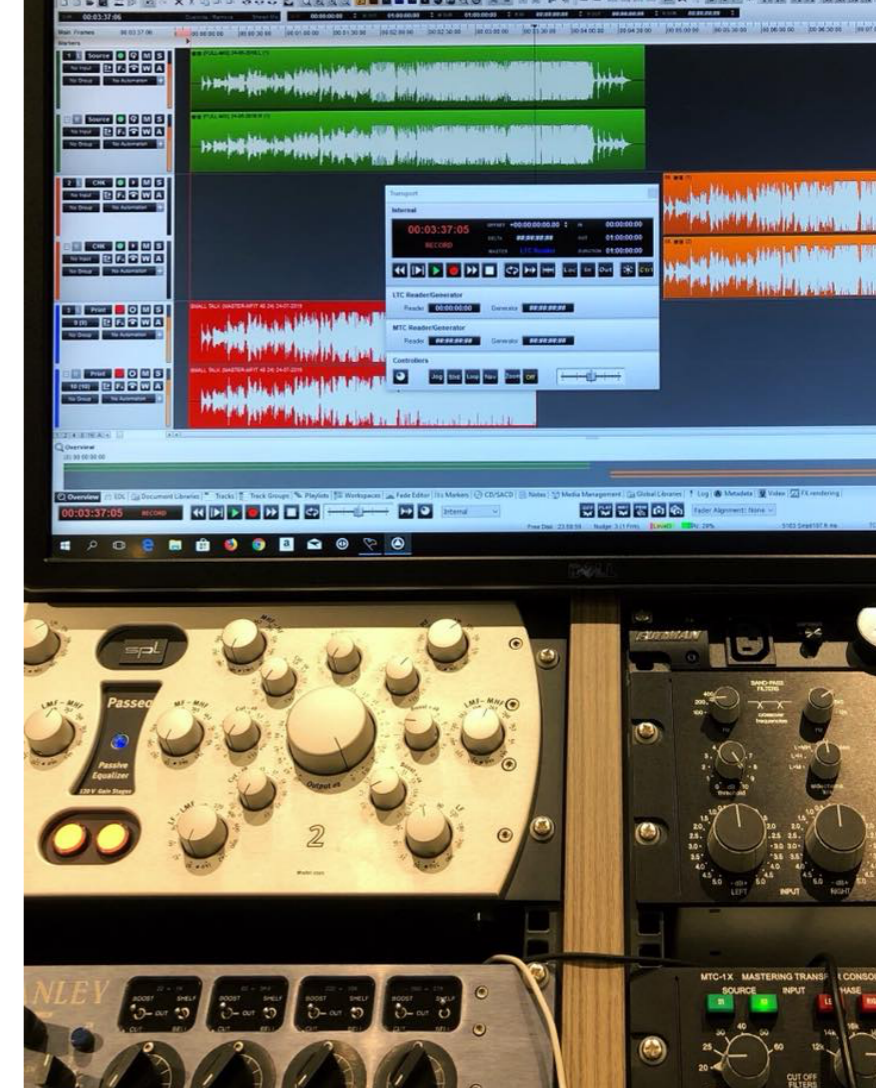
**AES, Merging Technologies, Digigram, ESPCI, Ircam**

- Développeur et support client AES67 chez Merging Technologies
- Membre du groupe de standardisation AES67
- Lead sur des tests d'interopérabilité
- Chef de projet AoIP
- Geek (cloud, docker, linux, Arduino...)

# Merging Technologies

## Haute qualité

- Clients en musique, radios, télé, opéra
- Notre DAW -> Pyramix
- Notre séquenceur/cartouchier -> Ovation
- Nos appareils -> Horus, Hapi, Anubis



Distribution

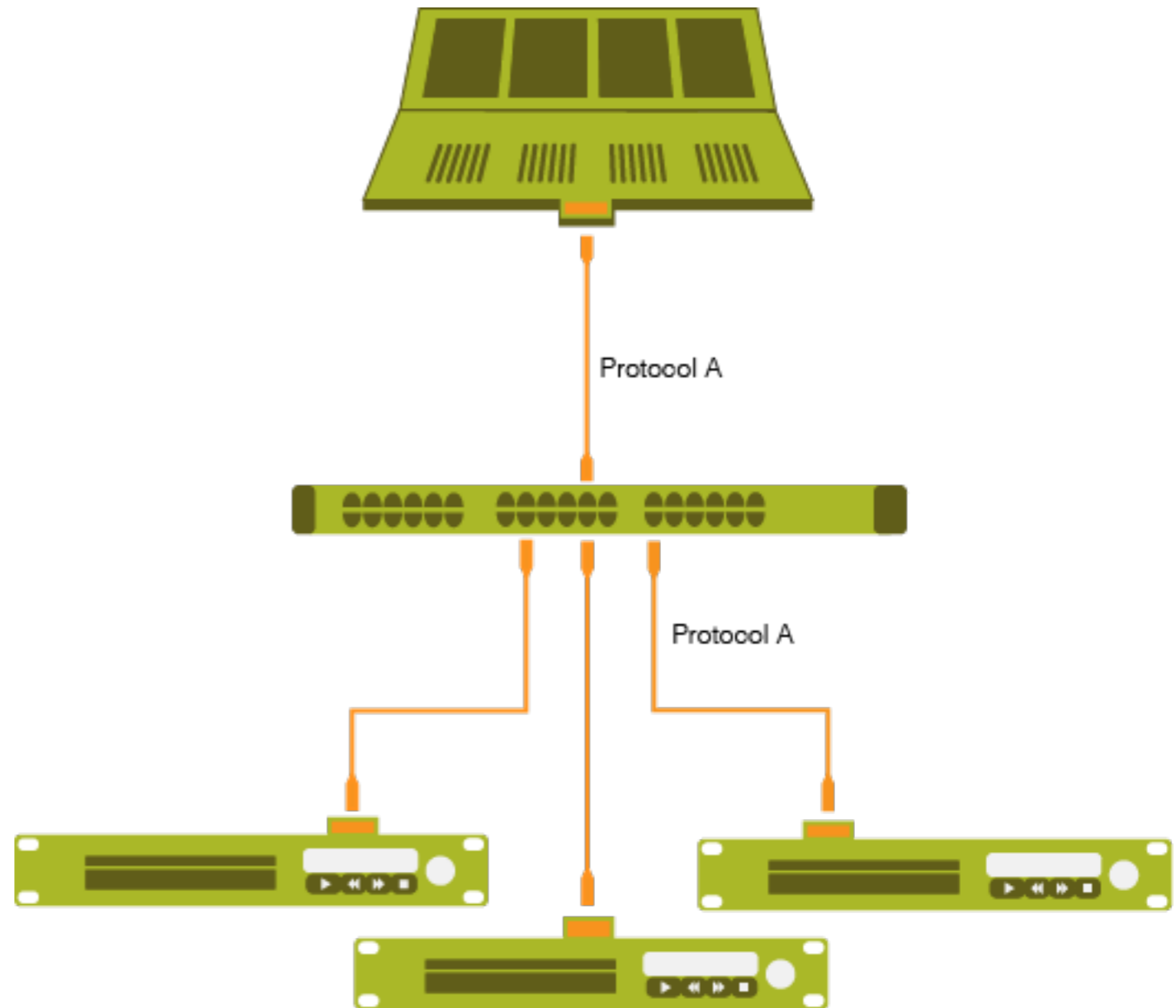
Debit

Machines virtuelles et logiciels

# Pourquoi l'AoIP ?

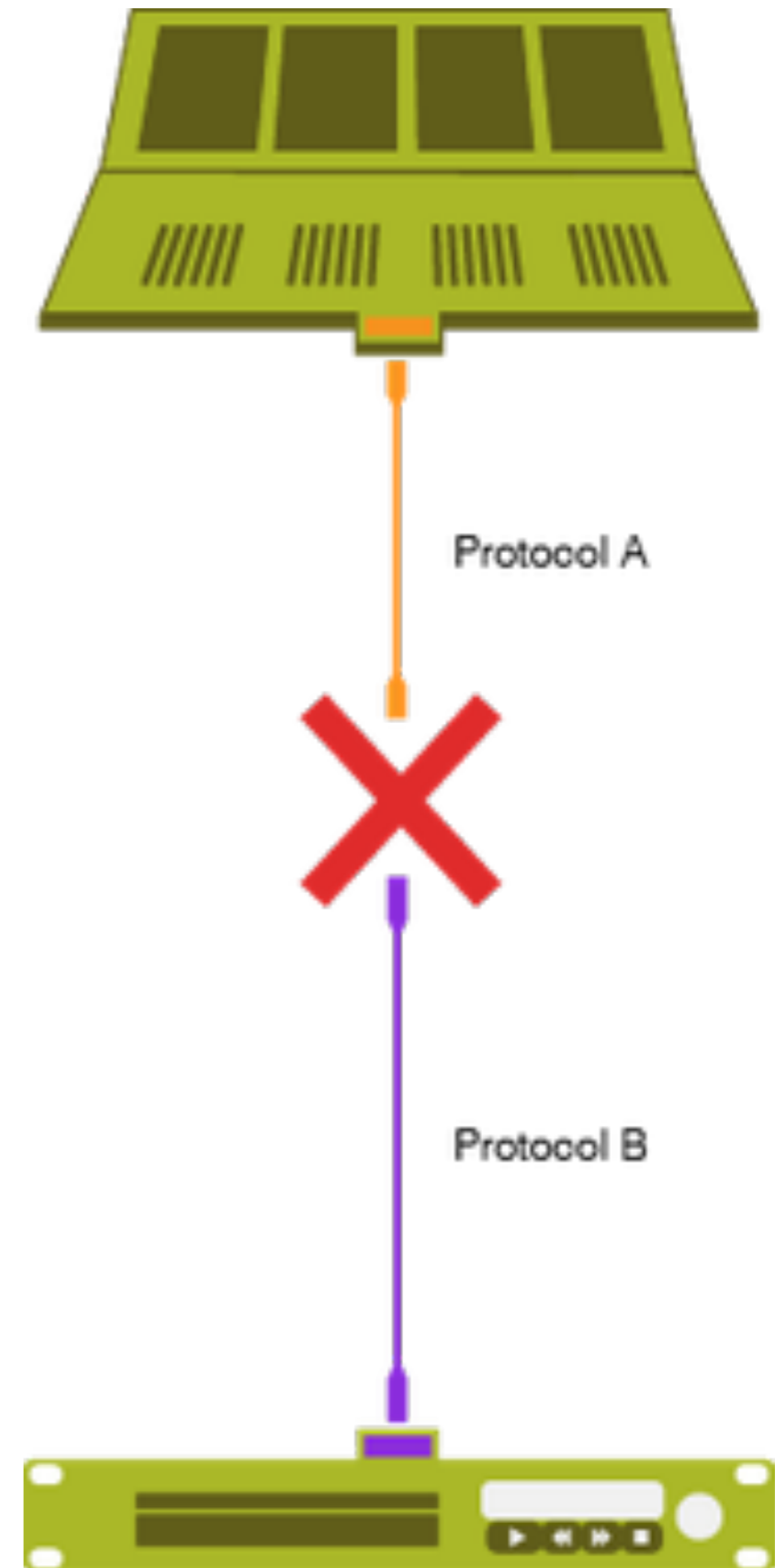
Cout des équipements

**Avec Dante**  
**C'est simple**



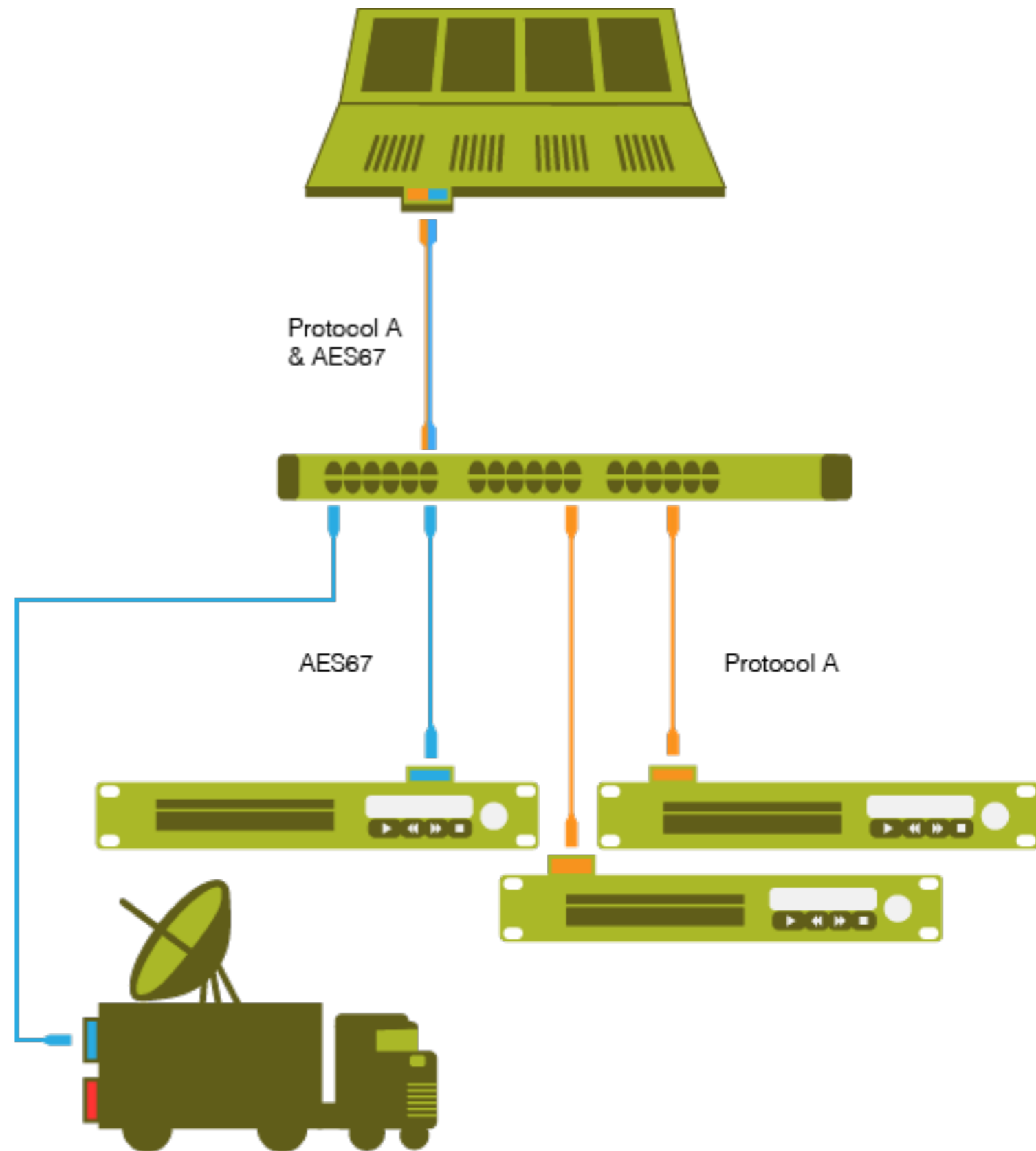
# Entre différents écosystèmes

Comment  
Inter-opérer ?



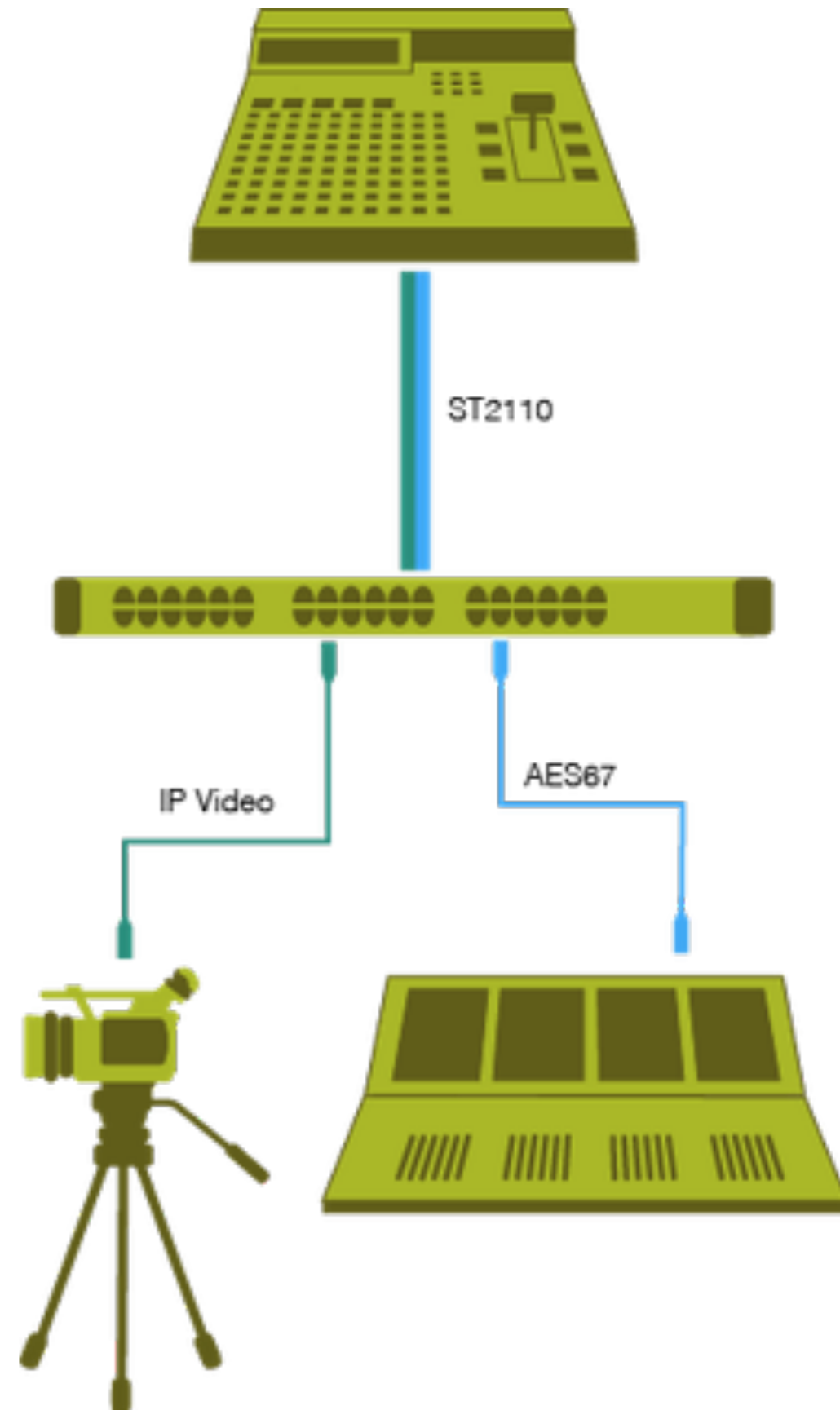
# AES67

## La pierre de rosette

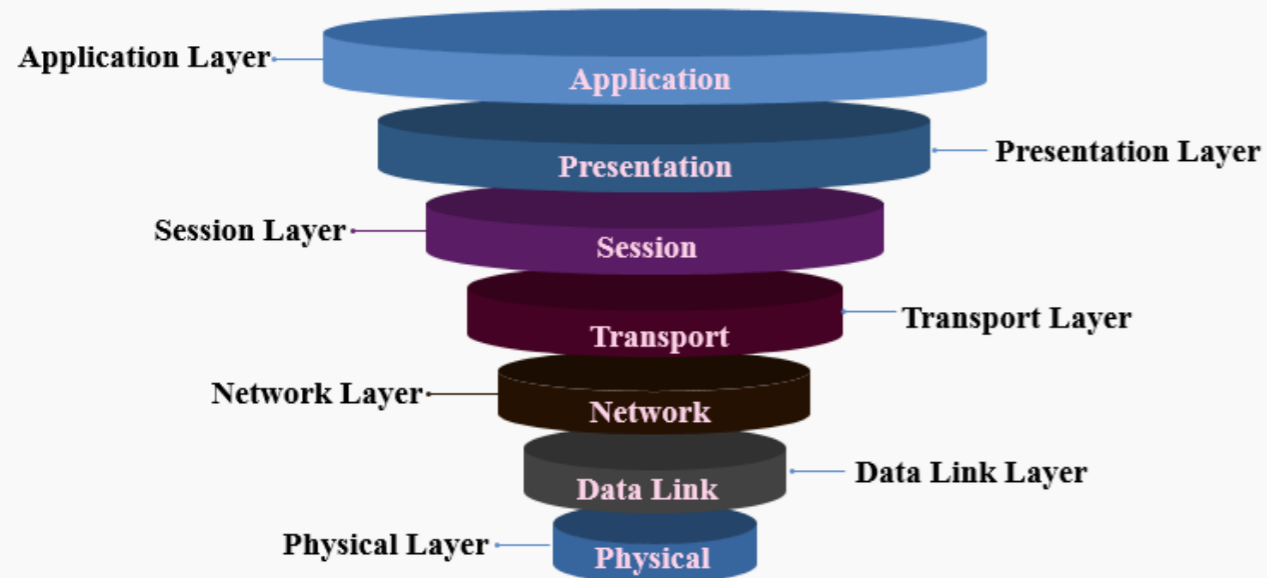


# ST2110

Le AES67 de la vidéo



## OSI Model



# Rappel réseaux



# AES67

**Comment ça marche ?**

Clock  
(PTP)

# AES67

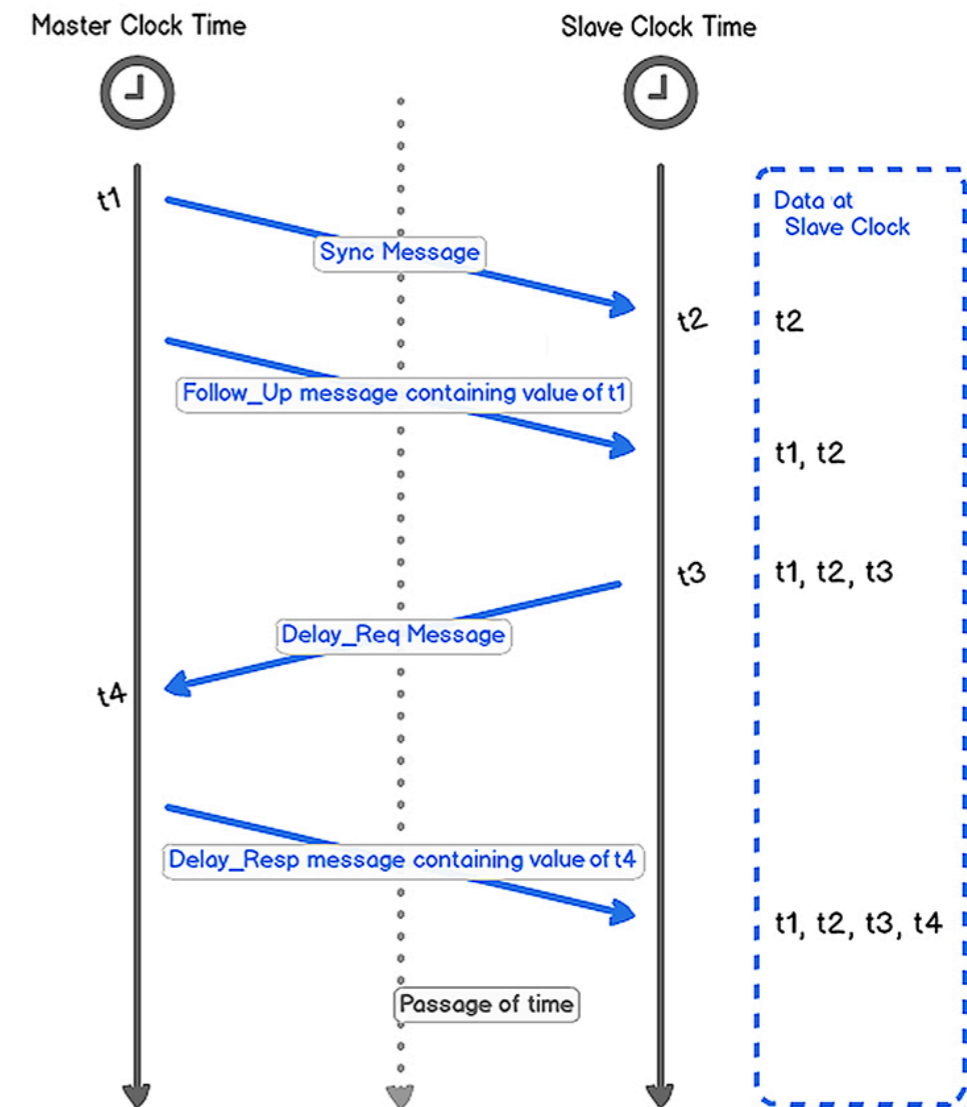
Streaming  
(QoS,  
RTP)

Signaling  
(SDP)

# PTP

## Distribution du temps, fréquence et phase

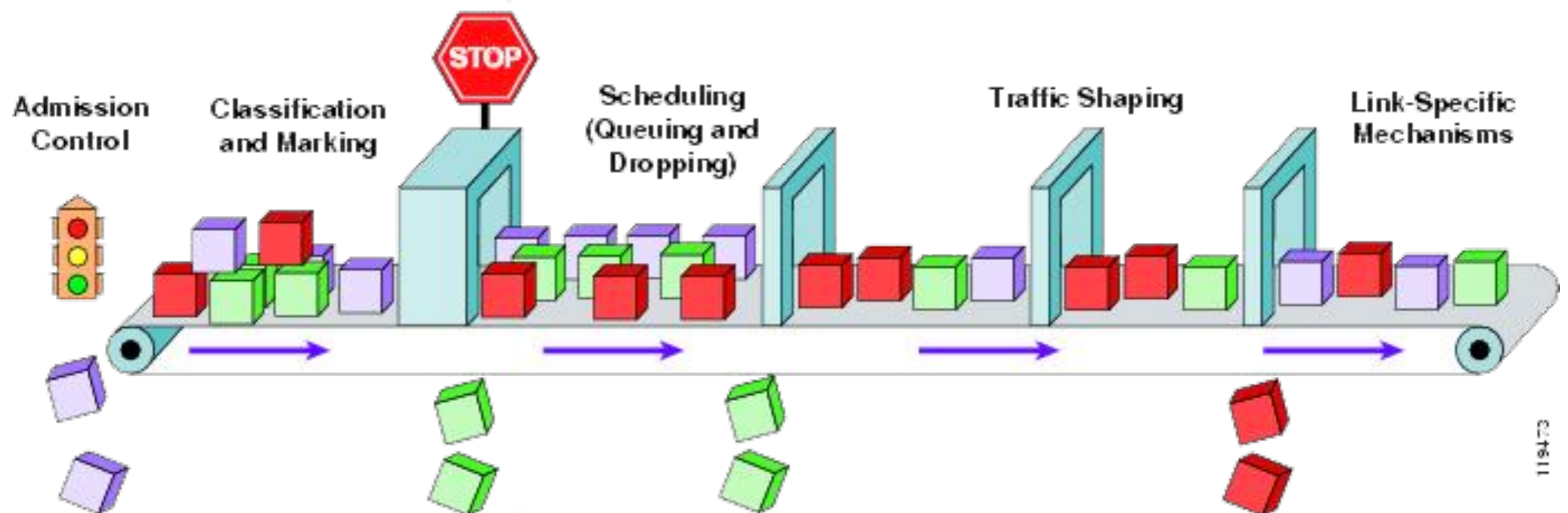
- Distribution du temps du leader
- Chaque follower reconstruit « l'horloge media »
- Boundary Clock, Transparent Clock et switches PTP



# Streaming

## RTP, QoS

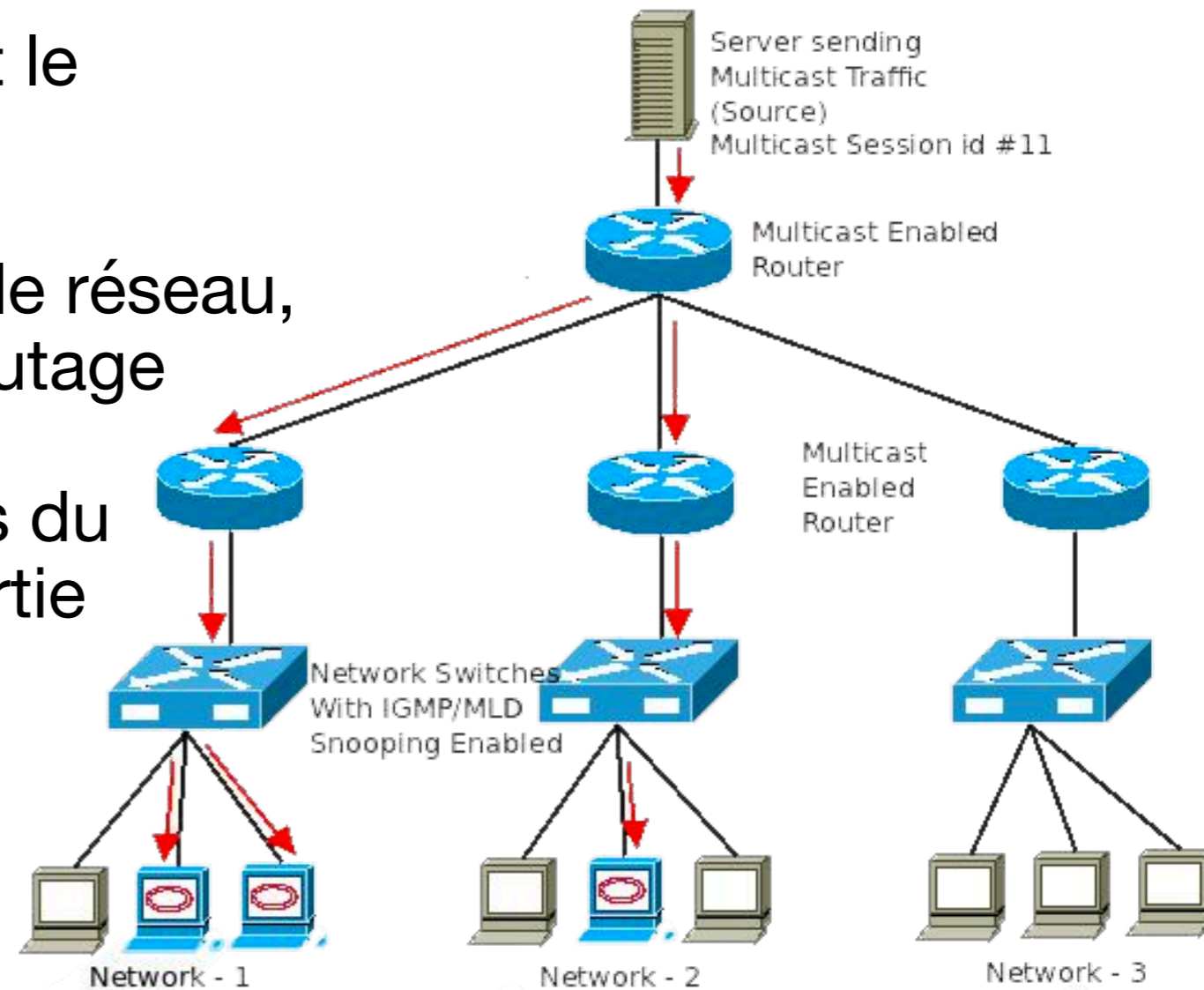
- RTP est utilisé pour le streaming depuis 20 ans
- But: allier rapidité (UDP) et detection de paquets manquants
- On utilise la QoS pour privilégier certains traffics



# Multicast

## Distribution plutôt que connection

- AES67 utilise préférentiellement le multicast
- But: mettre des ressources sur le réseau, laisser l'infrastructure faire le routage
- Avantage: on évite les flood lors du unicast ou la destination est partie
- Inconvenient: IGMP

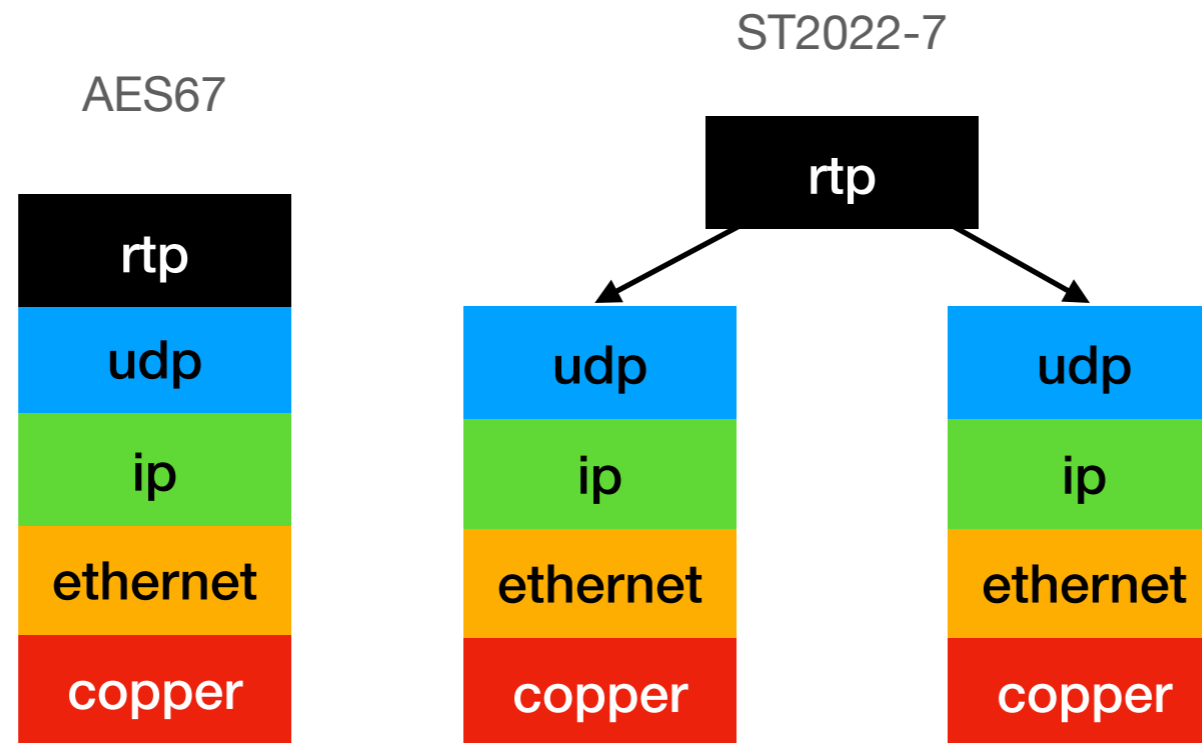


# SDP

**Décrire le flux, pour s'y connecter et le decoder**

```
v=0
o=- 23 0 IN IP4 169.254.0.8
s=Horus_80131_AES 1
c=IN IP4 239.1.0.8/1
t=0 0
a=clock-domain:PTPv2 0
m=audio 5004 RTP/AVP 98
c=IN IP4 239.1.0.8/1
a=rtpmap:98 L24/48000/8
a=sync-time:0
a=framecount:48
a=ptime:1
a=mediaclock:direct=0
a=ts-refclk:ptp=IEEE1588-2008:65-...-39-03:0
a=recvonly
```

# ST2110 et la redondance



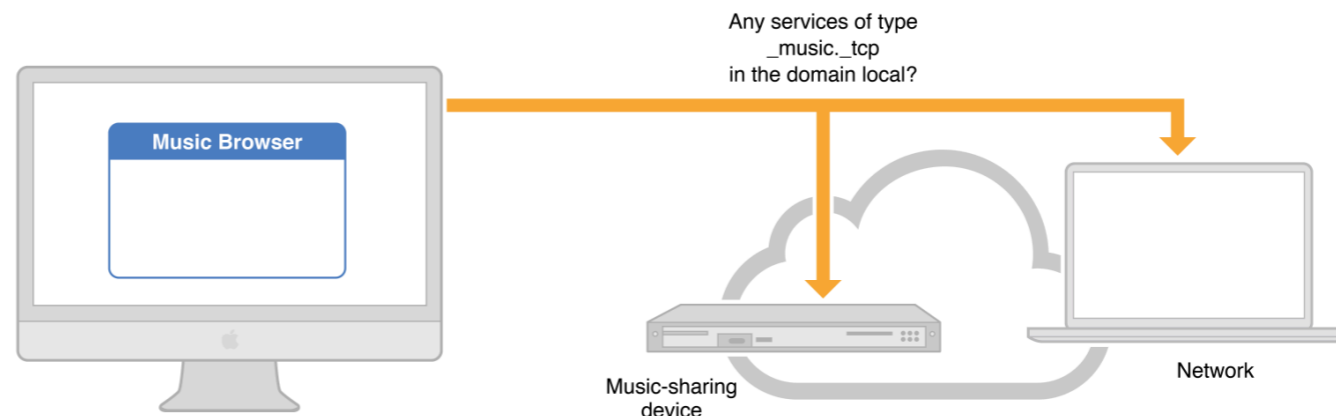
- A peine plus compliqué que Dante
- Multi Path Redundancy

# Et la découverte ?

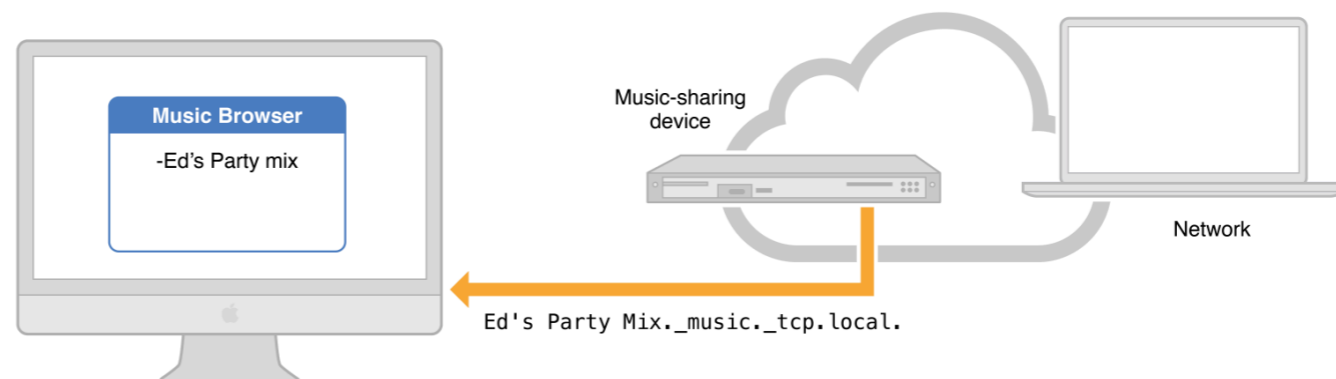
## AES67 ne parle que du transport

- SAP est utilisé par Dante
- mDNS par Ravenna
- Le bon vieux copier/coller...

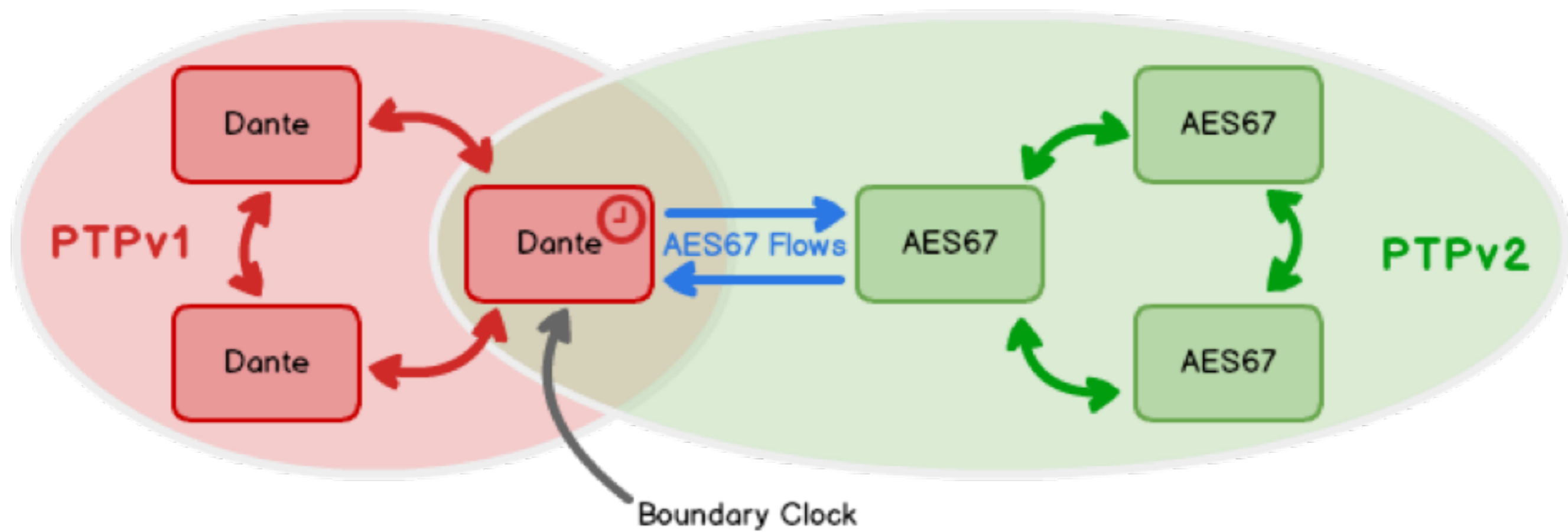
1. Query by service type



2. Response



**AES67 et Dante**



**Quelques softs utiles**

# Les outils: PTP Track Hound

**MEINBERG PTP TRACK HOUND v1.0.0**

Filters: Interface(s): All Protocol(s): All Domain(s): All Message(s): All Device(s): All Control

**Messages**

No.	Interface	Time	Msg. Type	Dom.	Seq. ID	Source	Destination
4445	eno1	2017-08-24, 10:01:47	PDelay R...	3	33948	172.27.100.124	224.0.0.107
4446	eno1	2017-08-24, 10:01:47	PDelay R...	3	33948	172.27.101.116	224.0.0.107
4447	eno1	2017-08-24, 10:01:47	PDelay R...	3	33948	172.27.101.116	224.0.0.107
4448	eno1	2017-08-24, 10:01:47	Delay Req.	82	19385	172.27.101.142	224.0.1.129
4449	eno1	2017-08-24, 10:01:47	Delay Resp.	82	19385	172.27.82.25	224.0.1.129
4450	eno1	2017-08-24, 10:01:47	Delay Req.	19	26335	172.27.19.63	224.0.1.129
4451	eno1	2017-08-24, 10:01:47	Delay Resp.	19	26335	172.27.19.91	224.0.1.129
4452	eno1	2017-08-24, 10:01:47	Sync	84	4478	172.27.84.153	224.0.1.129
4453	eno1	2017-08-24, 10:01:47	Follow Up	84	4478	172.27.84.153	224.0.1.129
4454	enp1s0	2017-08-24, 10:01:47	Sync	2	32603	EC:46:70:00:6...	01:80:C2:00:0...
4455	enp1s0	2017-08-24, 10:01:47	Follow Up	2	32603	EC:46:70:00:6...	01:80:C2:00:0...
4456	eno1	2017-08-24, 10:01:47	Sync	82	58822	172.27.82.25	224.0.1.129
4457	eno1	2017-08-24, 10:01:47	Follow Up	82	58822	172.27.82.25	224.0.1.129
4458	eno1	2017-08-24, 10:01:47	PDelay R...	3	17105	172.27.101.118	224.0.0.107
4459	eno1	2017-08-24, 10:01:47	PDelay R...	3	17105	172.27.100.124	224.0.0.107
4460	eno1	2017-08-24, 10:01:47	PDelay R...	3	17105	172.27.100.124	224.0.0.107
4461	eno1	2017-08-24, 10:01:47	Announce	1	18412	172.27.19.58	224.0.1.129
4462	enp1s0	2017-08-24, 10:01:47	Sync	2	32604	EC:46:70:00:6...	01:80:C2:00:0...
4463	enp1s0	2017-08-24, 10:01:47	Follow Up	2	32604	EC:46:70:00:6...	01:80:C2:00:0...
4464	eno1	2017-08-24, 10:01:47	Delay Req.	82	19265	172.27.101.148	224.0.1.129
4465	eno1	2017-08-24, 10:01:47	Delay Resp.	82	19265	172.27.82.25	224.0.1.129

**Message Details**

Sync

Length: 60 bytes

Protocol: IEEE 802.3

Domain: 2

Sequence ID: 32071

Receive Time: 10:00:40.846655

Ethernet II PTP Sync

Correction: 0.000 ns

Clock ID: 0xEC4670FFFE0069A9

Source Port ID: 1

Sequence ID: 32071

Control: Sync (0)

Log Message Period: -3

**Devices**

Type	Identity	Protocol	Dom.	ANN	SYN	FUP
GM	Meinberg_FFFE009F2E	IPv4	0	34	67	67
GM	Meinberg_FFFE0060C1	IPv4	1	67	133	133
GM	Meinberg_FFFE0069A9	IEEE 802.3	2	67	534	534
GM	Meinberg_FFFE00242E	IPv4	3	66	66	66
Unknown	Meinberg_FFFE00242D	IPv4	3	0	0	0
GM	Meinberg_FFFE00BFA8	IPv4	11	67	67	67
GM (6)	Meinberg_FFFE008FC9	IPv4	19	67	67	67
GM	Meinberg_FFFE002435	IEEE 802.3	38	67	67	67
GM (4)	Meinberg_FFFE009CF3	IPv4	82	66	67	67
GM (2)	Meinberg_FFFE0090B1	IPv4	84	67	67	67
Monitor	Meinberg_FFFE009F28	IPv4	Any	0	0	0
Monitor	Meinberg_FFFE00BFB5	IPv4	Any	0	0	0
Monitor	Meinberg_FFFE00BFB6	IPv4	Any	0	0	0

**Device Details (Grandmaster, Network: eno1, PTPv2, IPv4, Domain 1)**

Port Identity: 0xEC4670FFFE0060C1:00001

Address: 172.27.19.58

Vendor: Meinberg

Device: -

Management: -

GM Clock Quality: P1 128, CC 6, CA 0x21 (Within 100 ns), CV 13563, P2 128, SR 0

Port State: Master

Delay Mech.: Unknown

Ann. Rate: 1/s

Sync Rate: 2/s

Req. Rate: -

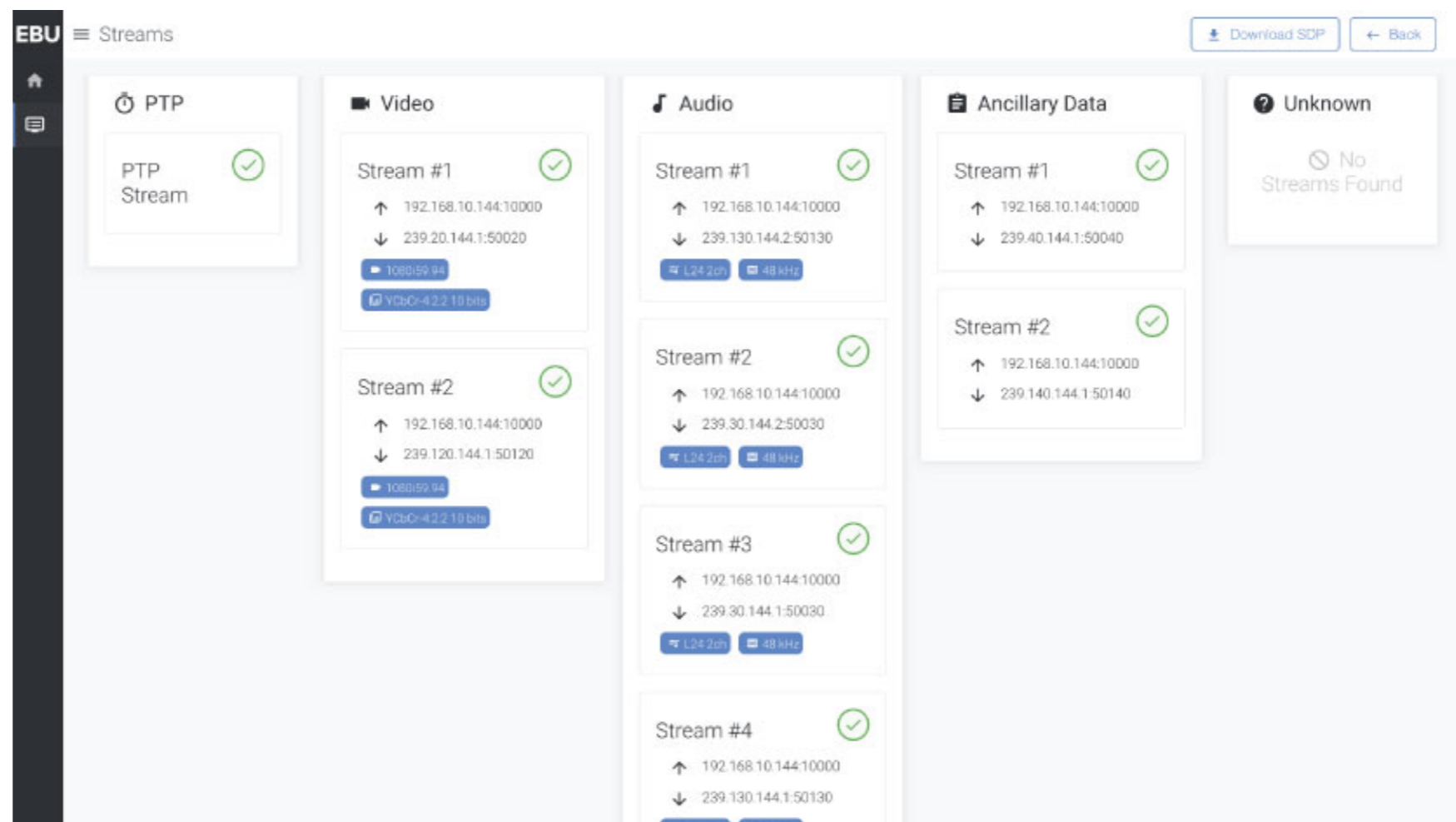
**Events**

Time	Identity	Description
2017-08-24, 10:01:31.485	Meinberg_FFFE00BFB6	State changed from Unknown to Active
2017-08-24, 10:01:30.470	Meinberg_FFFE00BFB6	Type changed from Unknown to Monitor
2017-08-24, 10:01:30.470	Meinberg_FFFE00BFB6	New device (Unknown, 172.27.19.93) detected
2017-08-24, 10:00:55.875	Meinberg_FFFE009EFB	State changed from Unknown to Slave
2017-08-24, 10:00:54.935	Meinberg_FFFE006056	State changed from Unknown to Slave
2017-08-24, 10:00:54.935	Meinberg_FFFE009EFA	State changed from Unknown to Slave
2017-08-24, 10:00:48.748	Meinberg_FFFE006056	Type changed from Unknown to Slave
2017-08-24, 10:00:48.748	Meinberg_FFFE006056	New device (Unknown, 172.27.84.152) detected
2017-08-24, 10:00:47.895	Meinberg_FFFE009EFB	Type changed from Unknown to Slave
2017-08-24, 10:00:47.297	Meinberg_FFFE006096	State changed from Unknown to Slave
2017-08-24, 10:00:46.492	Meinberg_FFFE009FE8	New device (Unknown, 172.27.19.68) detected

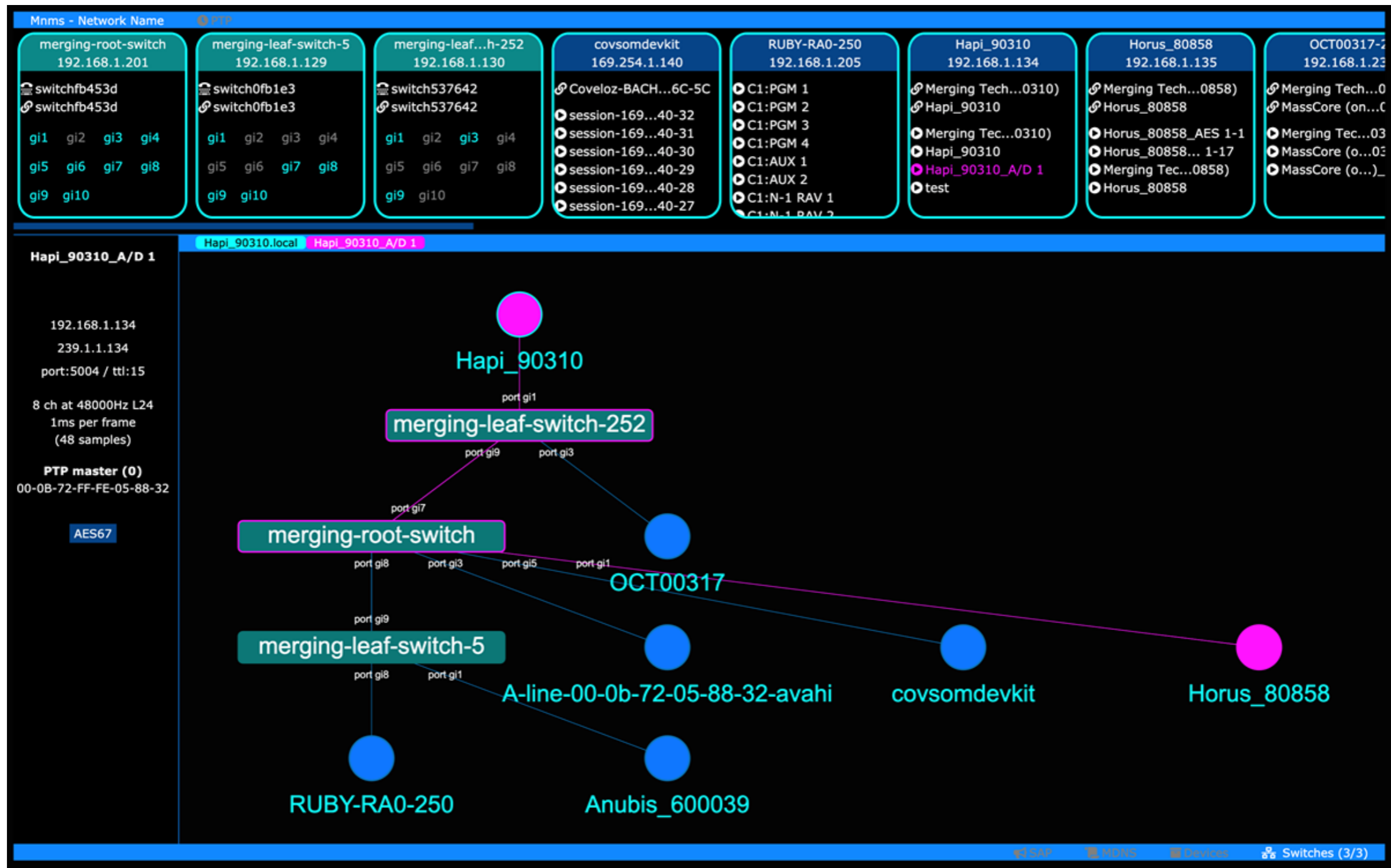
# Les outils : LIST

- Un outil d'analyse de flux de l'EBU
- Capturer un flux avec wireshark et l'analyser

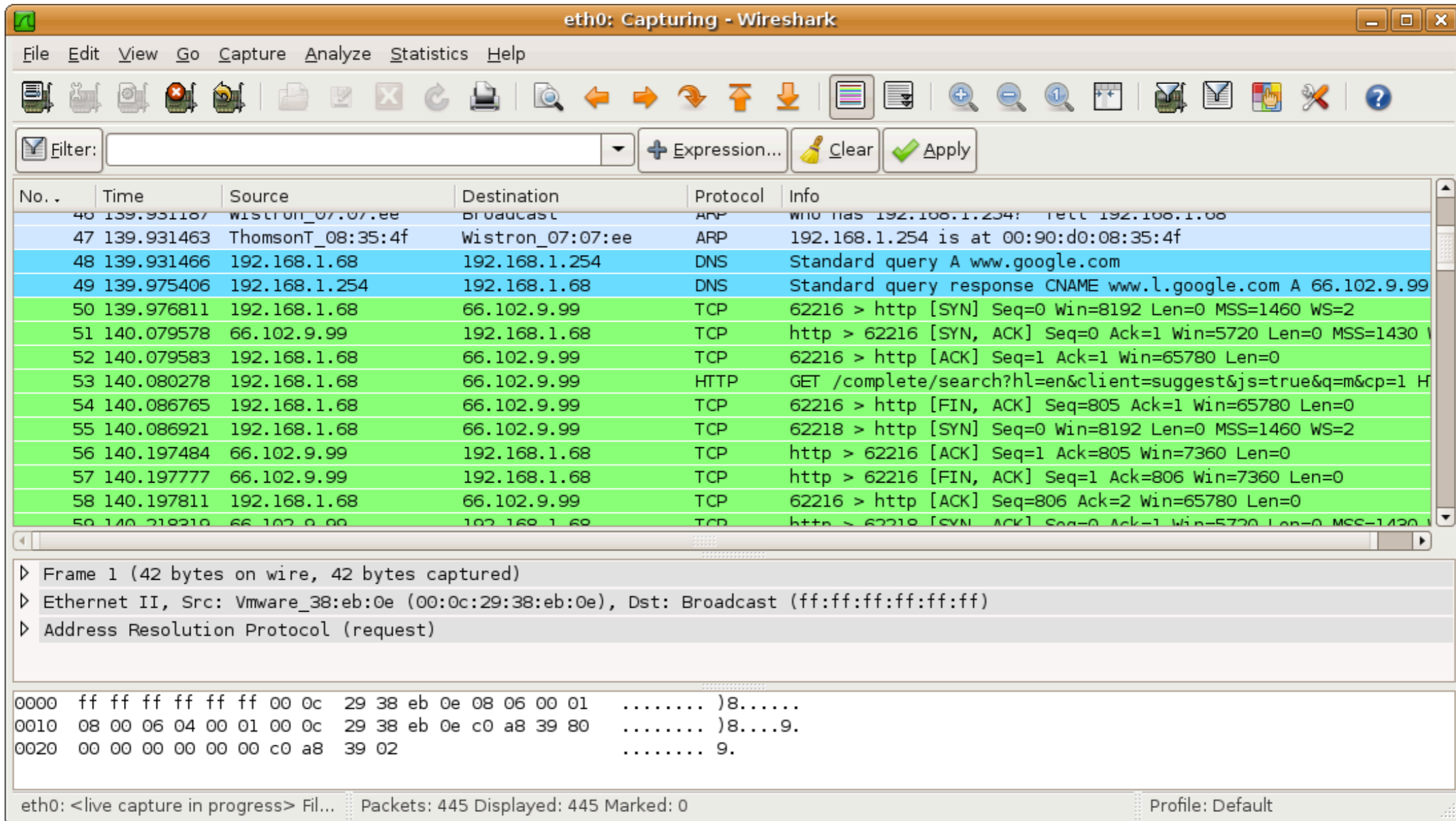
- <https://tech.ebu.ch/list>



# Les outils: MNMS



# Les outils: Wireshark



eth0: Capturing - Wireshark

File Edit View Go Capture Analyze Statistics Help

Filter:  + Expression... Clear Apply

No.	Time	Source	Destination	Protocol	Info
46	139.931187	Wistron_07:07:ee	Broadcast	ARP	who has 192.168.1.254? Tell 192.168.1.68
47	139.931463	ThomsonT_08:35:4f	Wistron_07:07:ee	ARP	192.168.1.254 is at 00:90:d0:08:35:4f
48	139.931466	192.168.1.68	192.168.1.254	DNS	Standard query A www.google.com
49	139.975406	192.168.1.254	192.168.1.68	DNS	Standard query response CNAME www.l.google.com A 66.102.9.99
50	139.976811	192.168.1.68	66.102.9.99	TCP	62216 > http [SYN] Seq=0 Win=8192 Len=0 MSS=1460 WS=2
51	140.079578	66.102.9.99	192.168.1.68	TCP	http > 62216 [SYN, ACK] Seq=0 Ack=1 Win=5720 Len=0 MSS=1430
52	140.079583	192.168.1.68	66.102.9.99	TCP	62216 > http [ACK] Seq=1 Ack=1 Win=65780 Len=0
53	140.080278	192.168.1.68	66.102.9.99	HTTP	GET /complete/search?hl=en&client=suggest&js=true&q=m&cp=1 H
54	140.086765	192.168.1.68	66.102.9.99	TCP	62216 > http [FIN, ACK] Seq=805 Ack=1 Win=65780 Len=0
55	140.086921	192.168.1.68	66.102.9.99	TCP	62218 > http [SYN] Seq=0 Win=8192 Len=0 MSS=1460 WS=2
56	140.197484	66.102.9.99	192.168.1.68	TCP	http > 62216 [ACK] Seq=1 Ack=805 Win=7360 Len=0
57	140.197777	66.102.9.99	192.168.1.68	TCP	http > 62216 [FIN, ACK] Seq=1 Ack=806 Win=7360 Len=0
58	140.197811	192.168.1.68	66.102.9.99	TCP	62216 > http [ACK] Seq=806 Ack=2 Win=65780 Len=0
59	140.218210	66.102.9.99	192.168.1.68	TCP	http > 62218 [SYN, ACK] Seq=0 Ack=1 Win=5720 Len=0 MSS=1430

Frame 1 (42 bytes on wire, 42 bytes captured)

Ethernet II, Src: Vmware\_38:eb:0e (00:0c:29:38:eb:0e), Dst: Broadcast (ff:ff:ff:ff:ff:ff)

Address Resolution Protocol (request)

```
0000  ff ff ff ff ff ff 00 0c 29 38 eb 0e 08 06 00 01  ..... )8.....
0010  08 00 06 04 00 01 00 0c 29 38 eb 0e c0 a8 39 80  ..... )8....9.
0020  00 00 00 00 00 00 c0 a8 39 02  ..... 9.
```

eth0: <live capture in progress> Fil... Packets: 445 Displayed: 445 Marked: 0 Profile: Default