

And Now for Something Completely Different

Ring Ring

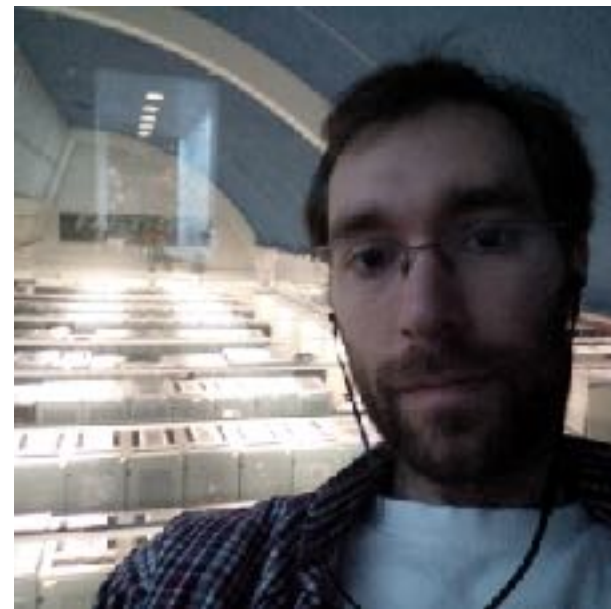
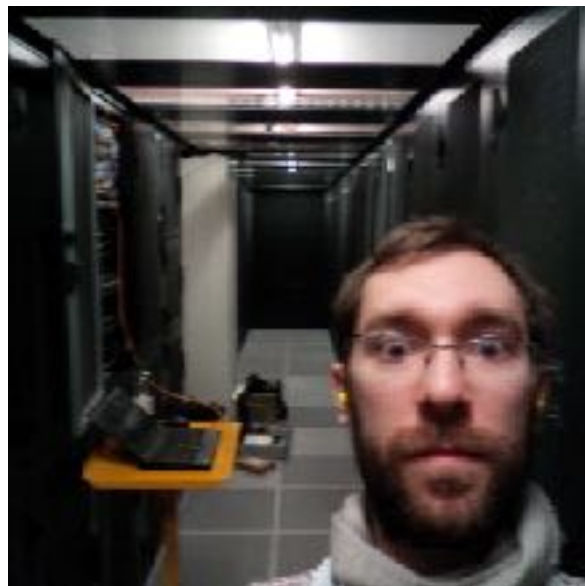
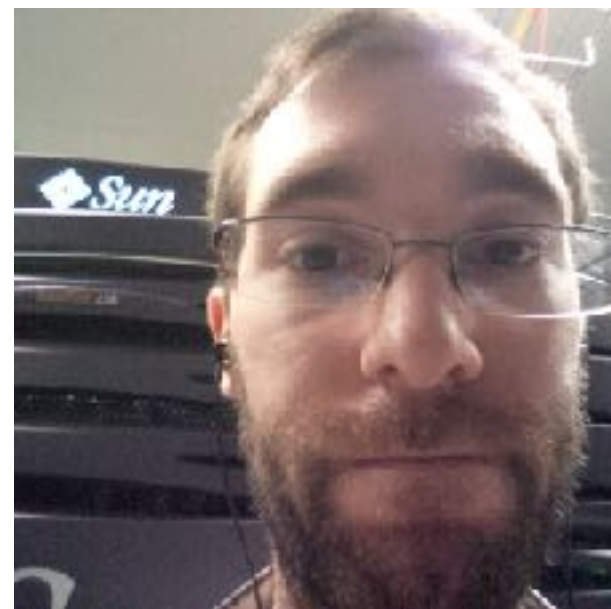
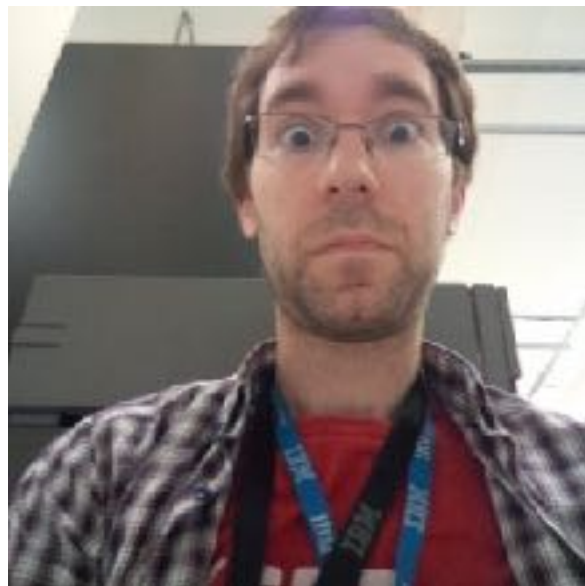
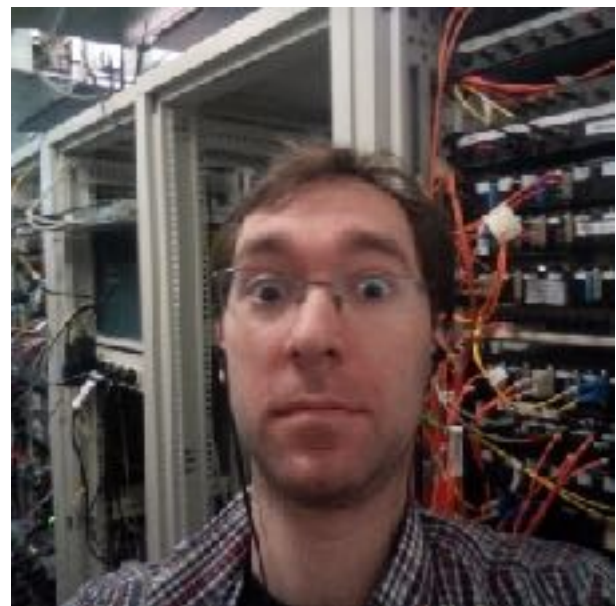
Leonardo Rizzi (XenT)



Who I am?

Not important slide

- I work in datacenters
- I drink tea



Everybody loves Retrocomputing

Why?

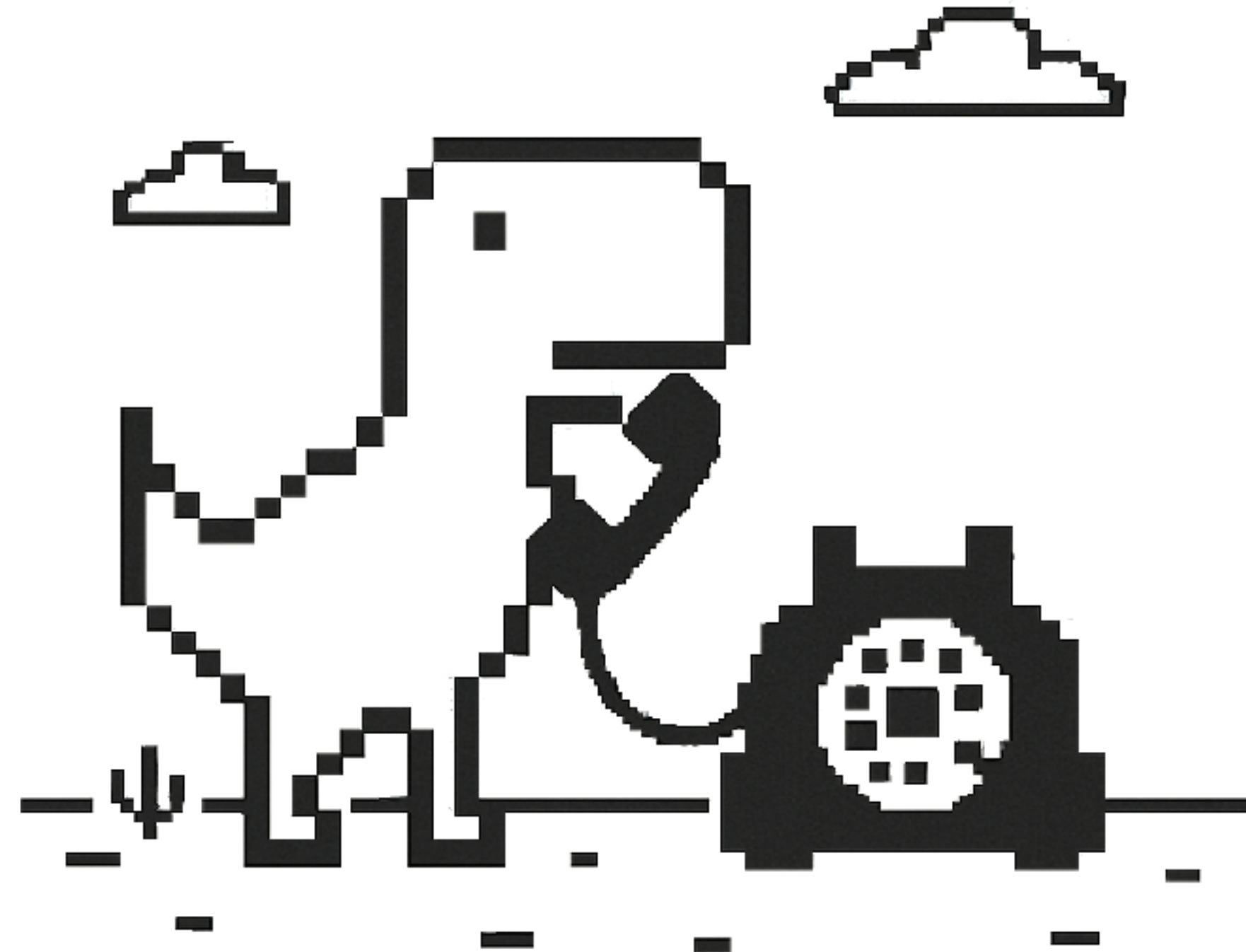
- Nostalgia
- History
- Aesthetics
- Challenge
- Discovery
- Understanding

Summary

In this presentation

Protocol War

ISDN

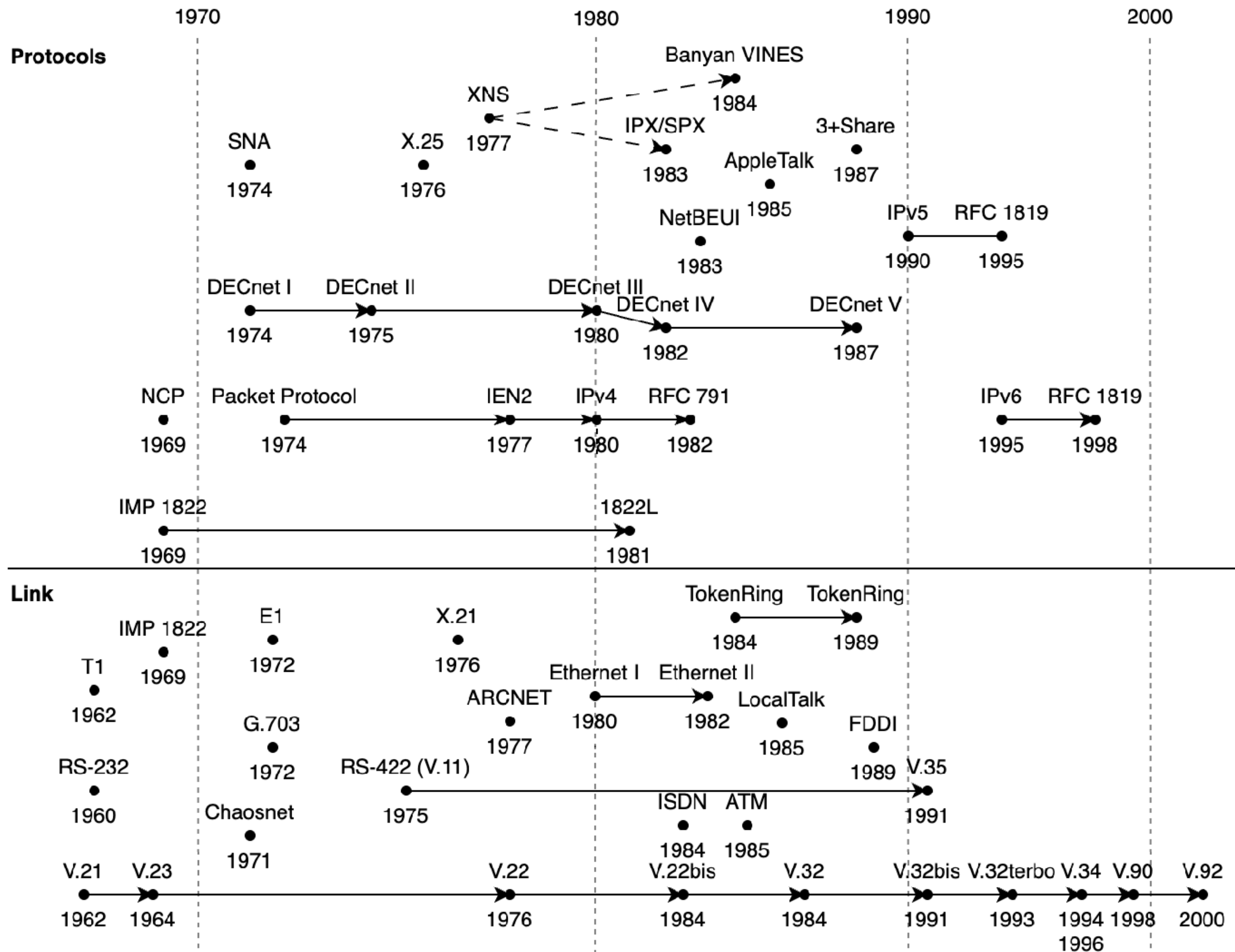


Protocol War

What network?

The beginning of the Protocol War

- What protocol?
- Circuit switching vs Packet switching
- Virtual circuits vs Datagrams
- TCP vs CYCLADES and INWG vs X.25
- Common host protocol vs translating between protocols
- Internet vs OSI



Circuit switching vs Packet switching

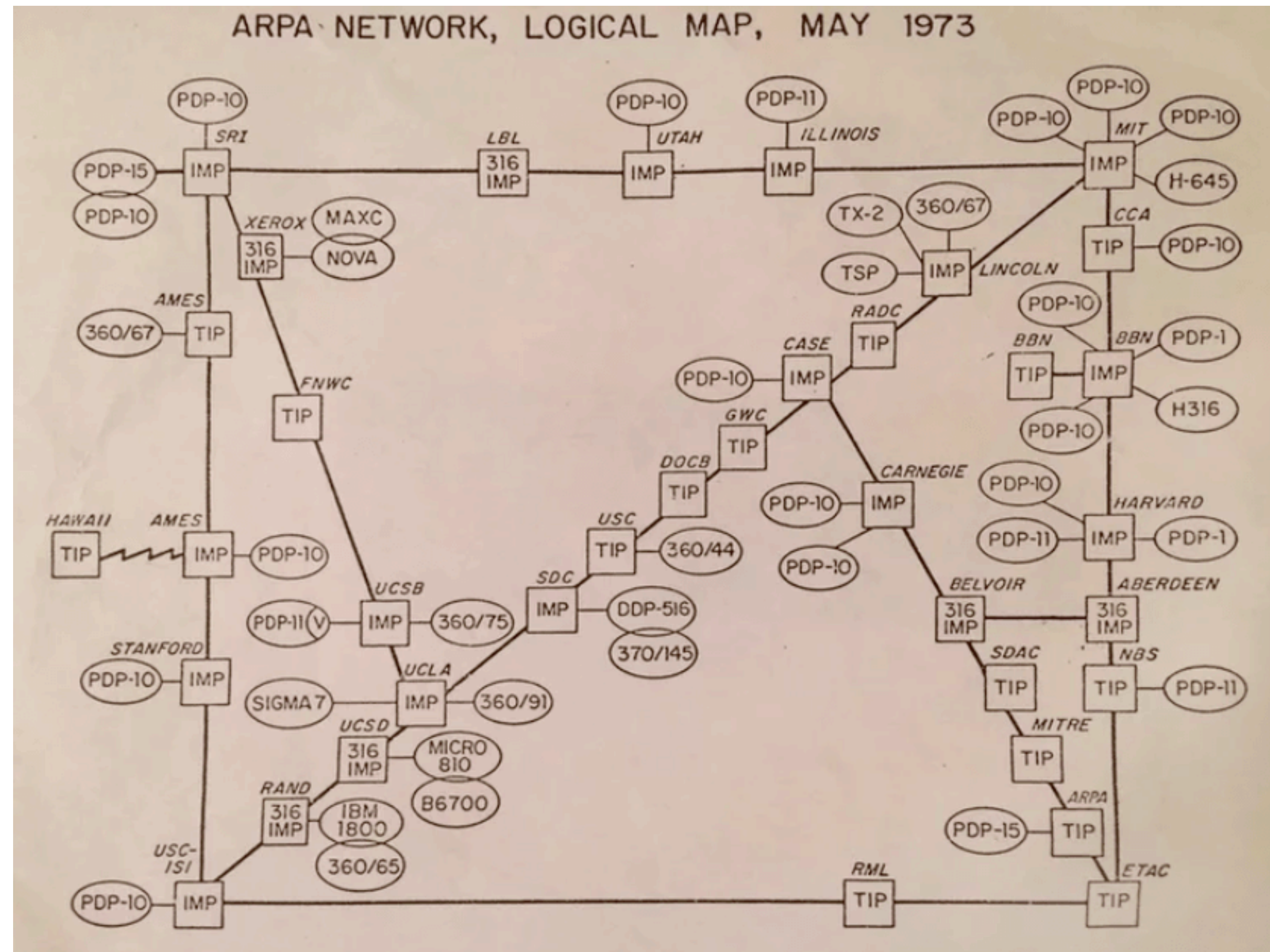
Circuit Switching	Packet Switching
Physical path between source and destination	No physical path
All packets use the same path	Packets travel indipendently
Bandwidth wastage	No bandwidth wastage
No store and forward transmission	Support store and forward transmission

Virtual Circuits vs Datagrams

Issue	Virtual Circuits	Datagram
Addressing	Each packet contains a short VC number	Each packet contains the source and the destination address
State Information	State information about each VC is maintained	Does not hold packet level state information
Routing	Route is chosen when VC is setup (all packets follow this route)	Each packet is routed independently
Congestion control	Easy (if enough buffers can be allocated in advantage)	Difficult (you over-provision the capacity)
Resource failure	All VCs passing through the failed resourced are terminated	Packets are lost only during the resource failure
Suitability	Connection-oriented service	Connection-oriented service and connectionless service

ARPANET

1822 Protocol / NCP



1973 ARPANET MAP

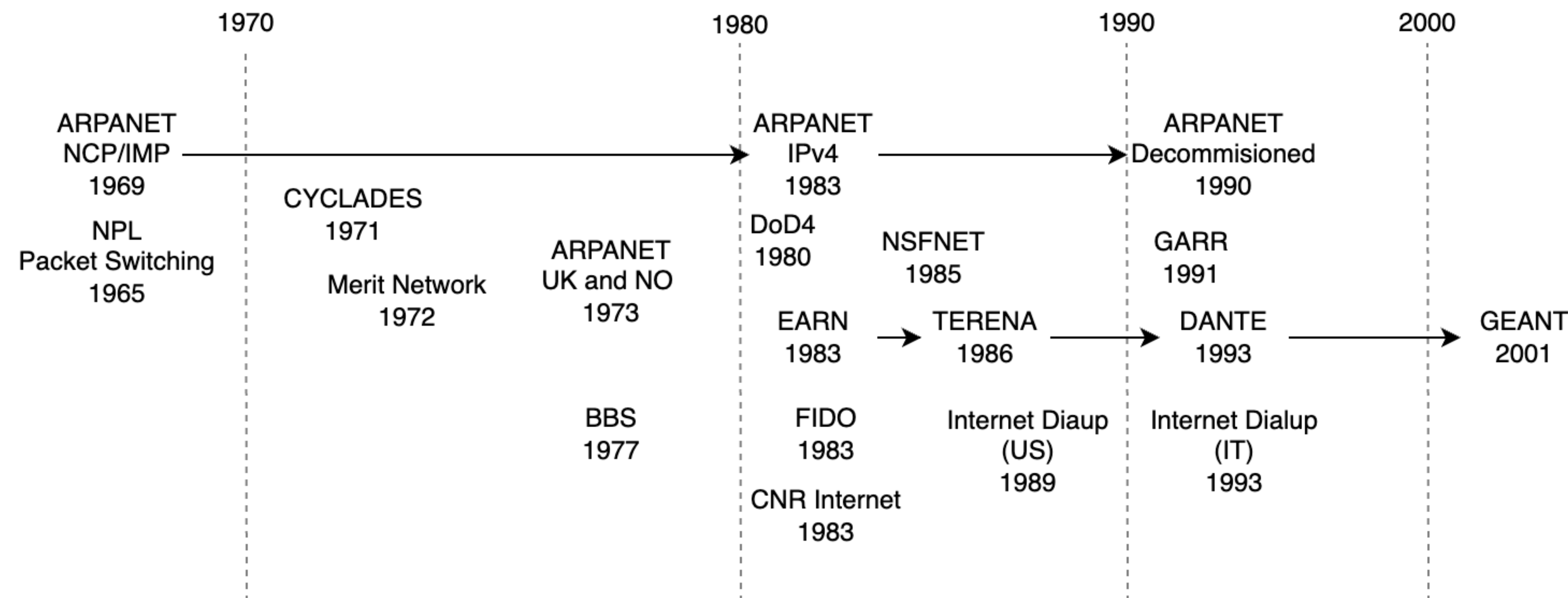


316 IMP

Uplink:
6 x DS0 (64kbit/s)

Host:
4 x Serial

Milestones



Meanwhile Cisco...

cisco Systems' Portable Gateway Server (PGS) is housed in a Zero Halliburton suitcase. It provides a portable means of bringing a gateway to a site and making it operational quickly.

To gain access to the PGS, open the suitcase and lay it flat to expose a panel with several connectors.

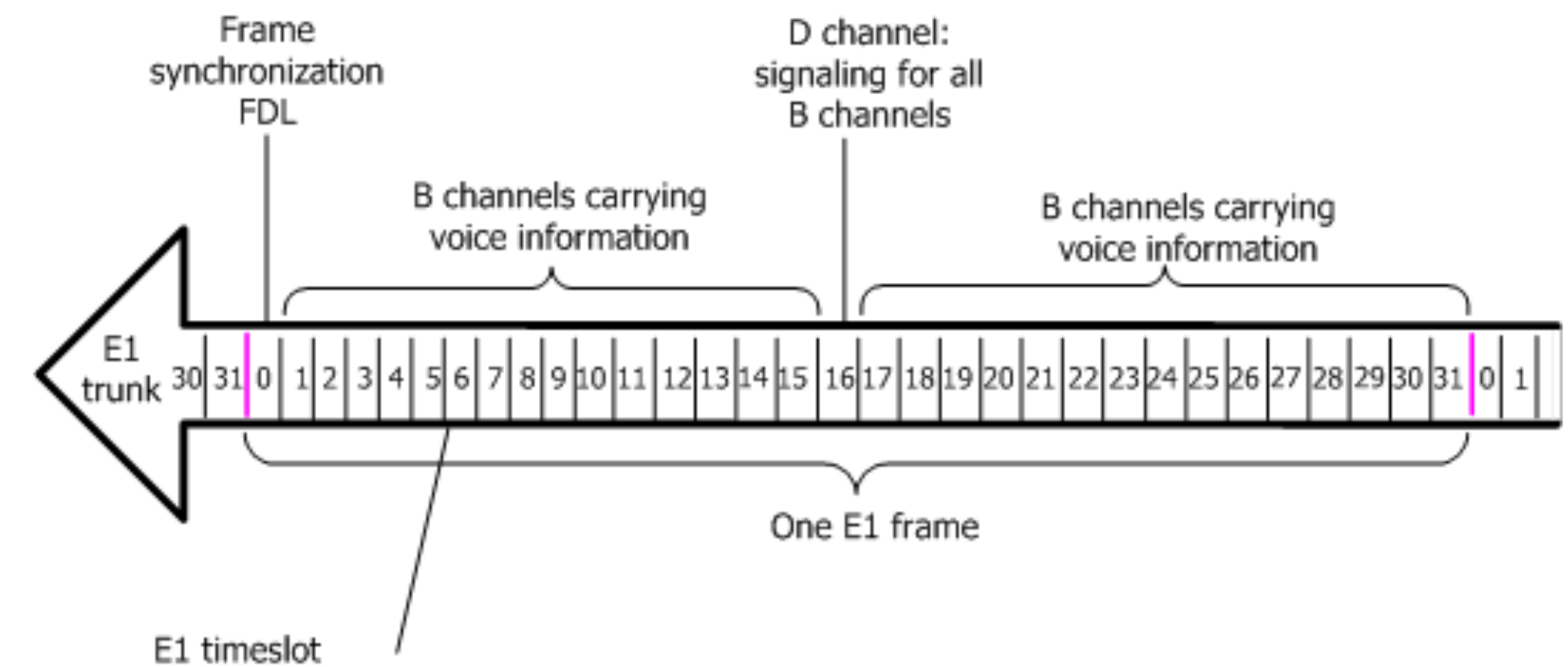
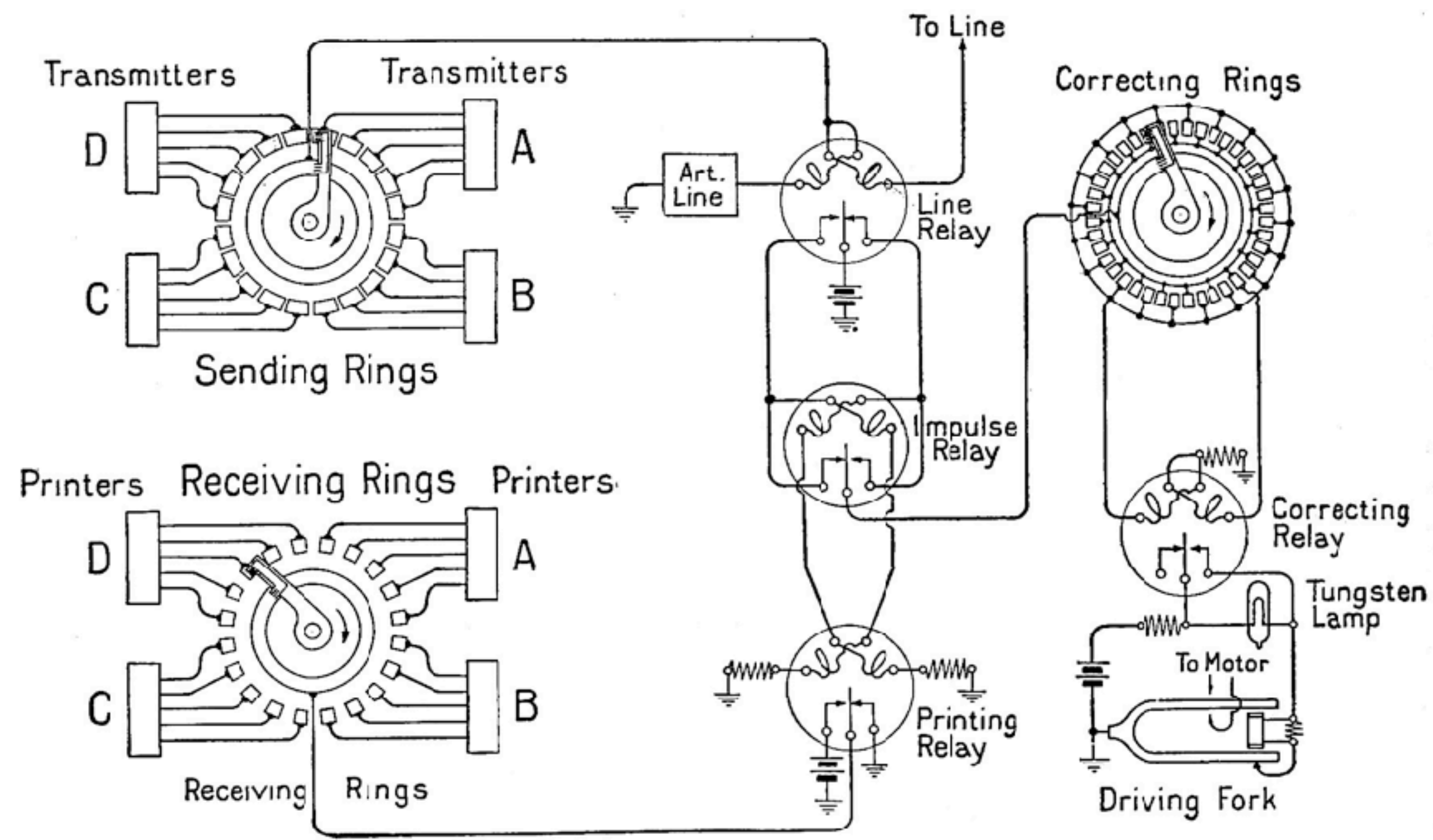


ISDN

TDM

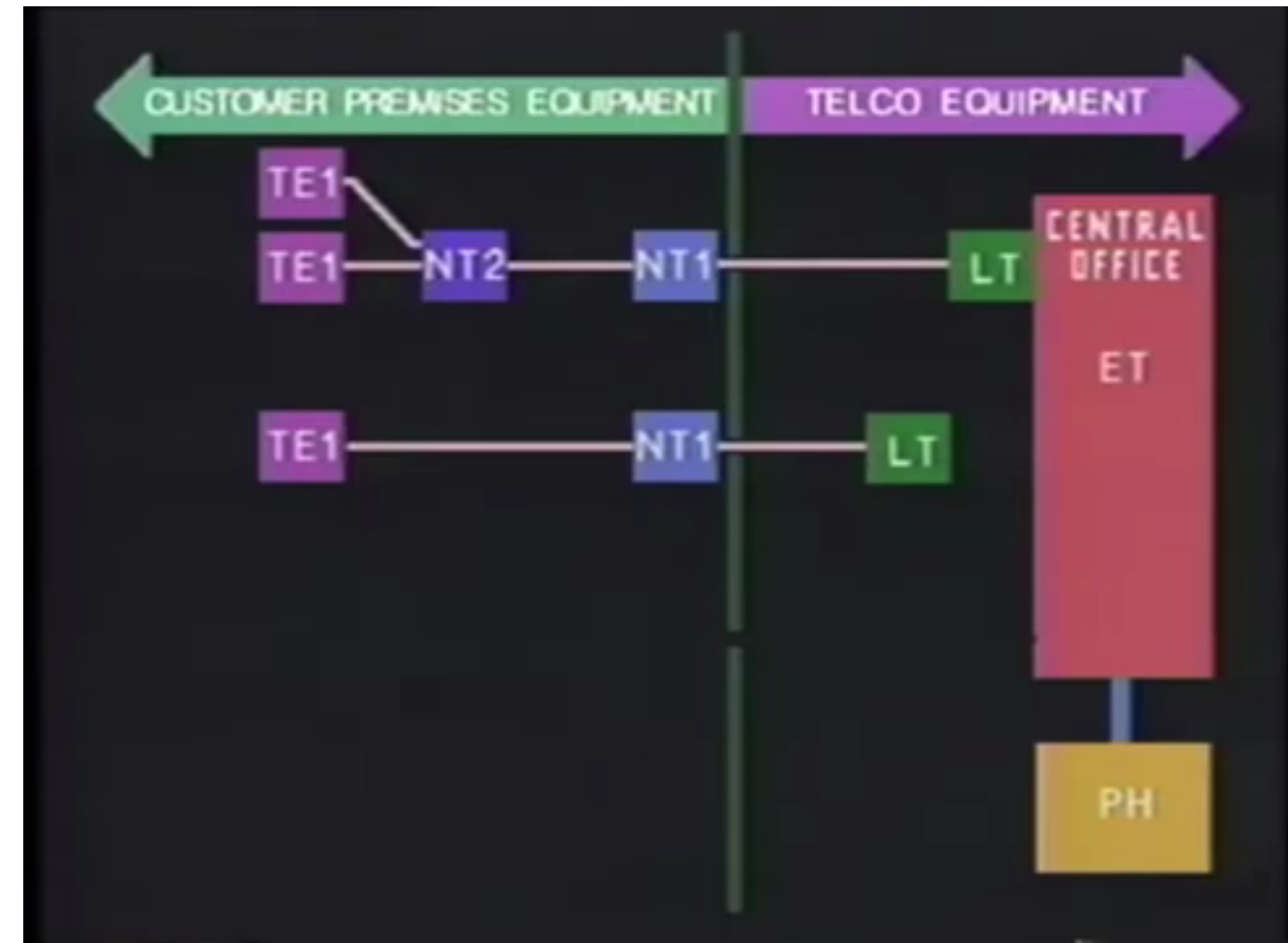
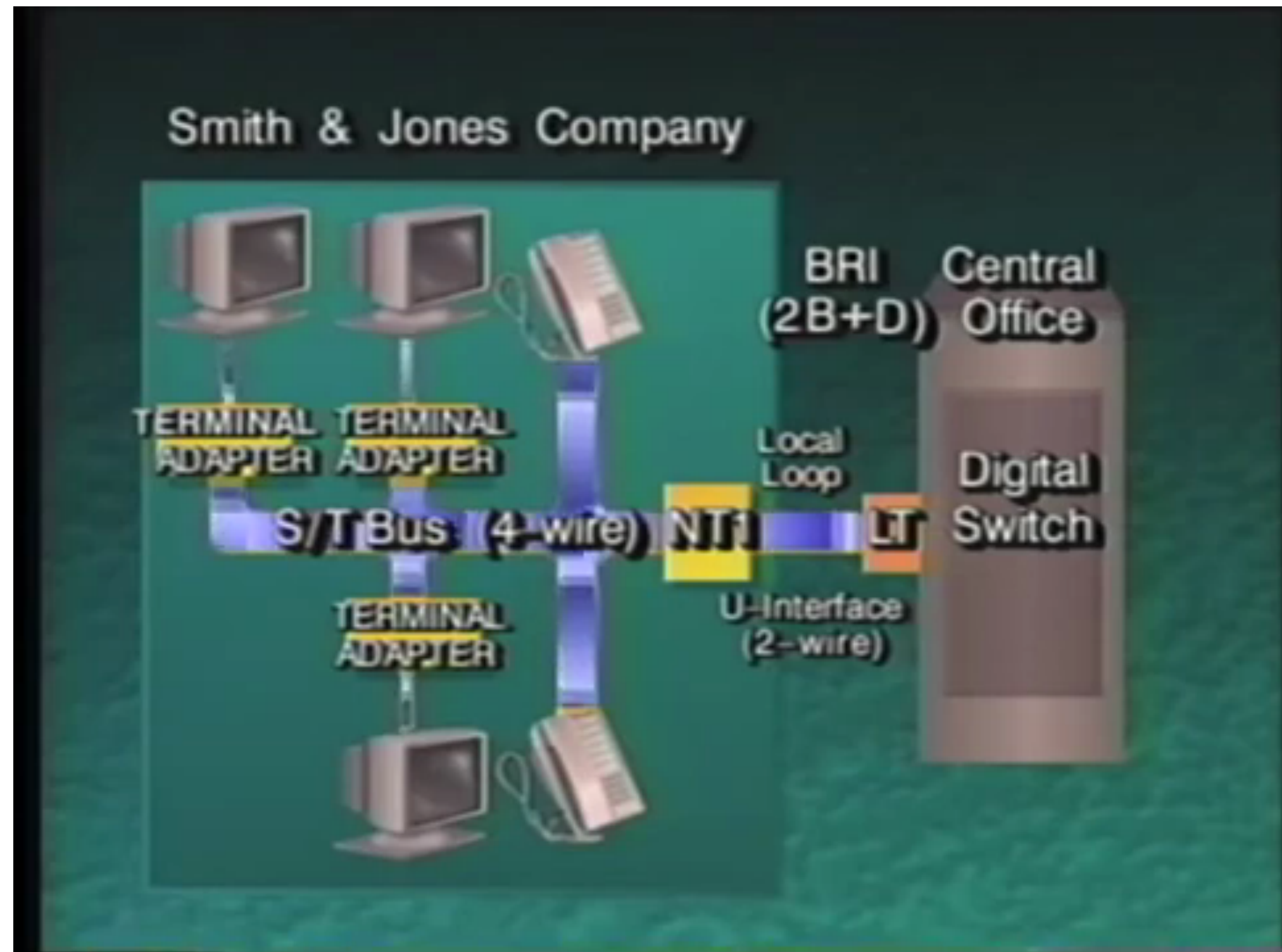
Time Division Multiplexing

First TDM Year 1872 (Baudot Multiplexer)



E1 TDM Frame 1972

Architecture



*Frames from AT&T corporate training video

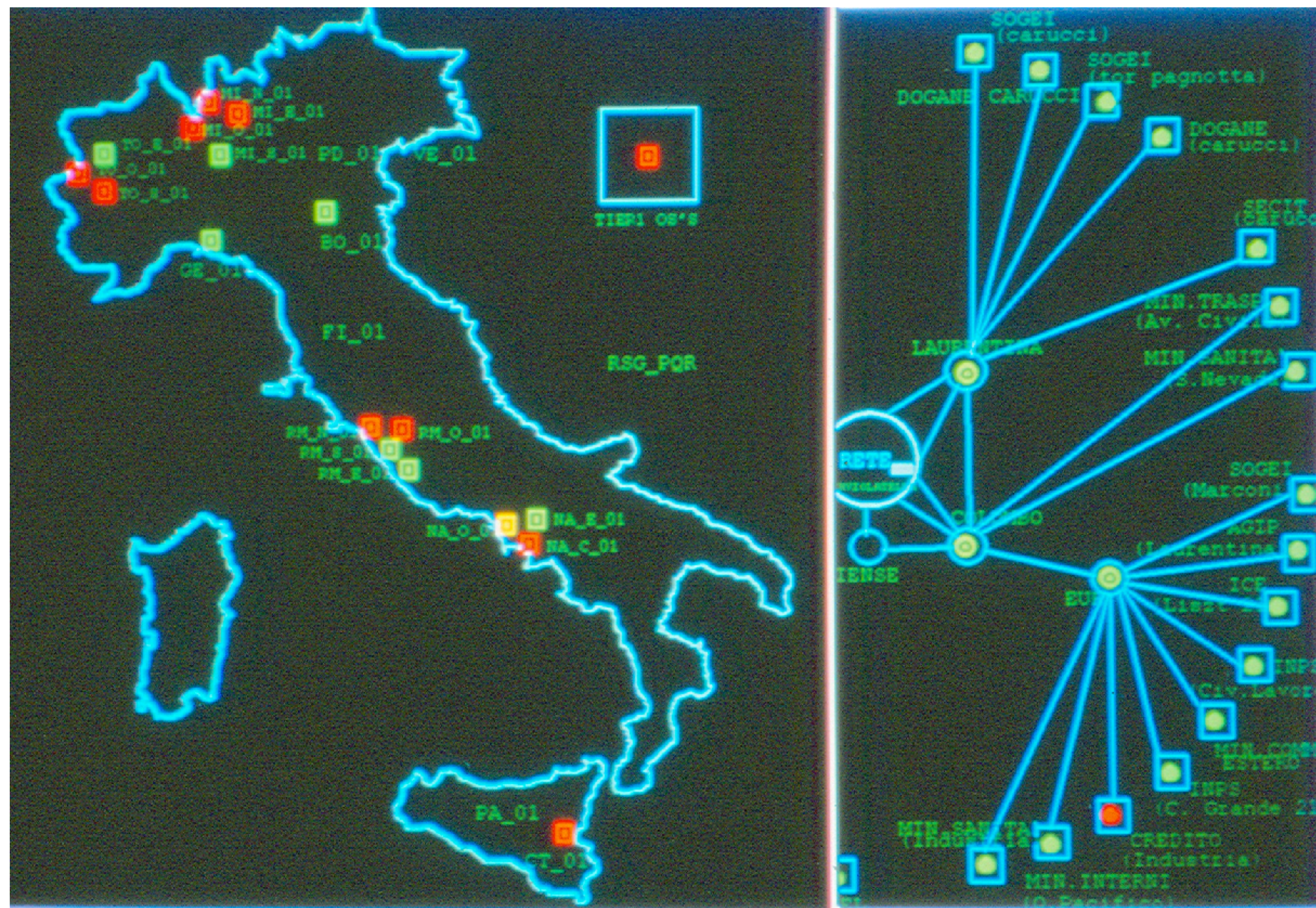
NT

- BRI (Basic Rate Interface)
 - D Channel (9.6 kbit/s)
 - B Channels x 2 (64 kbit/s)
- PRI (Primary Rate Interface)
 - D Channel x 2 (64 kbit/s) 1 time slot it's used for clock + sync
 - B Channels x 30 (64 kbit/s)

ISDN in Italy

Integrated Services Digital Network

- Pilot 1991
- GA 1994



La Rete Intelligente Telecom Italia

Price List in Europe

Price list from 1993

	BRI		PRI	
	NCR	MCR	NCR	MCR
Belgium	440.000 Lire 434 Euro	86.950 Lire 85,82 Euro	14.000.000 Lire 13.817,29 Euro	1.998.000 1.971,72 Euro
France	147.825 Lire 145,90 Euro	65700 Lire 64,84 Euro	903.750 Lire 891,96 Euro	671.250 Lire 662,49 Euro
Germany	97.500 Lire 96,23 Euro	55.500 Lire 54,78 Euro	150.000 Lire 148,04 Euro	388.500 Lire 383,43 Euro
Italy	400.000 Lire	50.000 Lire	600.000 Lire	690.000 Lire
	394,78 Euro	49,35 Euro	592,17 Euro	680,99 Euro
Netherlands	534.400 Lire 527,43 Euro	56.780 Lire 56,04 Euro	5.253.000 Lire 5.184,44 Euro	558.000 Lire 550,72 Euro
UK	858.000 Lire 846,80 Euro	60.000 Lire 59,22 Euro	9.105.500 Lire 8.986,67 Euro	1.917.630 Lire 1.892,60 Euro

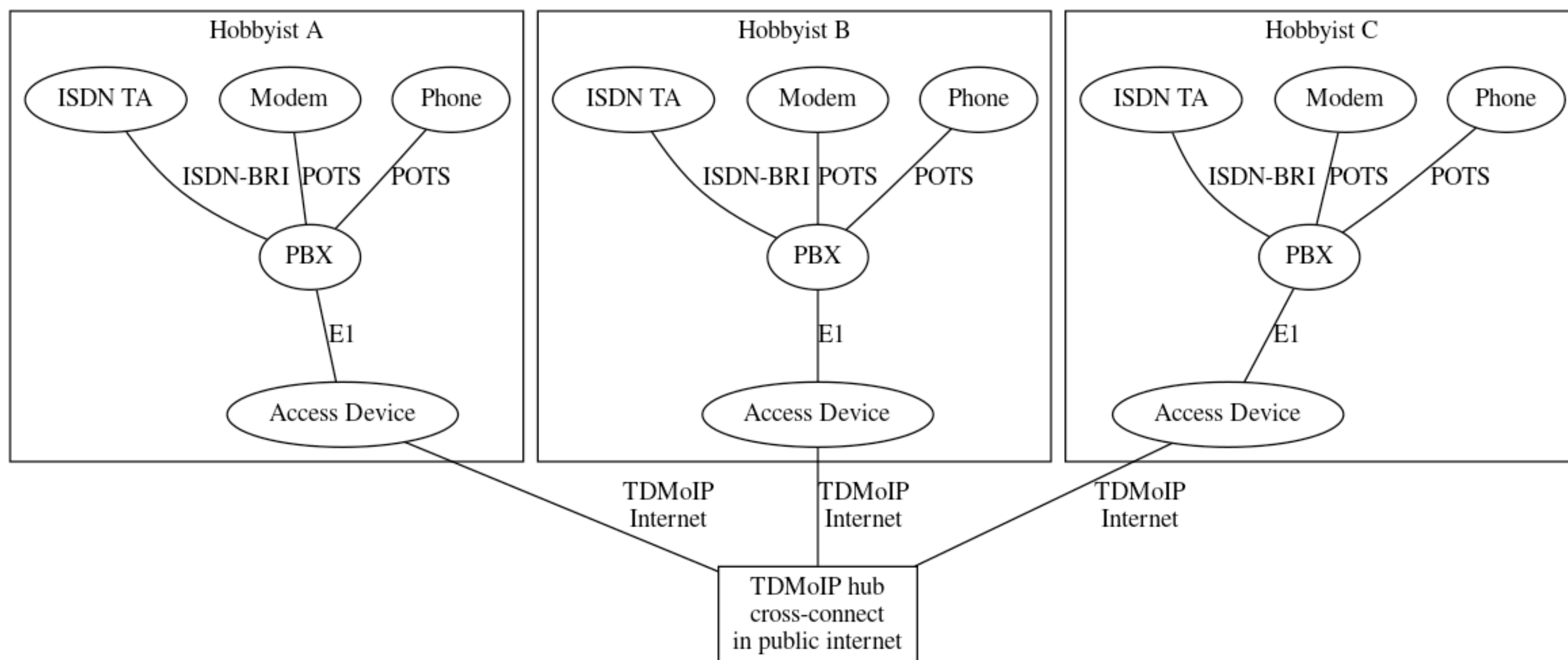
* inflation adjusted price 2025 (inflationhistory.com)

** price may do not include additional services (numbers or channels)

OCTOI - Osmocom Community TDM over IP

TDM/ISDN/SS7 Network

OCTOI is a community TDM/ISDN/SS7 network, which enable retronetworking enthusiasts around the world to interconnect their TDM equipment

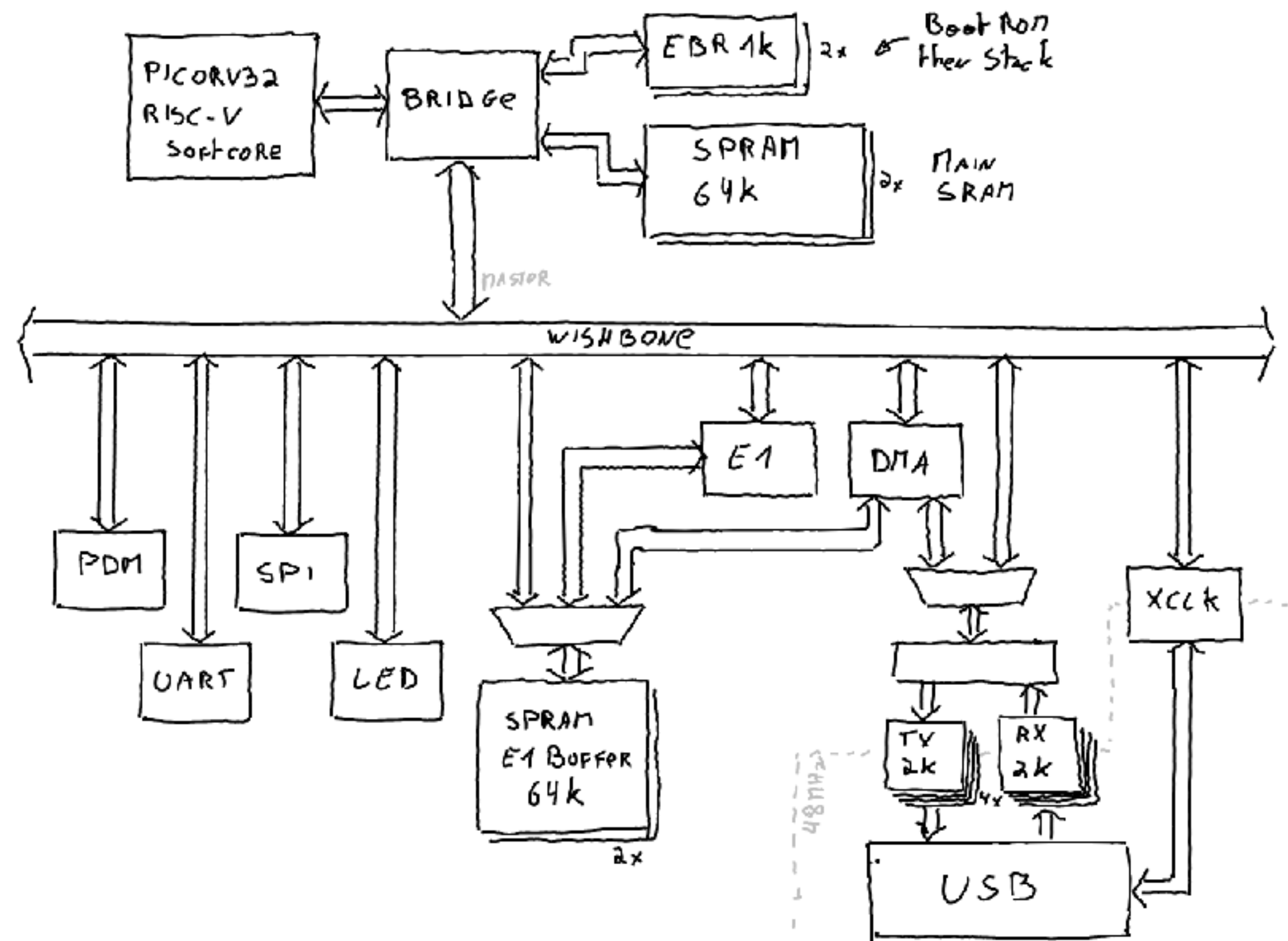


icE1usb

iCE40 E1 USB interface

The icE1usb is an E1 adapter with a USB interface:

- 2 x E1 Interfaces
- GPS-DO
- USB



*Sylvain Munaut's osmodevcon 2019 presentation



EWSD Switch installed at the 38C3

Thank You

Write me a feedback:

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