

Synchrone Digitale Hierarchie

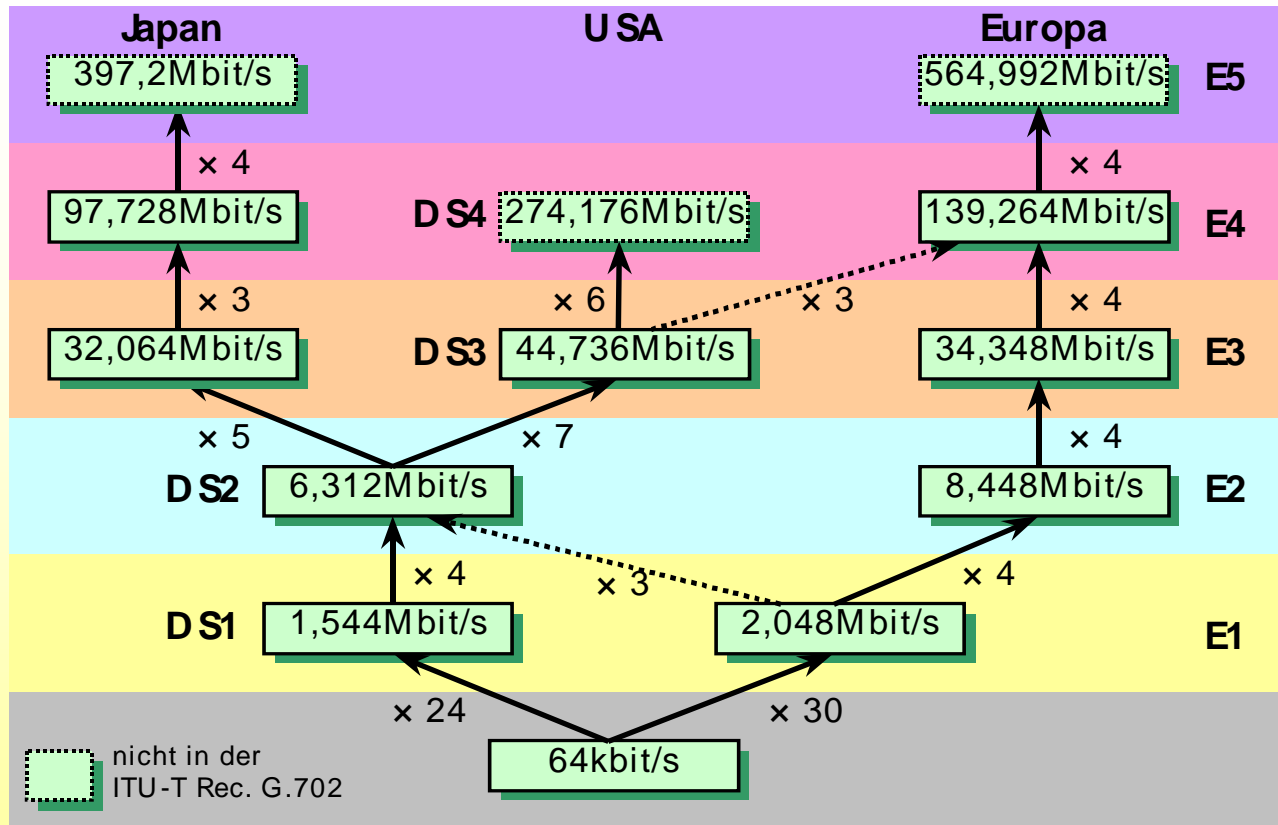
Vergleich PDH – SONET/SDH

Synchroner Transfer Modul

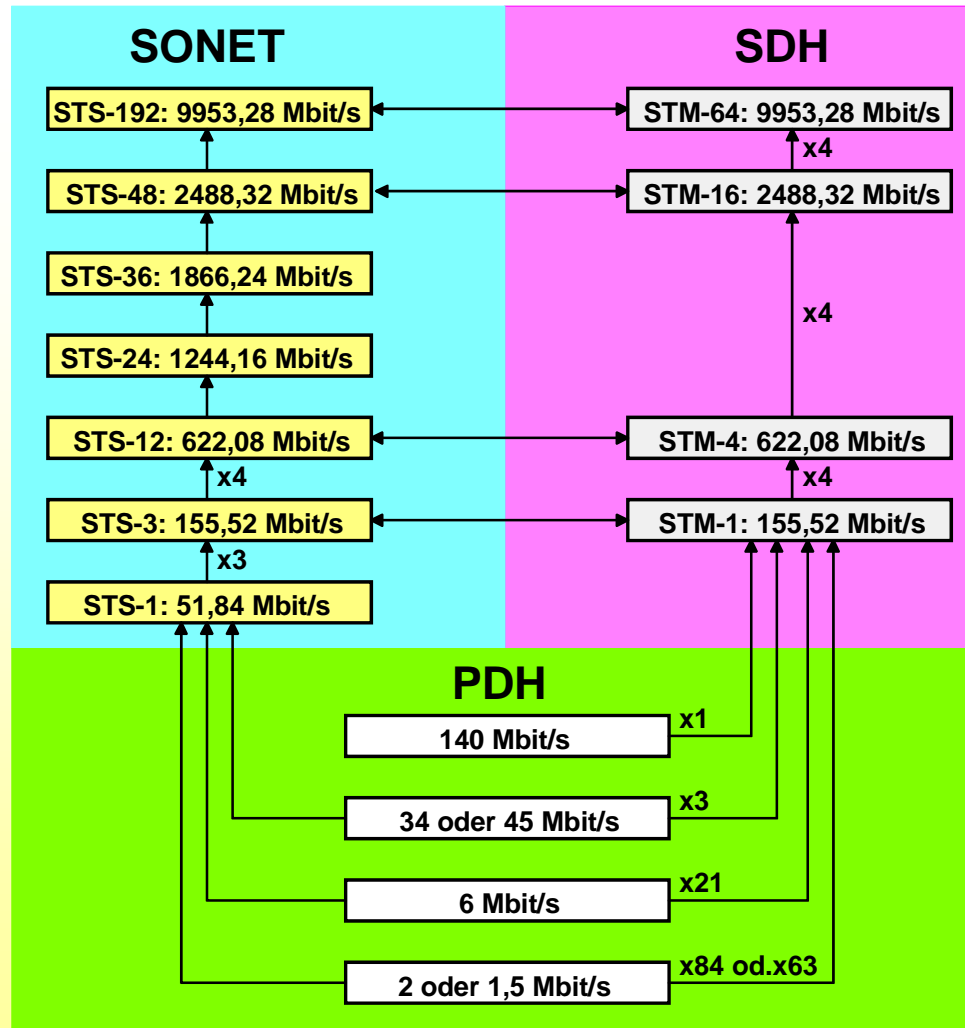
Netzelemente

Qualität und Zuverlässigkeit

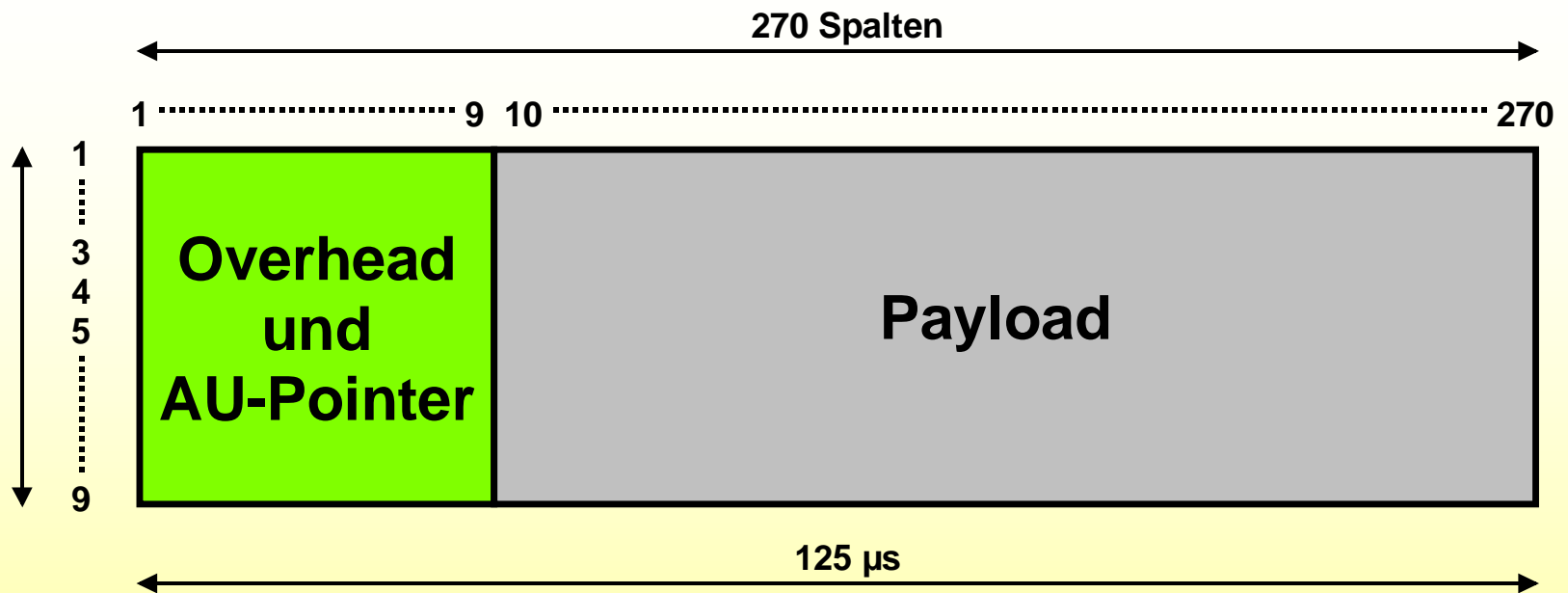
Aufbau der plesiochronen digitalen Hierarchie



SONET und SDH



Basissystem - Grundstruktur



Systeme höherer Geschwindigkeit

STM-1 **155,520 Mbit/s**

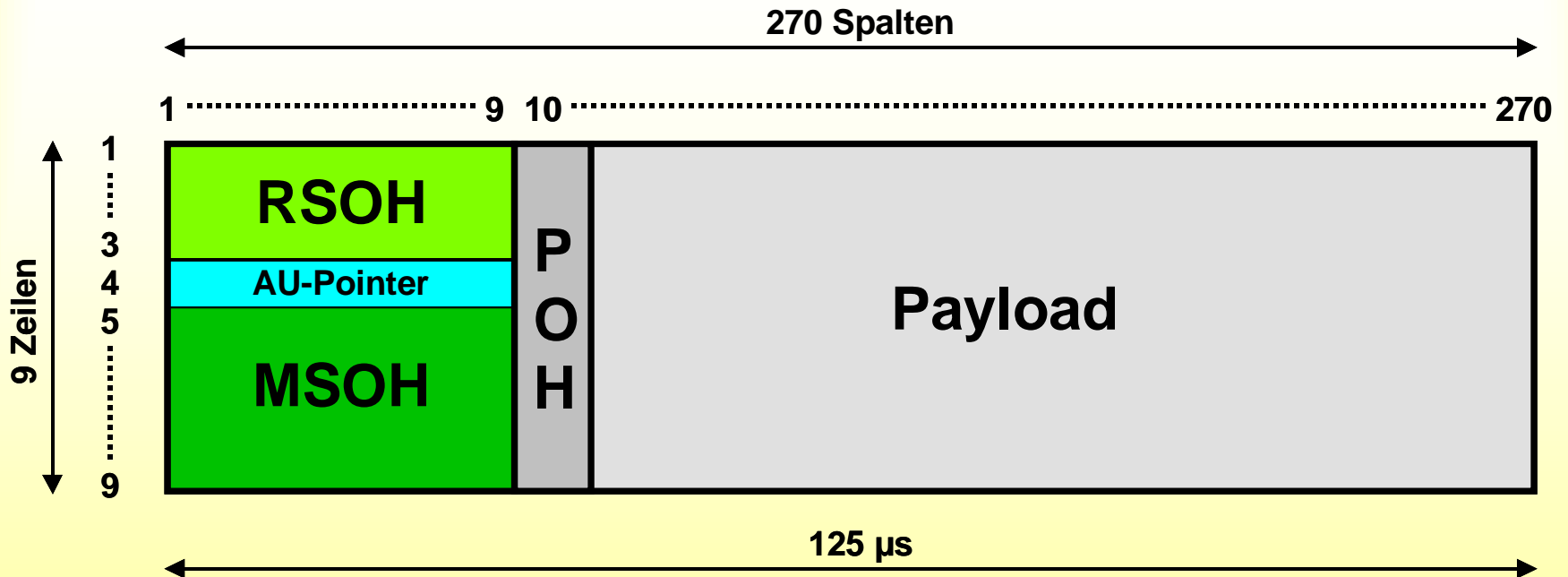
STM-4 = 4 • STM-1 Module **622,080 Mbit/s**

STM-16 = 4 • STM-4 Module **2488,329 Mbit/s**

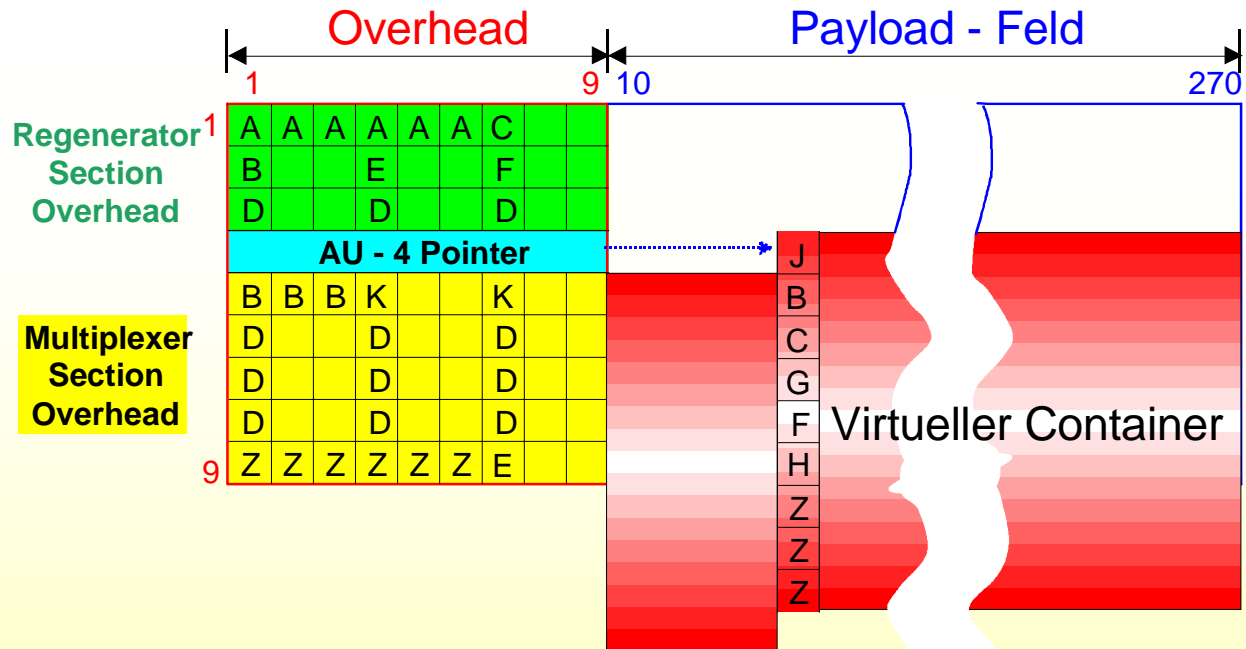
STM 64 = 4 • STM-16 Module **9953,316 Mbit/s**

STM 256 = 4 • STM-16 Module **9953,316 Mbit/s**

STM-1 Rahmenstruktur



STM-1 Overhead



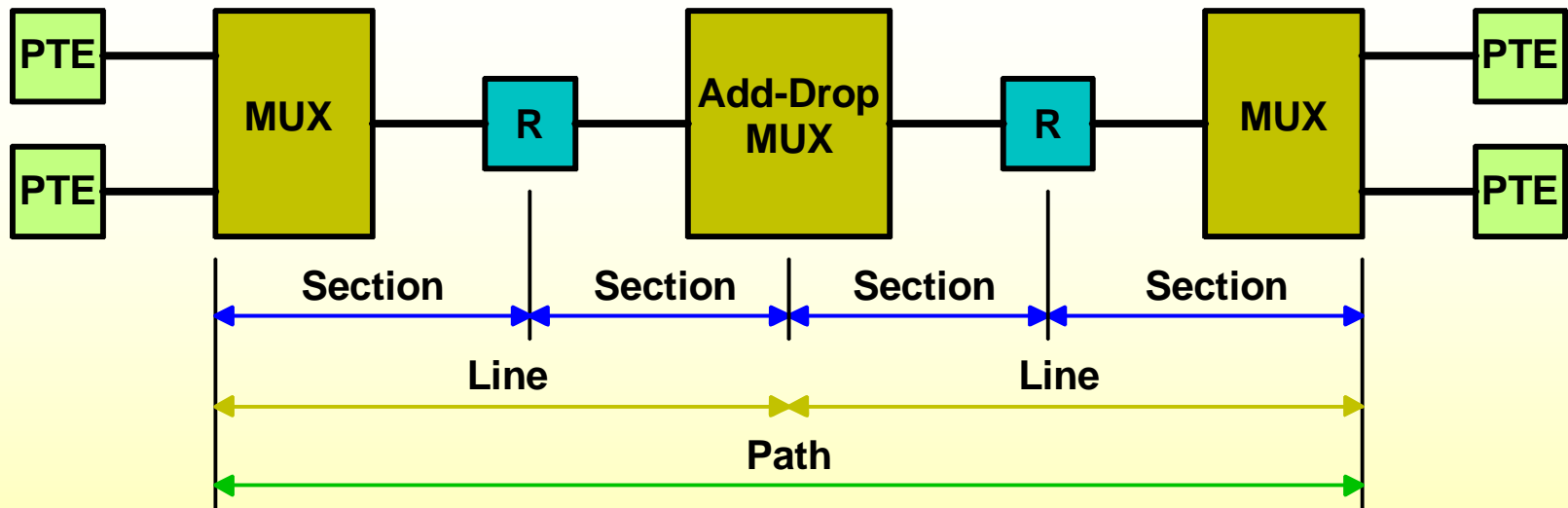
SOH:

- A.....Rahmensynchronisations-Bytes
- B.....Parity_kontroll-Bytes
- C.....STM-1 Kennzeichnung eines STM-N Rahmens
- D.....TMN-Datenbytes
- E.....Dienstfernsprechkanäle
- F.....Anwenderkanal
- K.....Steuerung von Ersatzschaltungen
- Z.....Ersatzkanäle

VC-4 POH:

- J.....Pfadkennung
- B.....Parity-Kontroll.Byte
- C.....VC-Kennung
- G.....Pfad Status
- F.....Pfad-Anwenderkanal
- H.....Überrahmenkennung
- Z.....Reservekanäle

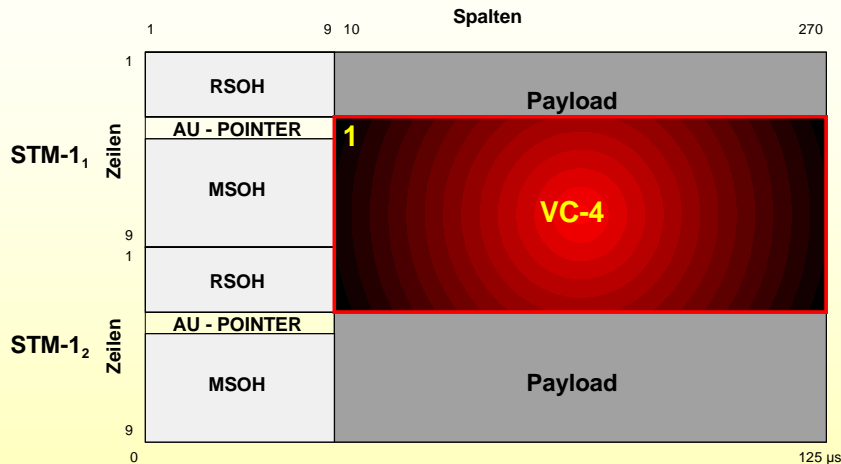
Wirkbereiche des Overhead



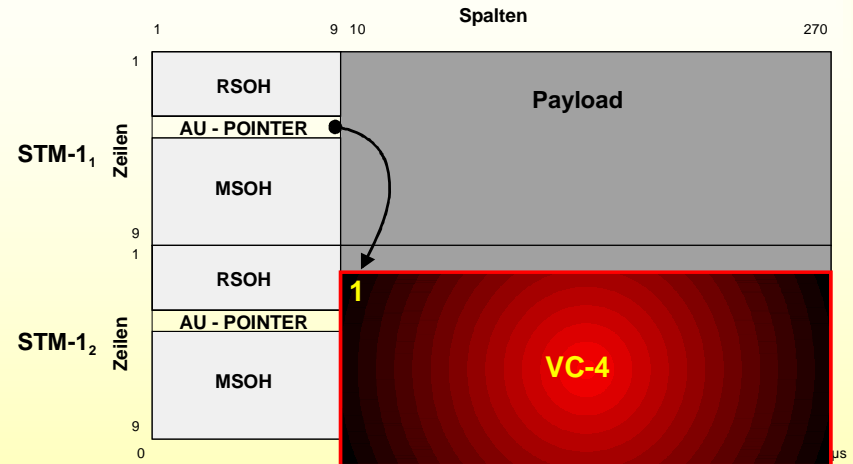
PTE...Path Terminal Equipment

R...Repeater

Adressierung durch AU4 Pointer

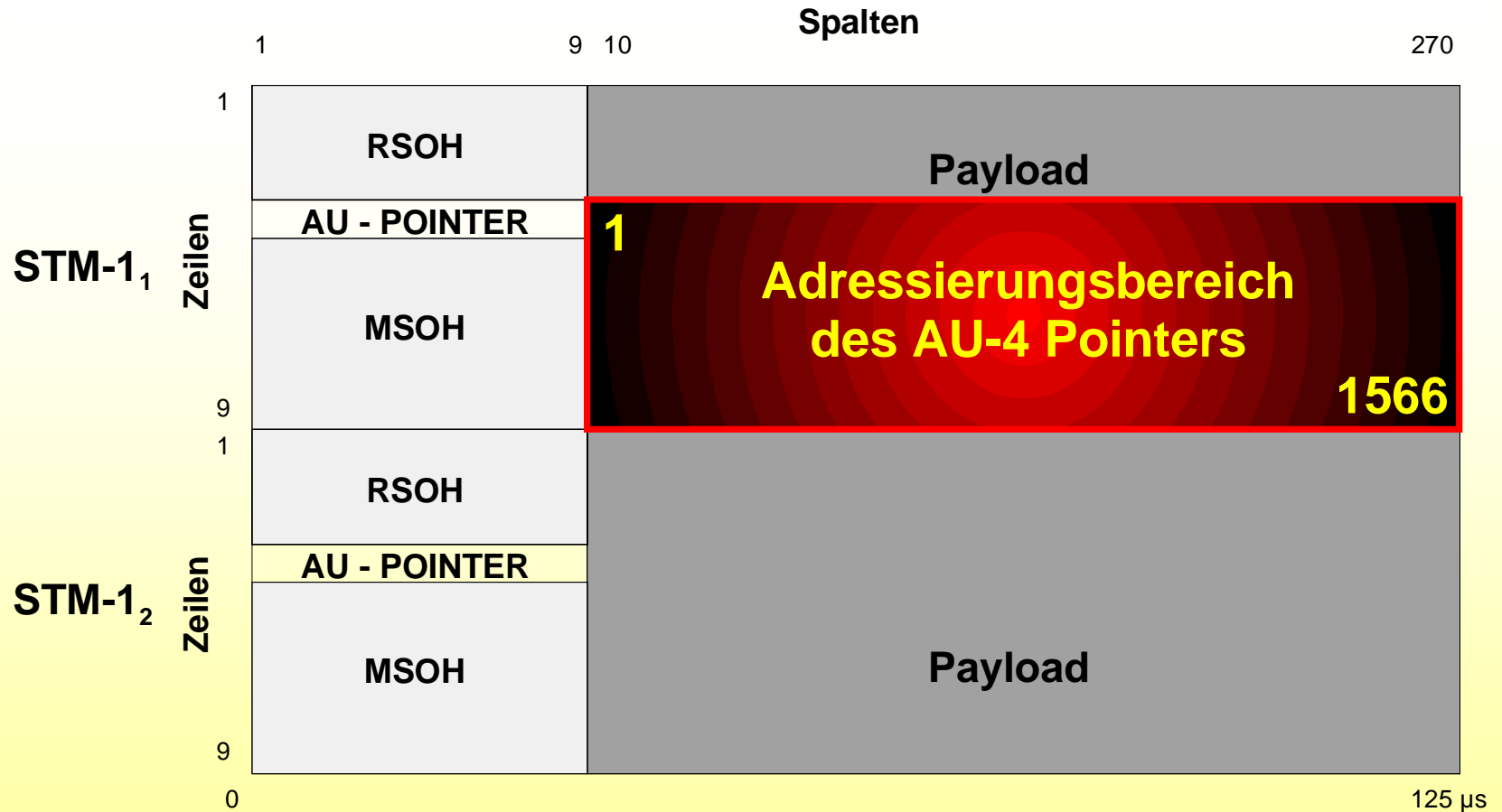


richtig

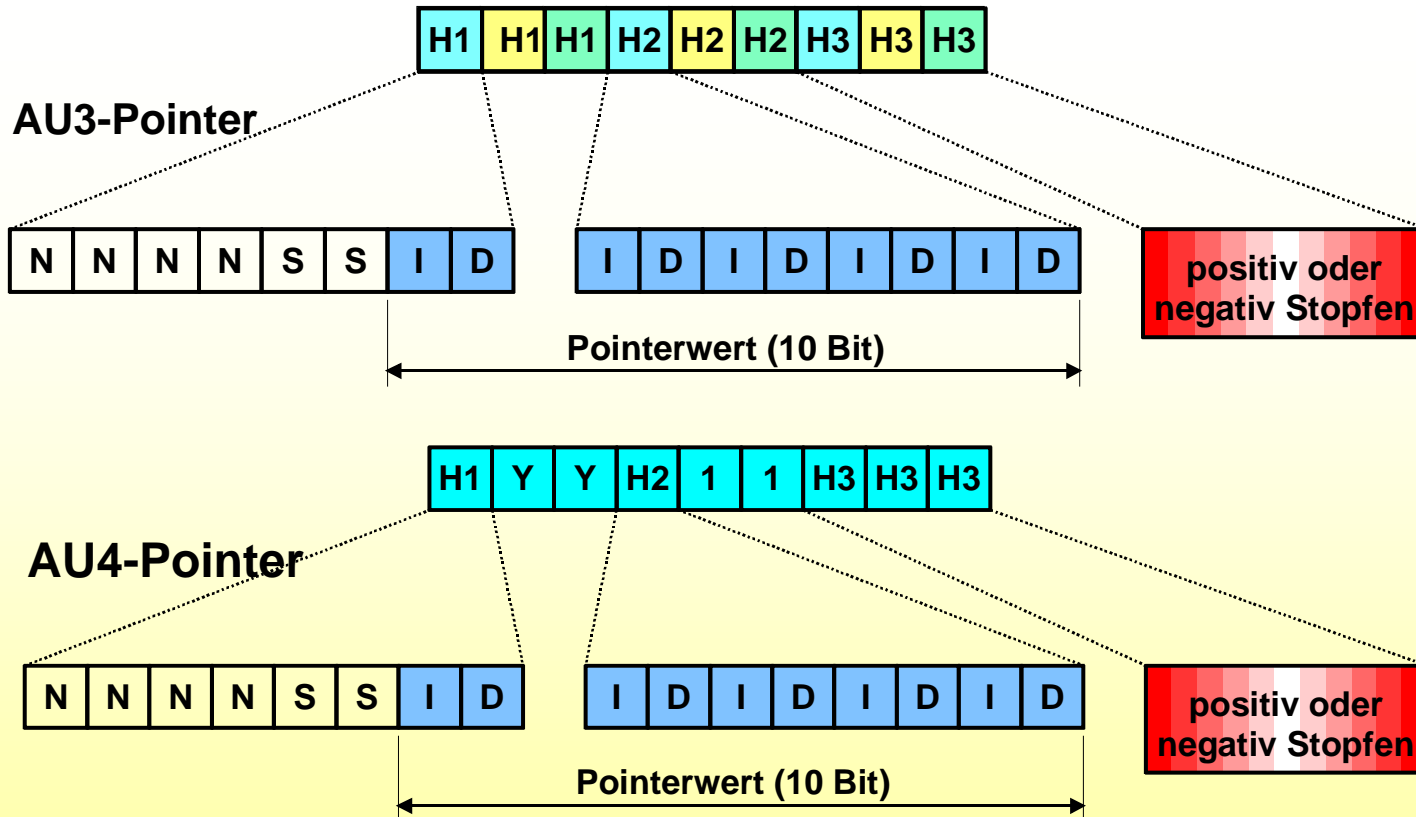


falsch

Pointertechnik

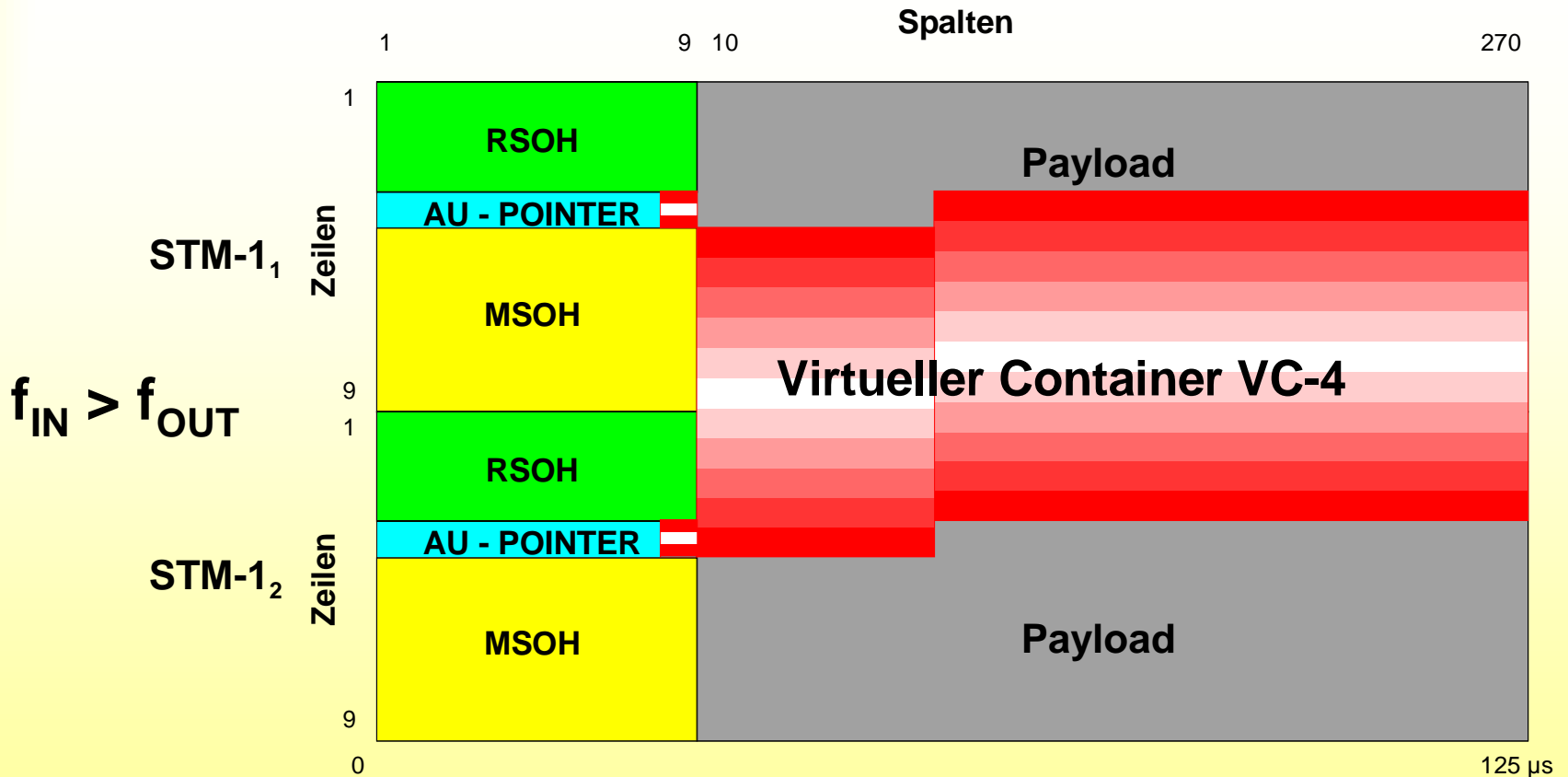


AU3- und AU4-Pointer-Aufbau

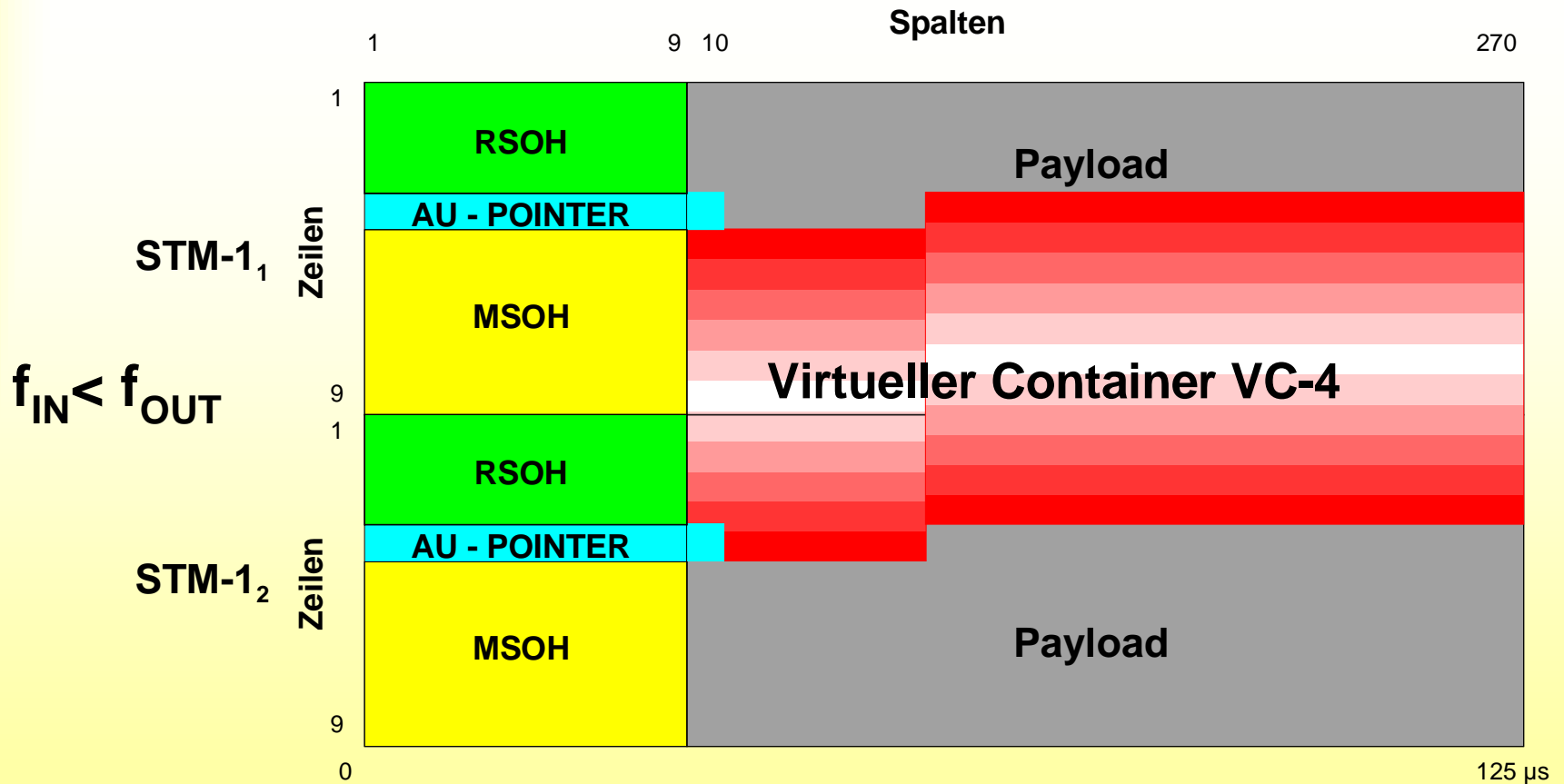


**D = Decrement Bits, I = Increment Bits, N = New Data Flag,
S = AU-Typ, Y = 1001XX11**

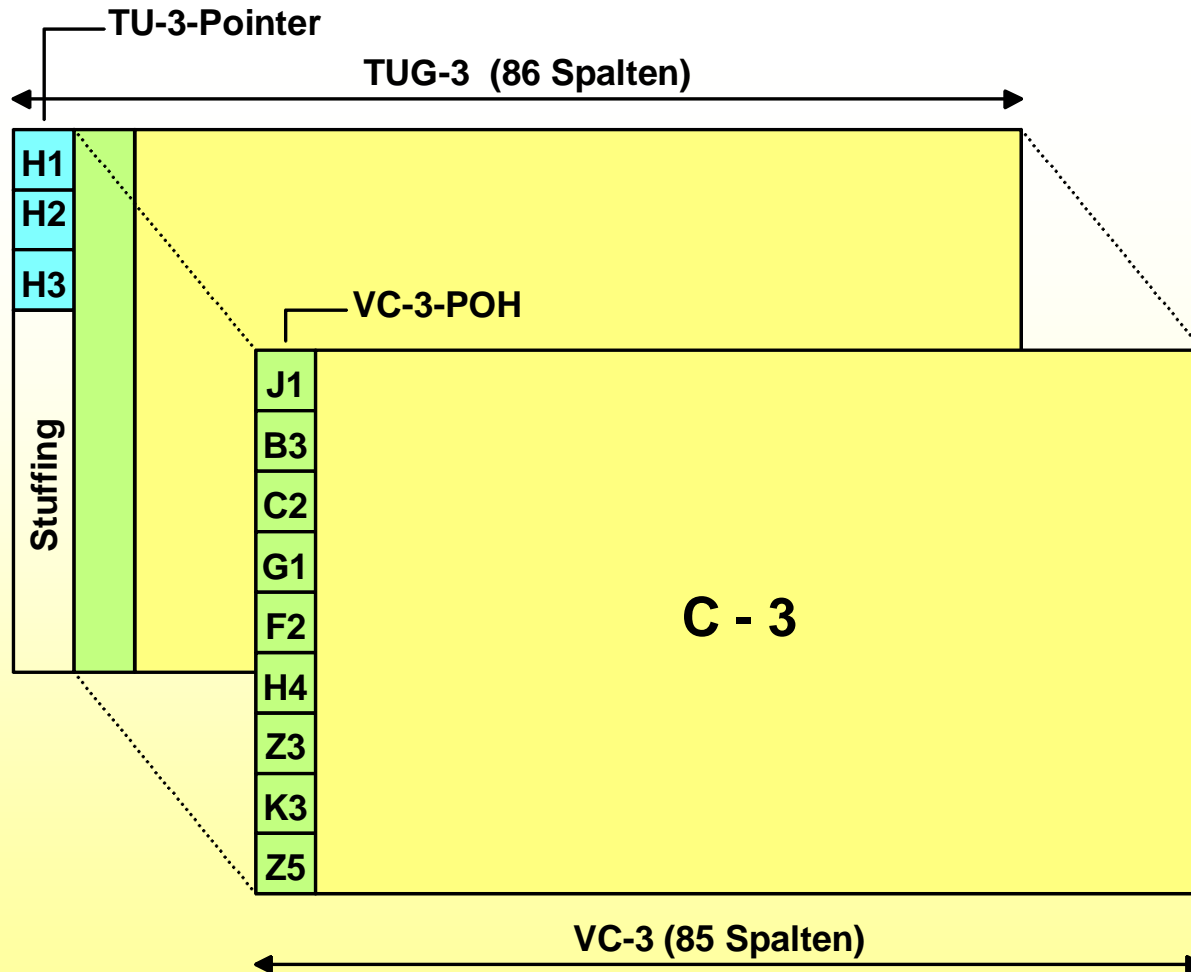
Negativ-Stopfen (Negative Justification)



Positiv-Stopfen (Positive Justification)



TU-Pointer

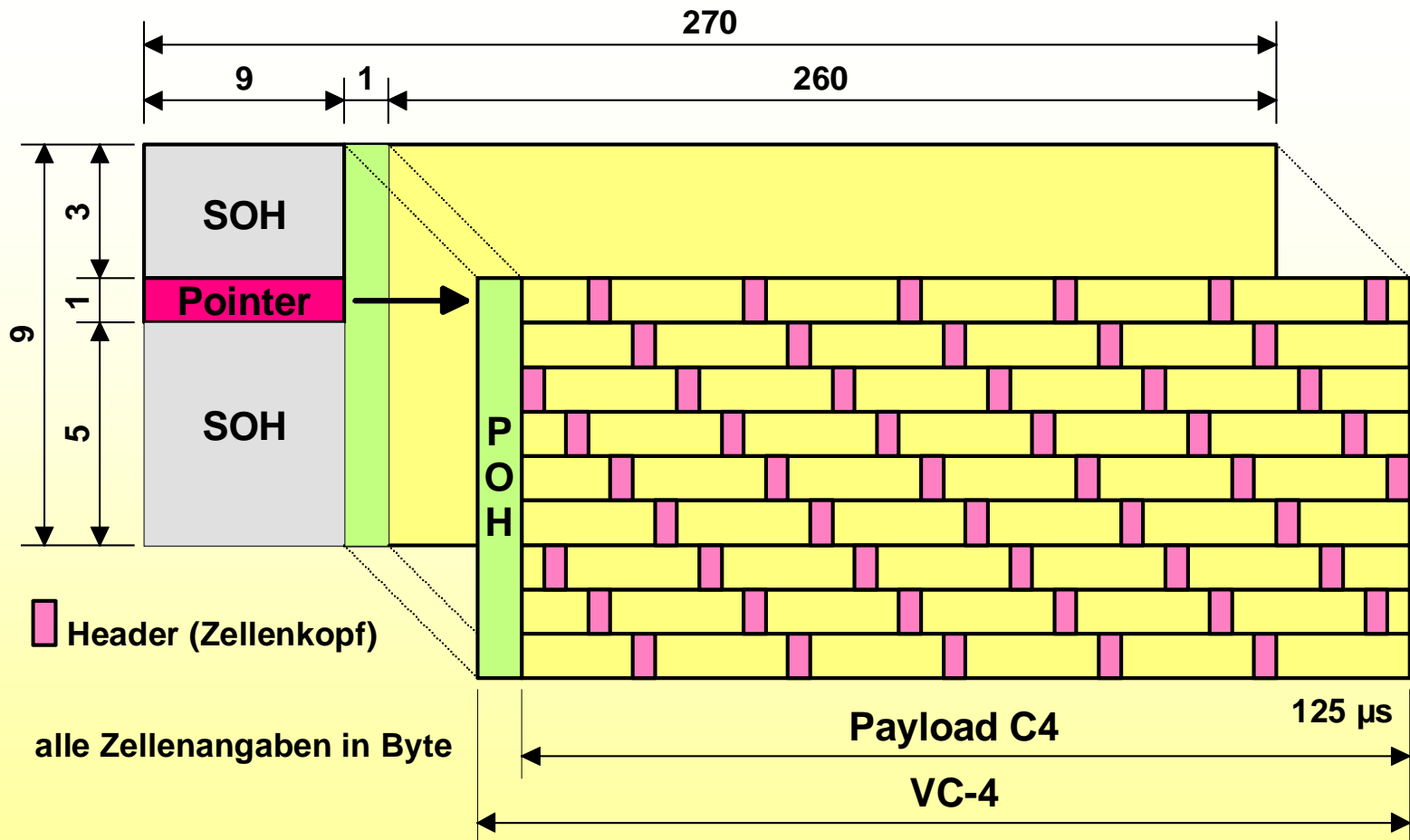


Payload

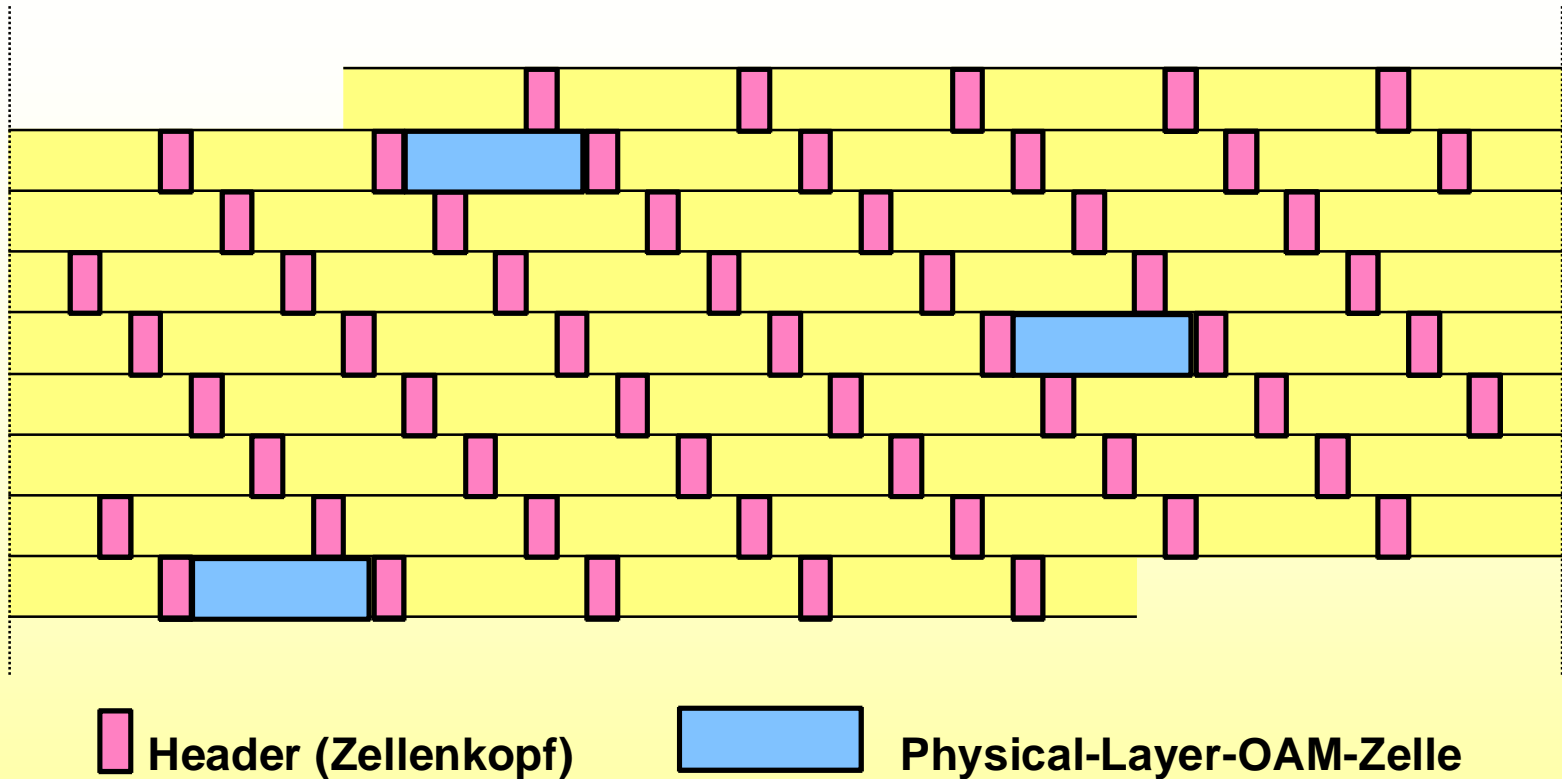
Im Payloadfeld eines STM-1-Moduls können transportiert werden:

- **ATM-Zellen über**
 - **SDH-basierte Schnittstellen**
 - **Zellen-basierte Schnittstellen**
 - **PDH-basierte Schnittstellen**
- **PCM-Systeme, d.h. PDH-Signale, sog. Tributaries**

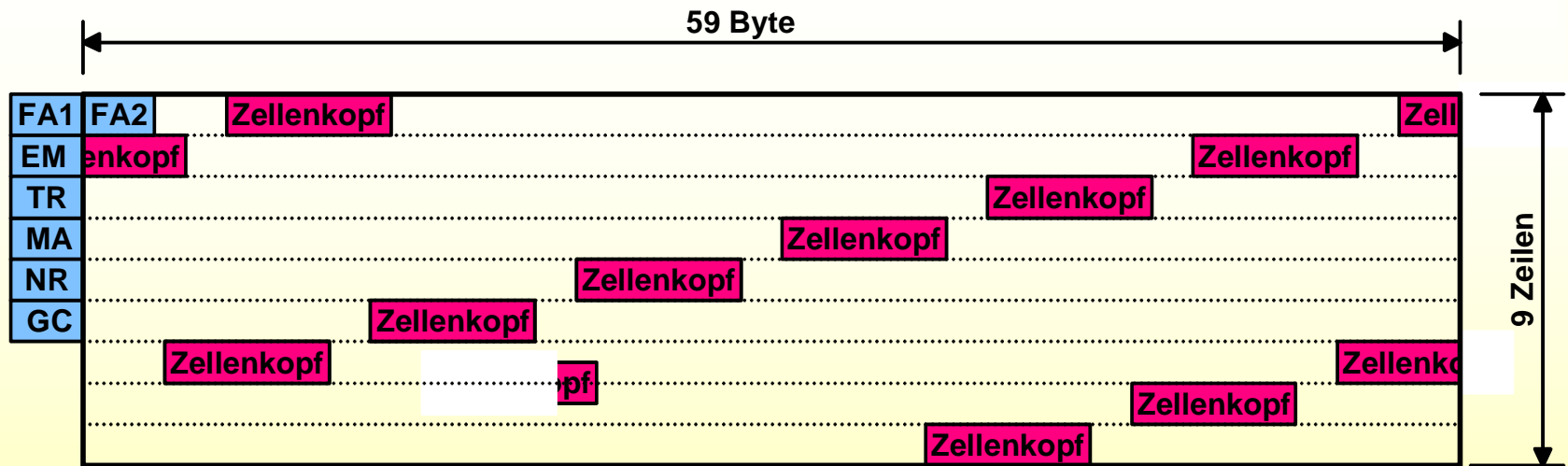
ATM Zellentransport in STM-1



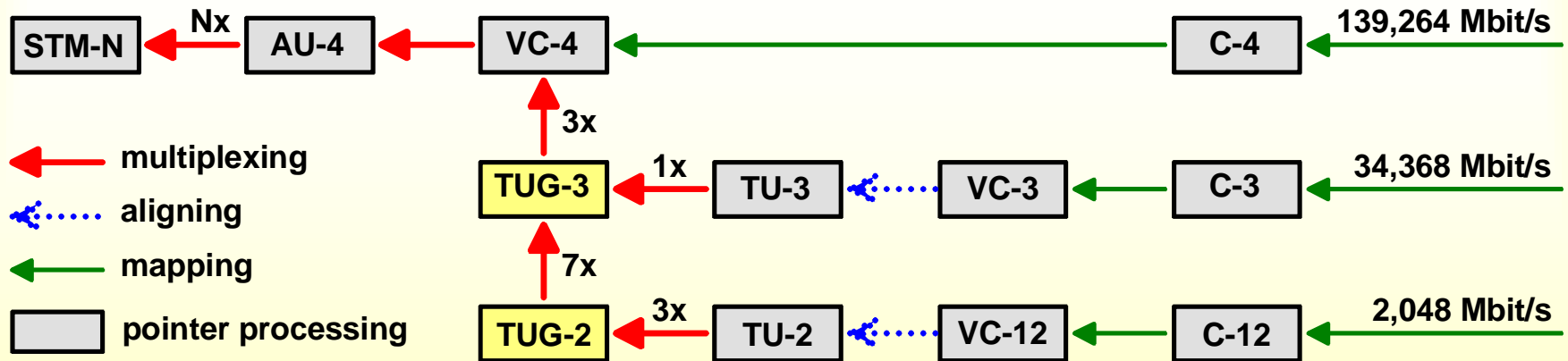
Kontinuierlicher Zellenstrom



Zellen-Mapping bei 34 Mbit/s



Transport von PCM-Systemen (Tributaries)



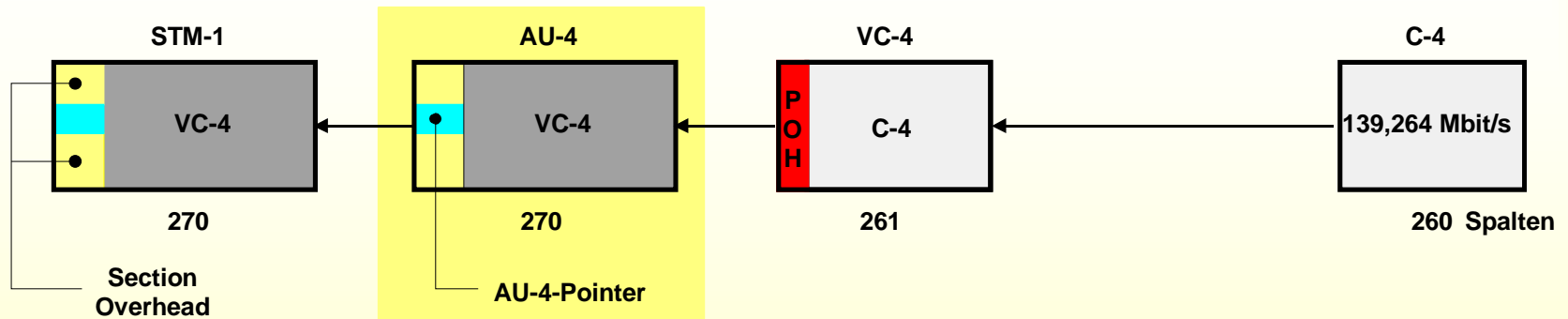
SDH-Multiplexstruktur nach ETSI

Transport von PCM-Systemen

grundlegende Schritte

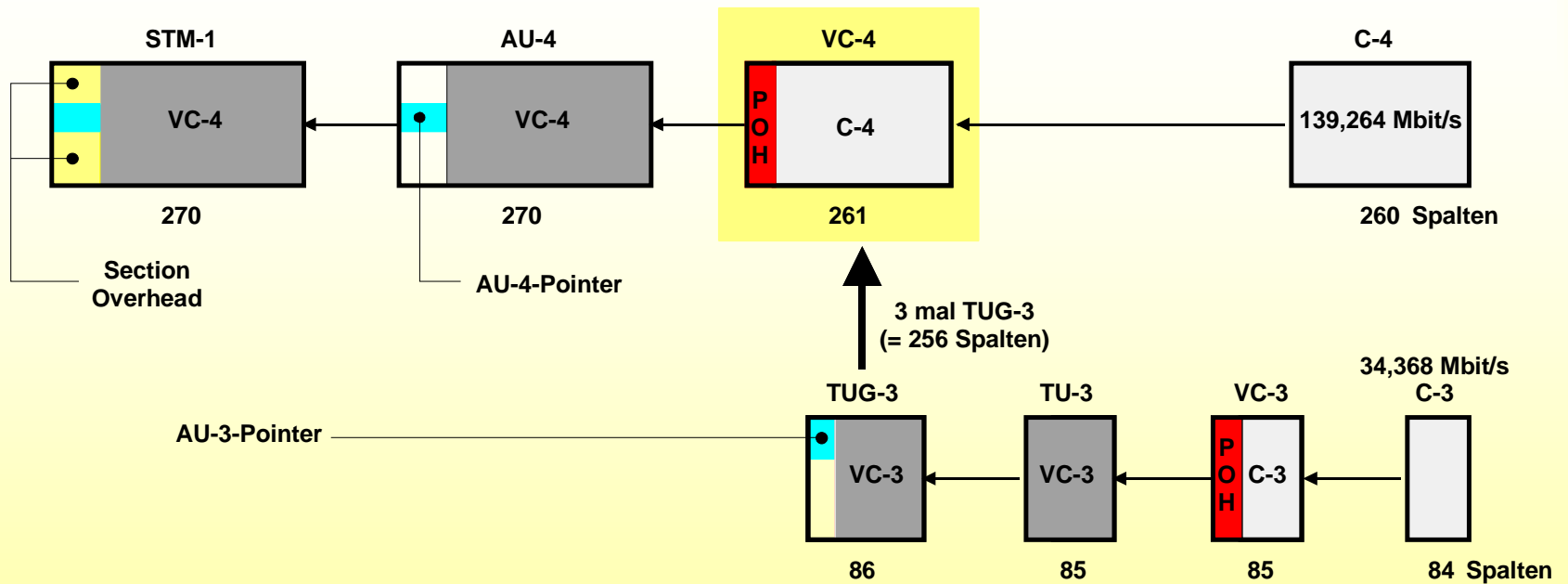
- **Mappen des PCM-Systems in einen Container**
- **Hinzufügen eines POH (Container wird Virtueller Container)**
- **Einfügen des Virtuellen Containers in eine Transport Unit**
- **Multiplexen mehrerer Transport Units in eine Transport Unit Group**
- **Einfügen einer oder mehrerer Transport Unit Groups in eine Administrative Unit**
- **Multiplexen der Administrative Unit Group in einen Synchronen Transport Modul**

Administrative Unit AU-4

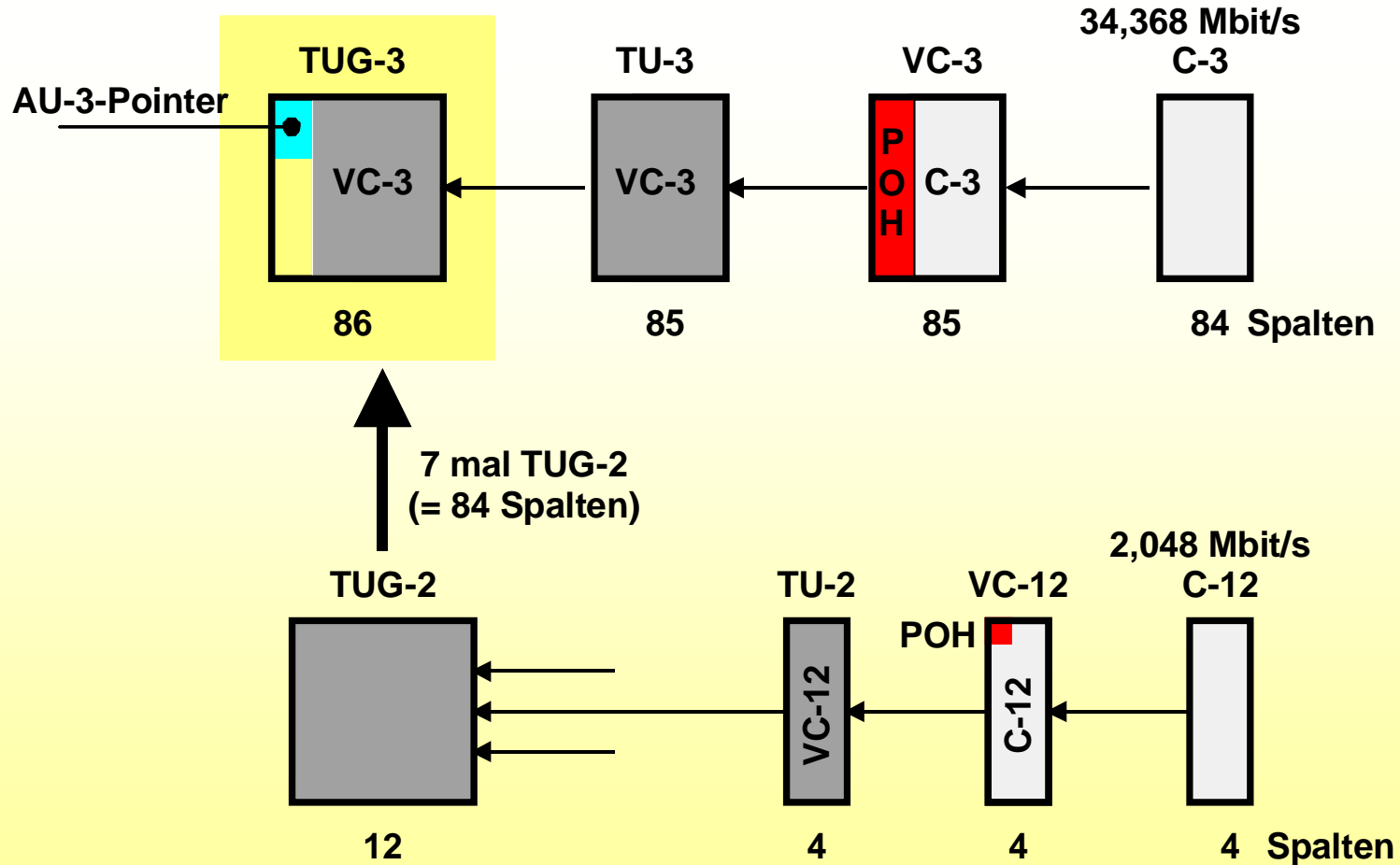


Der VC-4 und der AU-4 Pointer bilden zusammen die Administrative Unit 4

Virtueller Container VC-4

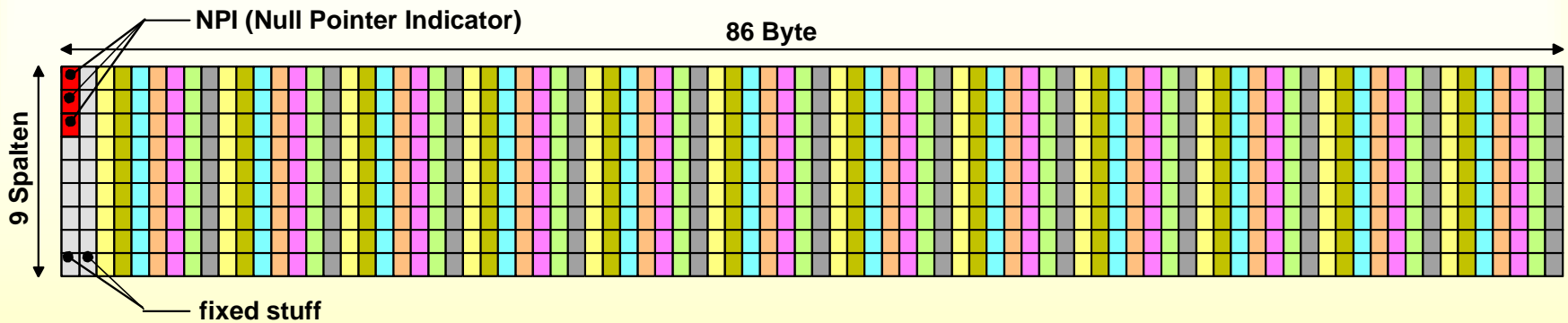


Tributary Unit Group TUG-3

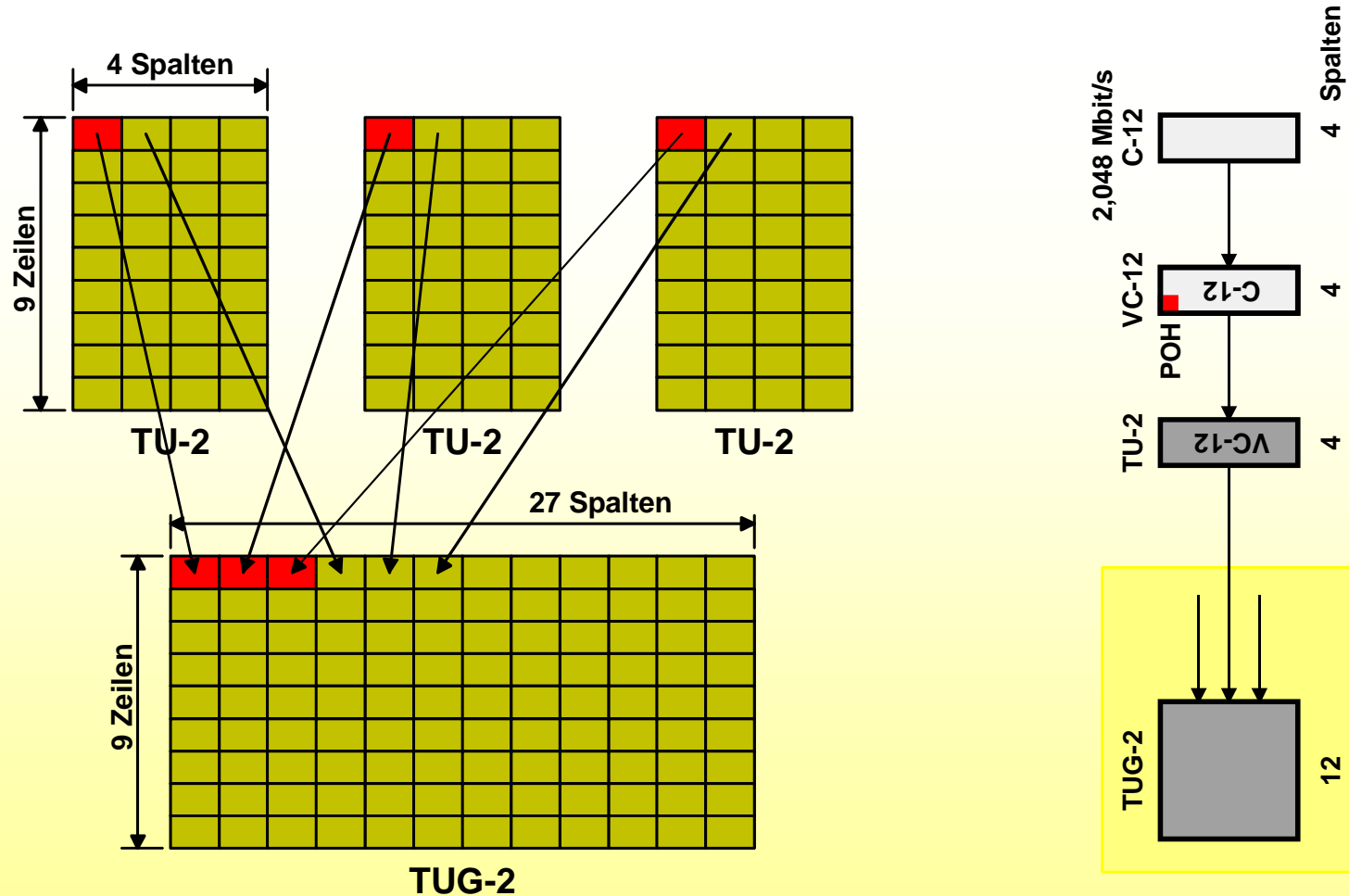


Tributary Unit Group TUG-3

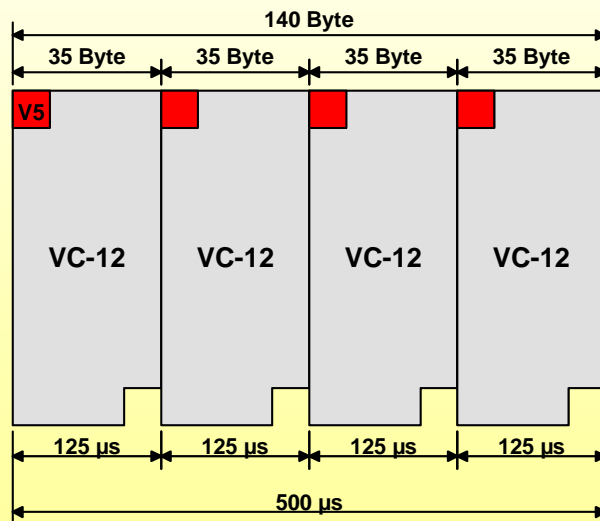
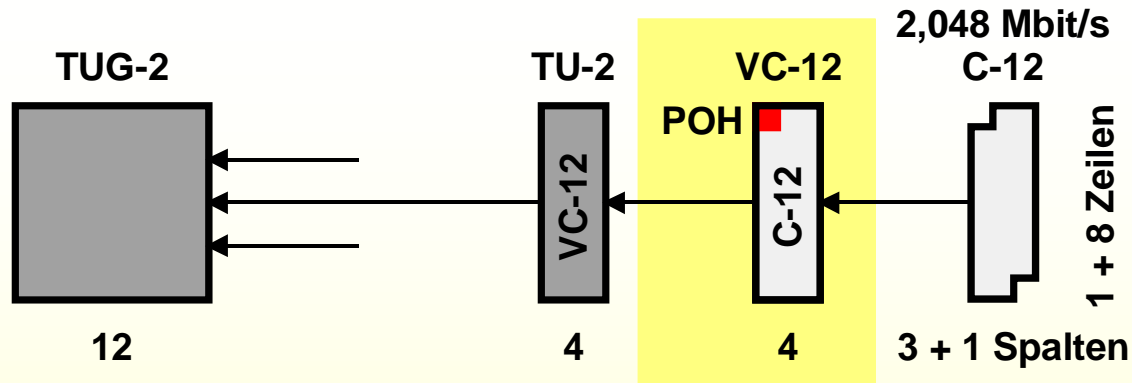
zusammengesetzt aus 7 TUG-2



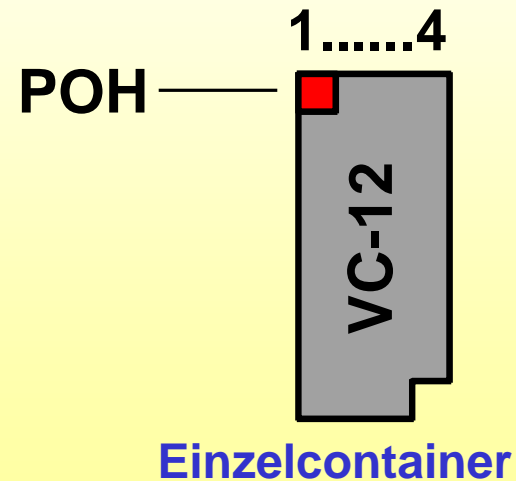
Tributary Unit Group TUG-2



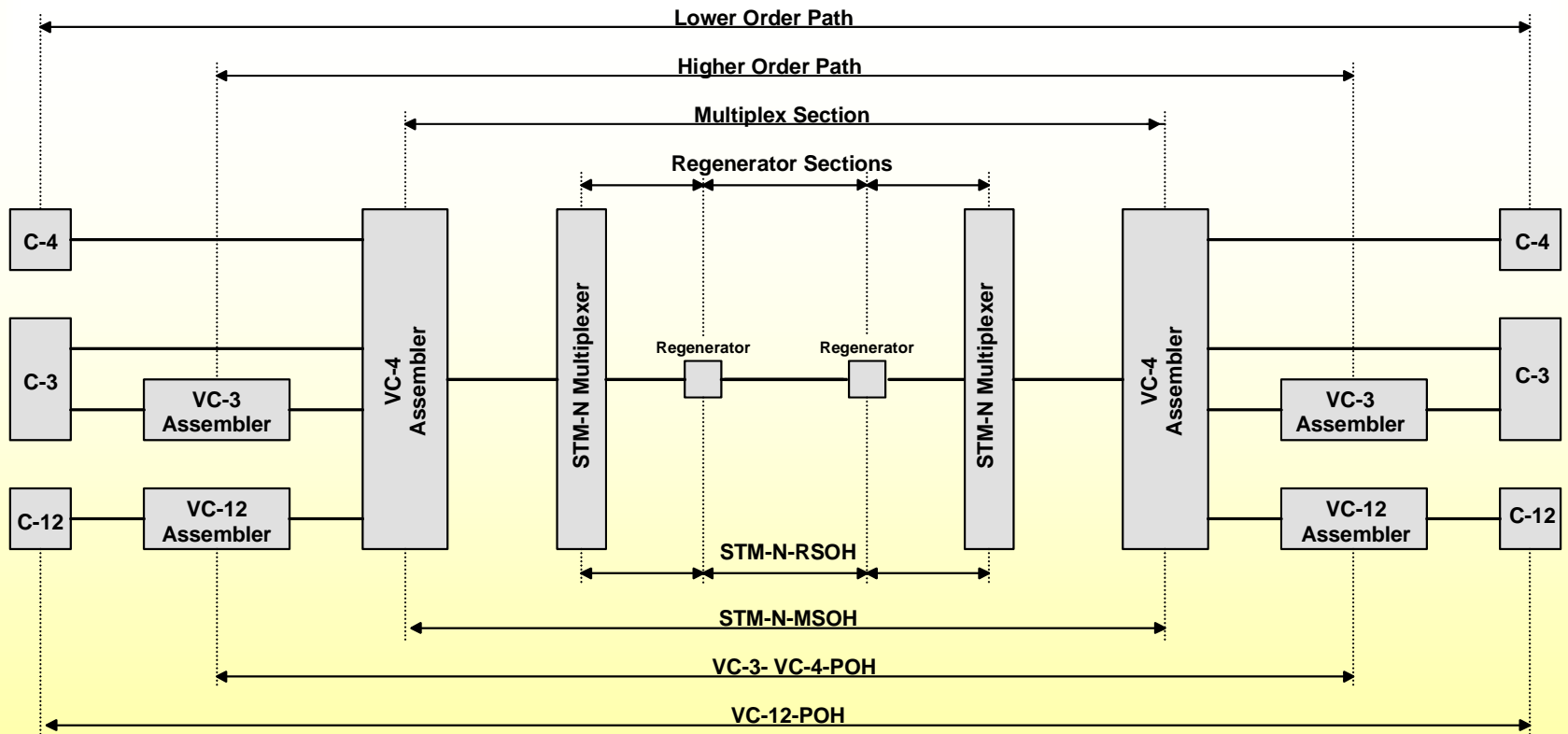
Virtueller Container VC-12



Multiframe



Path Overhead



Path Overhead

Path Overhead des VC-3 und VC-4

J1
B3
C2
G1
F2
H4
Z1
Z2
Z3

- J1 = Path Trace (Verbindungskennzeichnung)
- B3 = Fehlerkontrolle (anhand Prüfsummenbildung)
- C2 = Path Signal Label (Gibt die Struktur der Nutzlast des VC's an)
- G1 = Path Status (Überwachung des Verbindungszustands)
- F2 = interner Kommunikationskanal
- H4 = Multiframe Indikator
- Z1-Z3 = nicht belegt

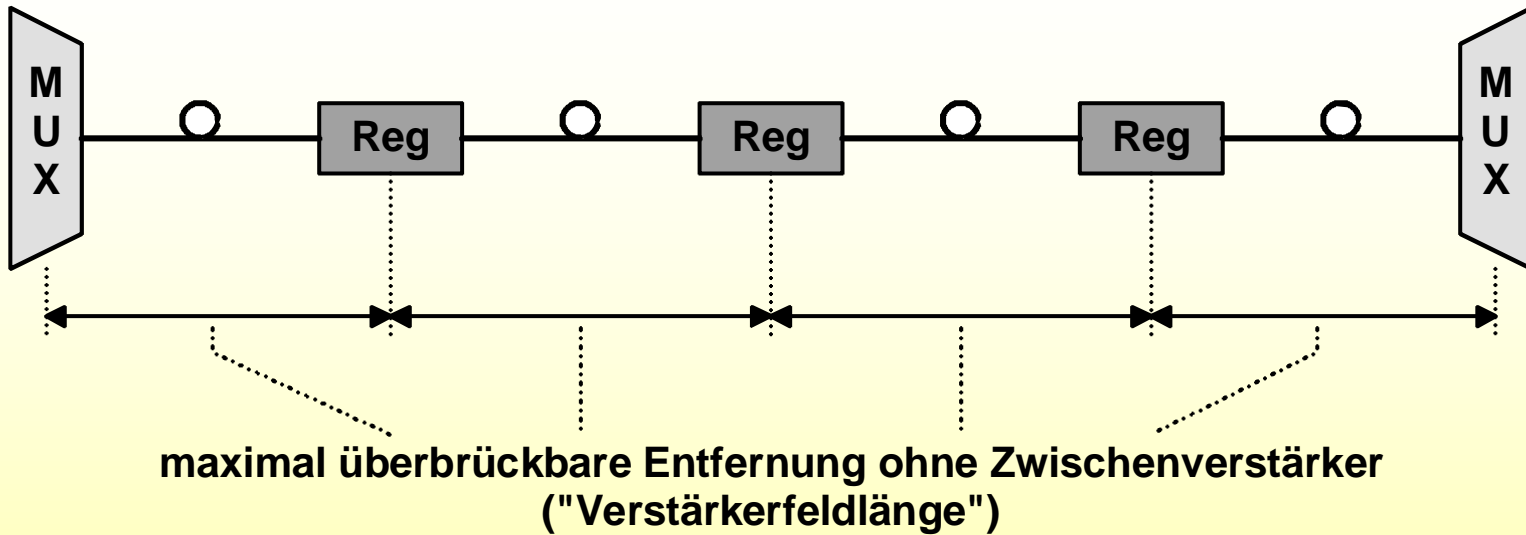
Path Overhead VC-12 (V5- Byte)

1	2	3	4	5	6	7	8
Fehler- kontrolle		FEBE	Path Trace		Signal Label		FERF

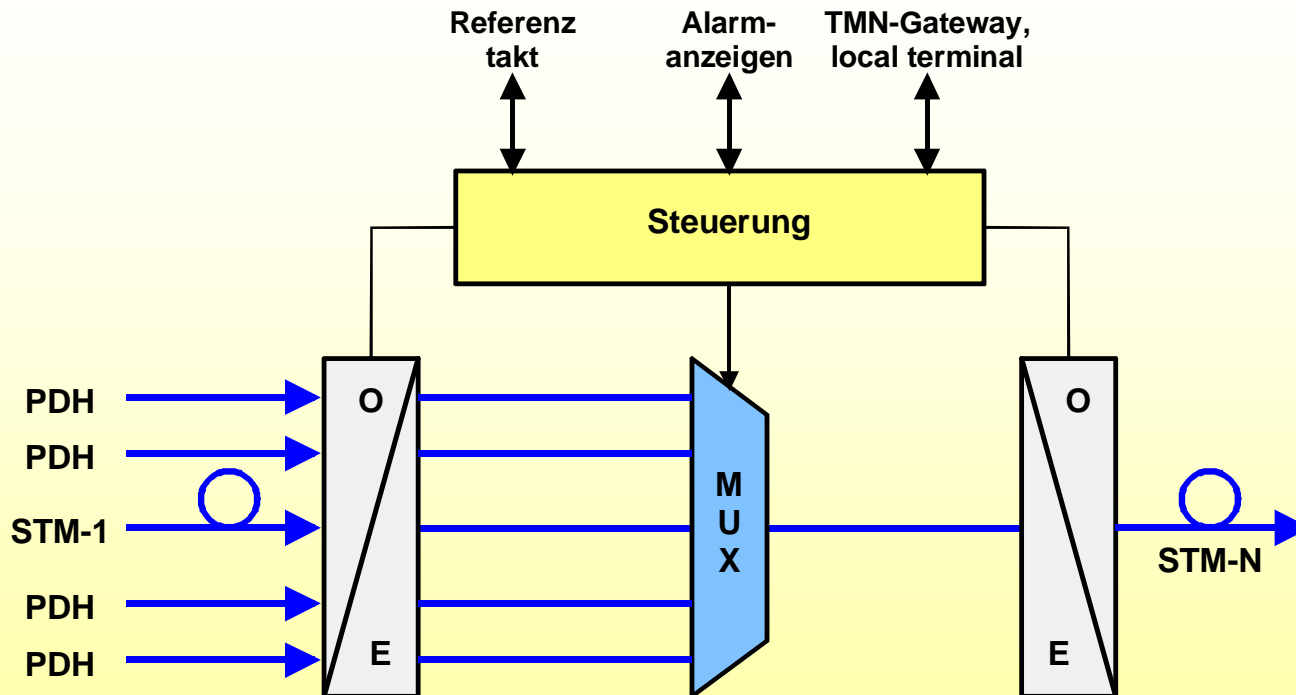
Netzelemente

- **Regeneratoren (REG)**
- **Multiplexer (MUX)**
 - **Terminalmultiplexer (TM)**
 - **Synchronous Multiplex Terminal (SMT)**
- **Add- and Drop- Multiplexer (ADM)**
- **Cross-Connects (CC)**

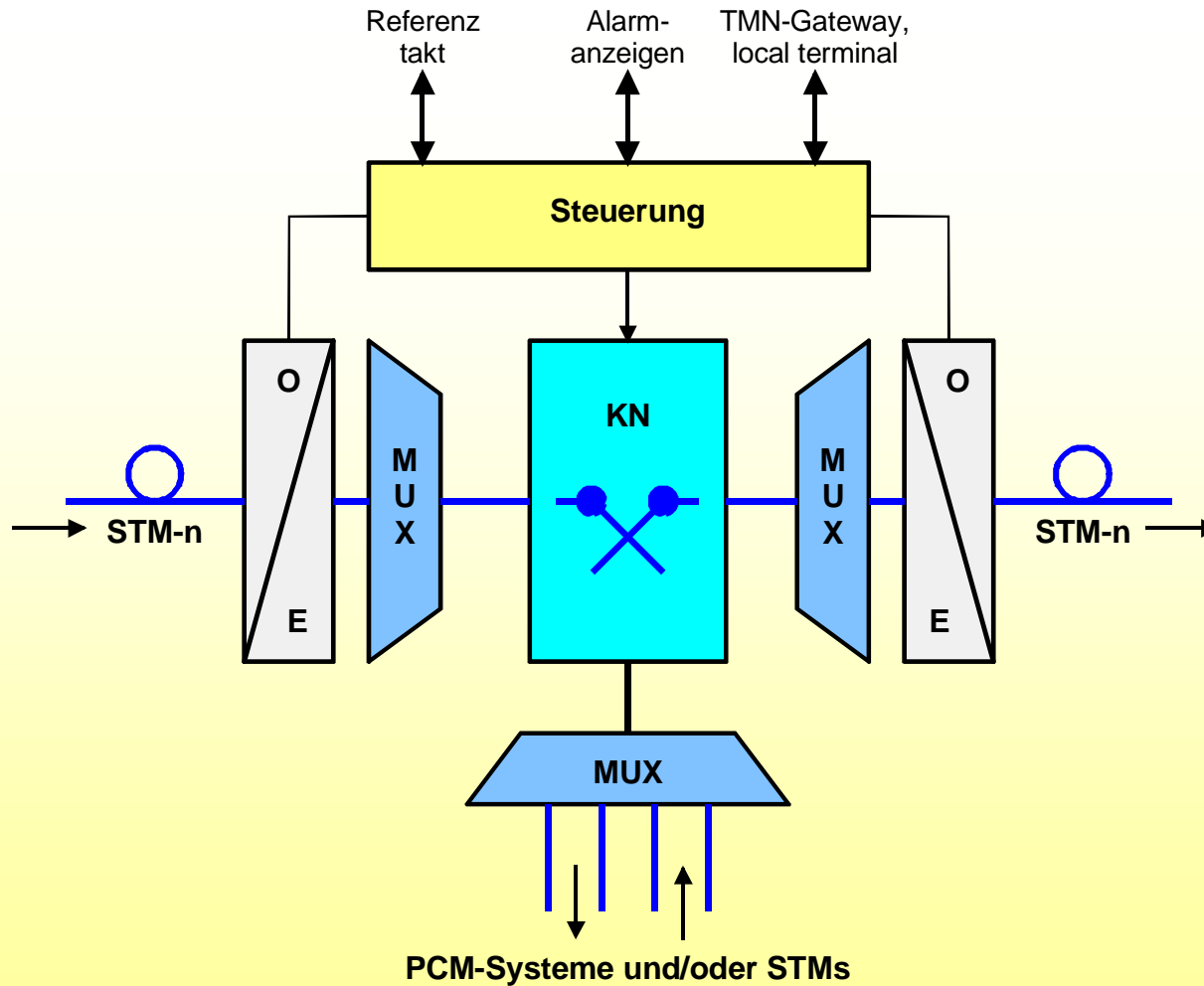
Regenerator



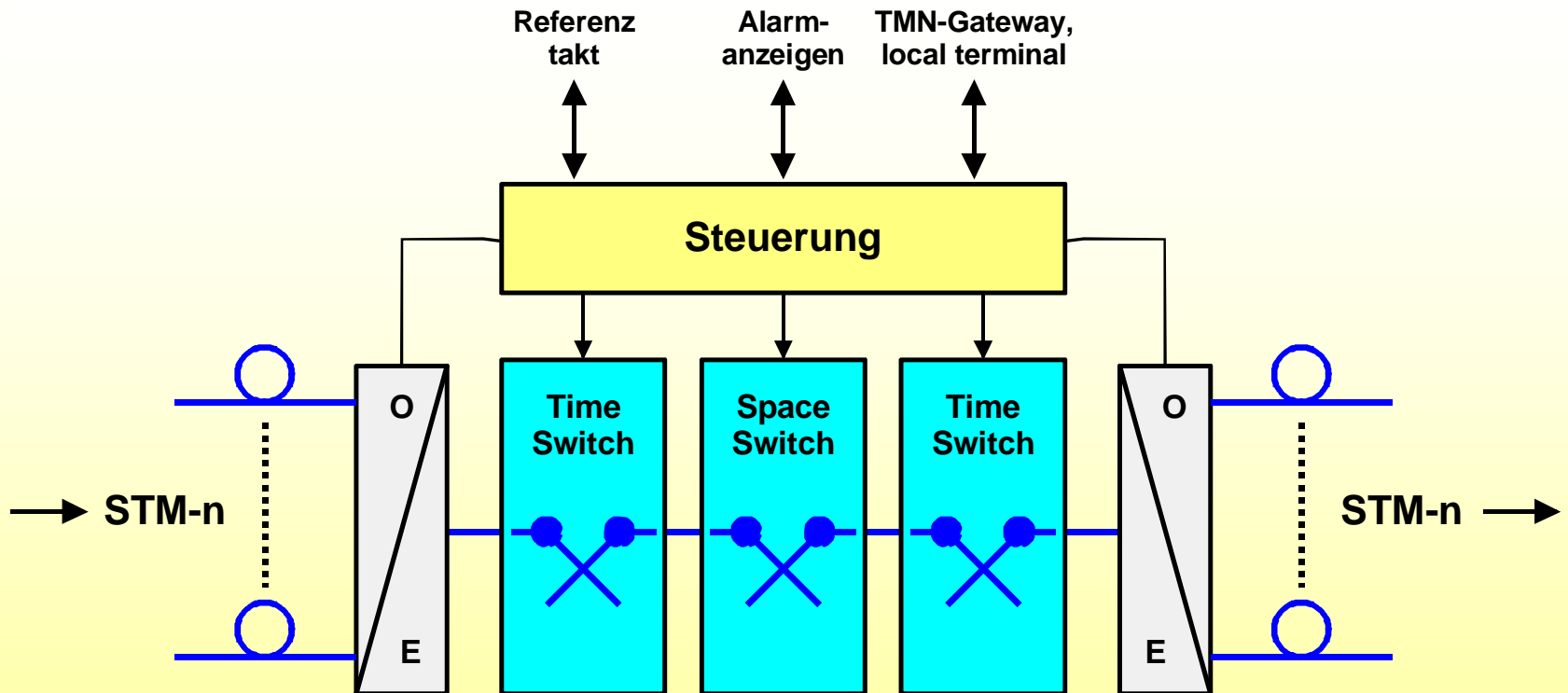
Synchronous Multiplex Terminal



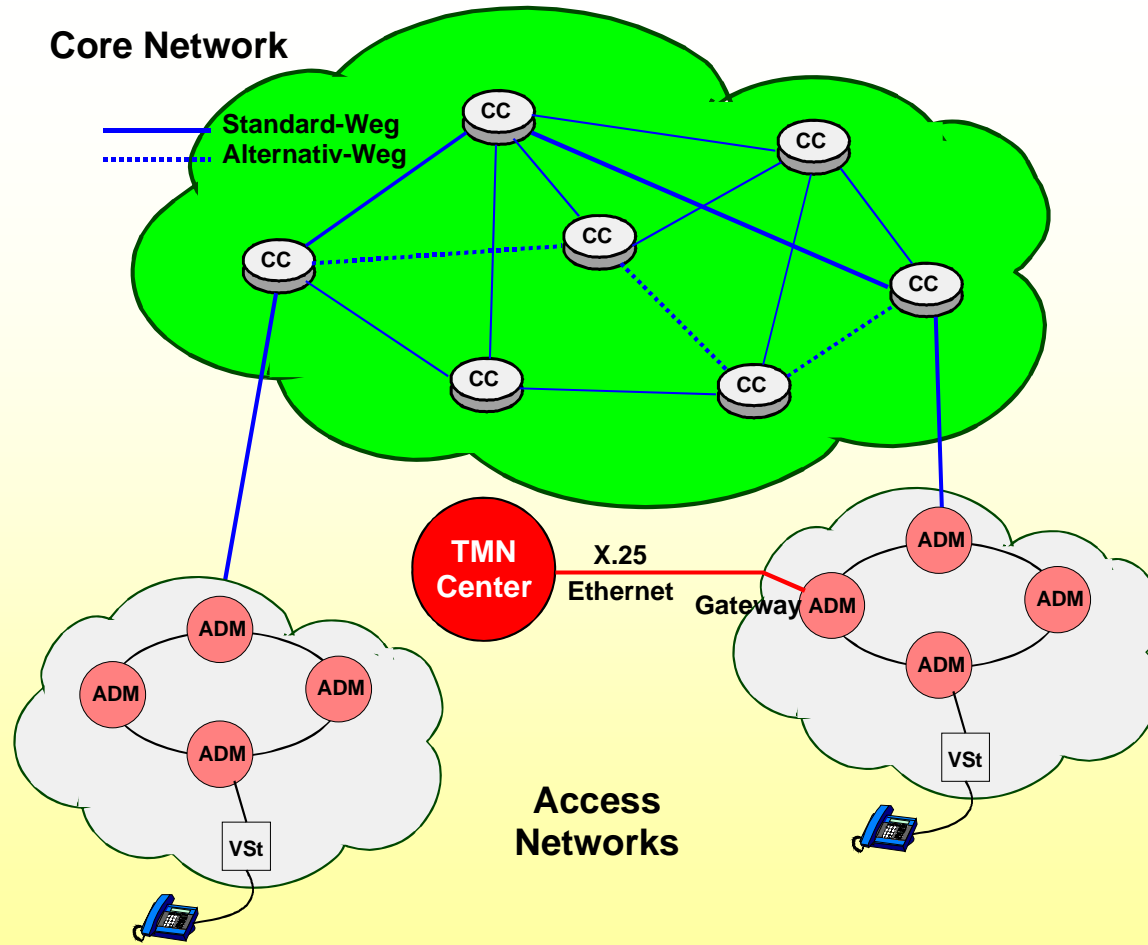
Add-and-Drop-Multiplexer



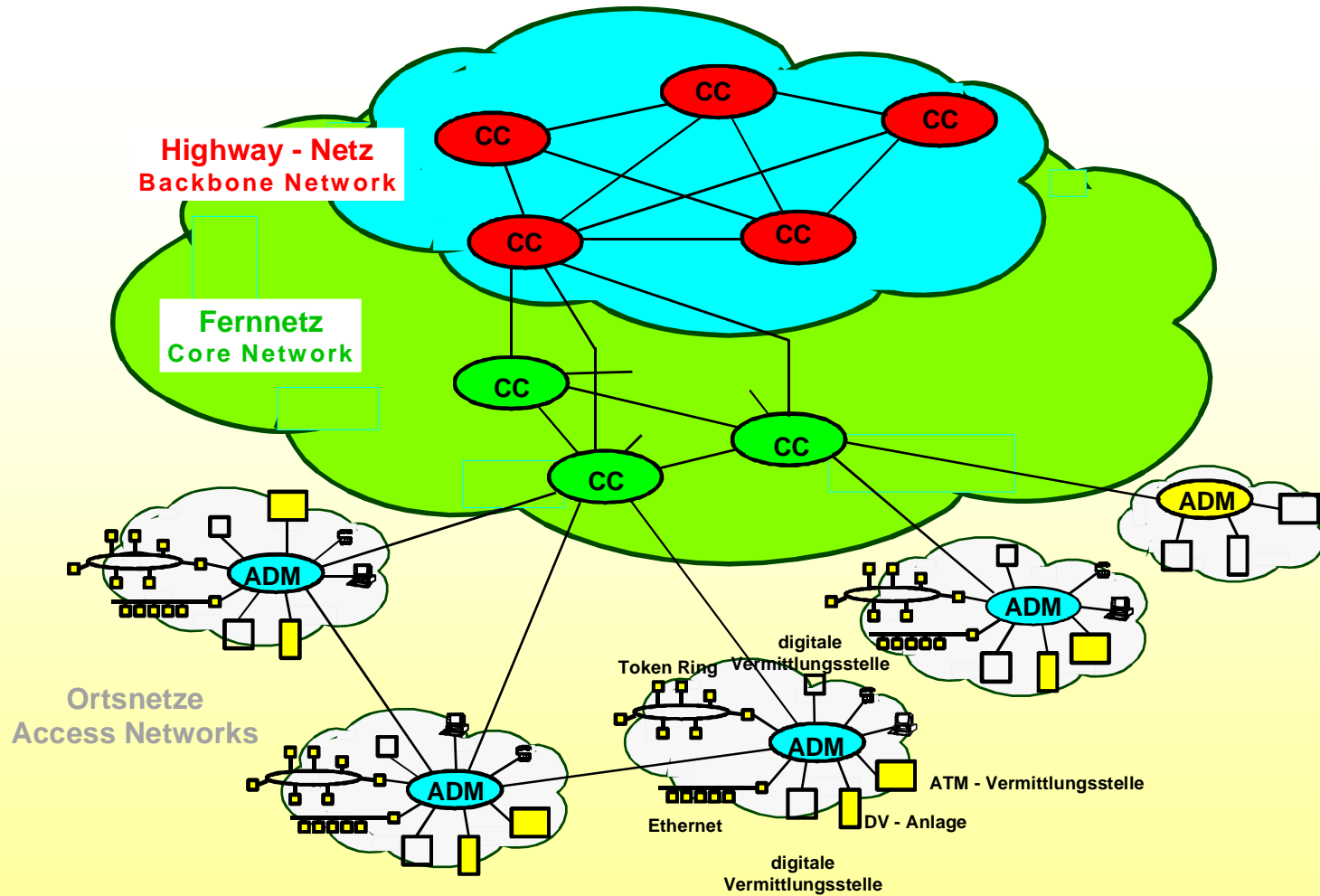
Cross Connect



Einsatz von Cross Connects



Netzstruktur

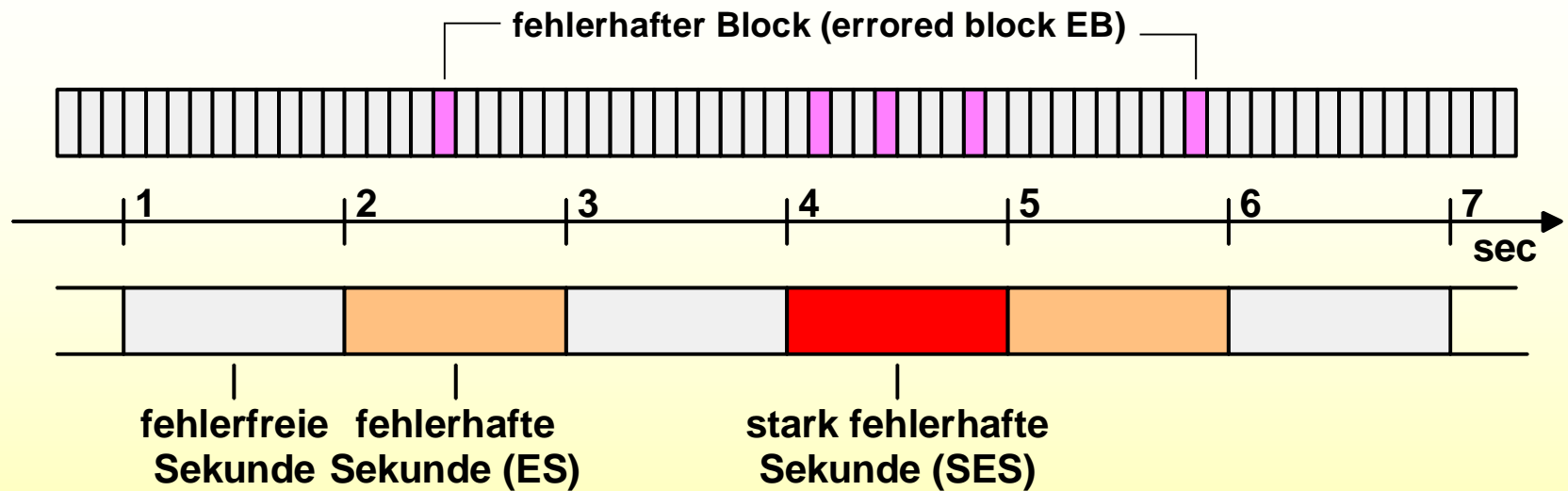


Qualität und Zuverlässigkeit

- Errored blocks – EB
- Errored seconds – ES
- Errored seconds ratio – ESR
- Severely errored second – SES
- Severely errored second ratio – SESR

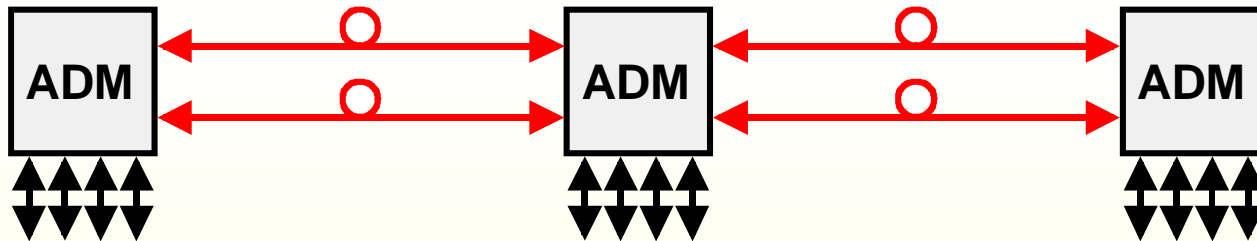
Für VC-4:	Verbindungslänge	27500 km
	Bits/Block	8000
	ESR	0,04
	SESR	0,002

Fehlerhafte Sekunden und fehlerhafte Blöcke

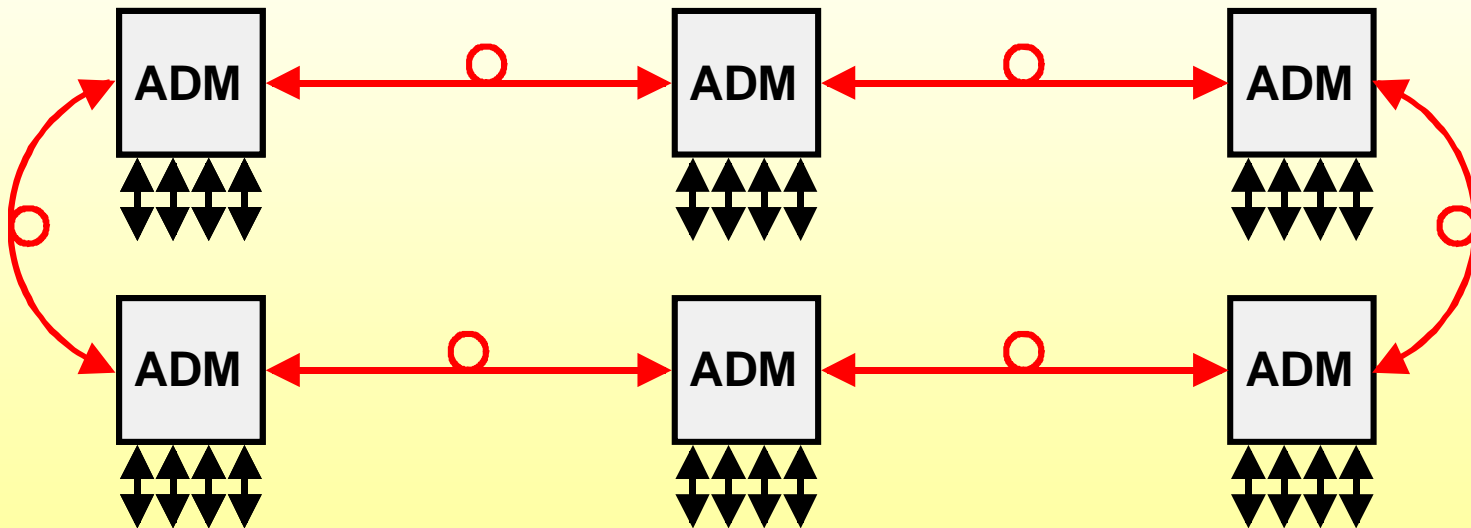


Sicherheitsmaßnahmen

Geschützter Bus (Chain)



Linearer Ring



Fehlerüberwachung und Fehlermeldung

- **Bitfehlerüberwachung**
- **Fehlerrückmeldung FEBE
(Far End Block Error)**
- **Ausfallrückmeldung FERF
(Far End Receive Failure)**

Network Management

