DATEX-L, the German CSPDN
(Circuit Switched Public Data Network)

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Disclaimer

- I never used Datex-L back in the day
- All information presented is from historical books / specs / articles
- My understanding might be incorrect; Corrections welcome!

CSPDN? WTF?

- Circuit Switched
    - dedicated circuits, dialled and released
    - just like the good old telephony (PSTN) network
- Public Data Network
    - available to the general public (like PSTN)
    - used for data, not speech (unlike PSTN)

CSPDNs were **separate** networks, independent of telephony networks

Before CSPDNs

- Public switched Telephony network (PSTN)
  - analog 3.4 kHz circuit, end-to-end
  - initially manually switched, later electromechanical switching
- Public switched Telex network (Telex)
  - 50 bit per second, asynchronous, analog
  - initially manually switched, later electromechanical switching
- direct point-to-point links (Standleitung, HfD)
  - no switching involved; dedicated permanent leased circuit
  - HfD: *Hauptanschluß für Direktruf*: leased line with DCE/modem provided by operator
  - *Überlassung posteigener Stromwege*: just the bare coper, no DCE/modem provided by operator

Some basic terminology

|	
DBP	Deutsche Bundespost; German postal services
CSPDN	Circuit Switched Packet Data Network; describes abstract concept (CCITT/ITU-T)
DATEX	DATa EXchange; Data services provided by Deutsche Bundespost
DATEX-L	DATa EXchange Leitungsorientiert; CSPDN by Deutsche Bundespost
DATEX-P	DATa EXchange Paketorientiert; PSPDN by Deutsche Bundespost (off-topic here)
IDN	Integriertes Text- und Datennetz; German network used to provide Telex, Gentex and Datex services
EDS	Elektronisches Datenvermittlungs-System; Switching technology used to implement IDN

Different Services/Networks in 1980
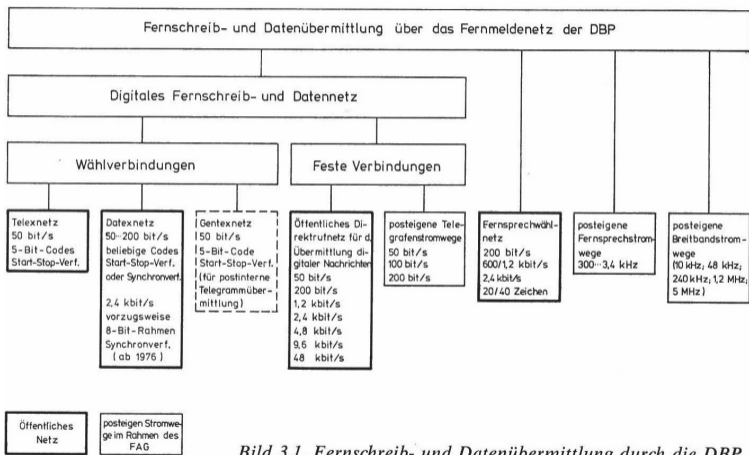
*Bild 3.1. Fernschreib- und Datenübermittlung durch die DBP*

Why DATEX-L or a CSPDN?

Why have a separate data network, indepedent of the telephony network?

- it's difficult to transmit digital data over hundreds or even thousands of kilometers of analog telephone lines
- Modems for the PSTN were very expensive and slow in the 60s and 70s
- Very long connection establishment time (pulse dialing, electromechanics)
- a network with digital switching enables *re-generating* the signal hop-by-hop
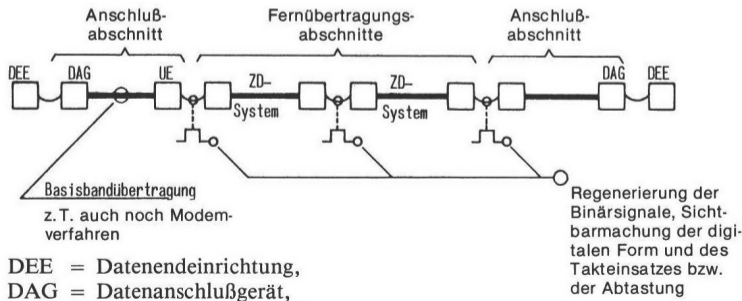
DATEX-L Network Architecture
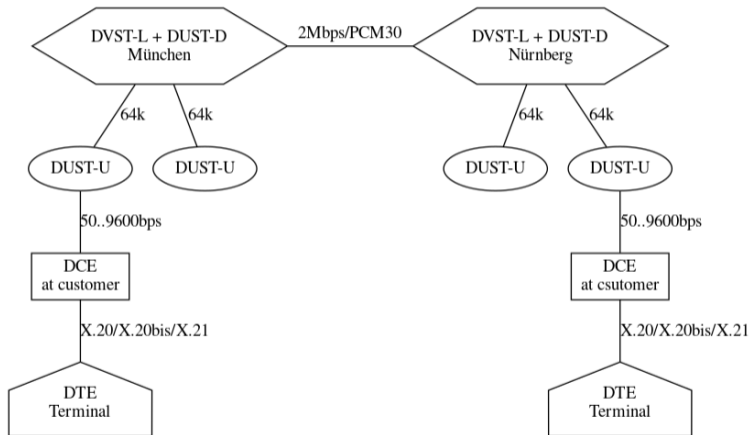
DATEX-L points of presence

Bild 3-21: Standorte der Datenvermittlungsstellen des DATEX-L-Netzes

- 18 Datex-L Switches (DVST) all over Germany
- 18 switch co-located mulitplexers (DUST-D)
- 400 remote Multiplexers (DUST-U)

DATEX-L Terminology

DVST   *Datenvermittlungsstelle*; Data Switch

DUST-D   *Datenumsetzerstelle am Standort der Datenvermittlungsstelle*; subscriber line multiplexers co-located with DVST

DUST-U   *Datenumsetzerstelle der unteren Netzebene*; subscriber line multiplexers located remote from switches; typically in PSTN central offices that had no DVST

DEE   *Datenendeinrichtung*; DTE (Data Terminal Equipment)

DÜE   *Datenübertragungseinrichtung*; DCE (Data Communications Equipment)

UEB   *Übertragungseinheiten*; line transmission interface at DUST

DFG   *Datenfernschaltgerät*; Siemens implementation of DÜE (DCE)

DEE-DÜE (DTE-DCE) Interfaces

- interface to network was not the subscriber line, but a serial port
- DATEX-L was a synchronous network, so synchronous interfaces preferred
  - sync interfaces: X.20 (300 bps) or X.21 (2400/4800/9600 bps)
  - async interfaces: X.20bis (300 bps), X.21bis (2400/4800/9600 bps)
- asynchronous interfaces were more expensive, as
  - additional circuitry needed in DEE (DCE)
  - lower net throughput due to bits wasted for start/stop bits

DATEX-L Services

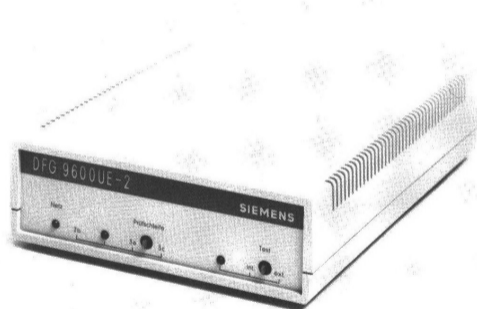| Name	bps	Inaugurated	Subscriber Interface
DATEX-L200	50-200	1967	X.20bis
DATEX-L300	300	1976	X.20 or X.20bis
DATEX-L2400	2400	1978	X.21 or X.21bis
DATEX-L4800	4800	1979	X.21 or X.21bis
DATEX-L9600	9600	1970	X.21 or X.21bis

DATEX-L DÜE/DCE/DFG: DFG 300 / DFG 2400

DATEX-L DÜE/DCE/DFG: DFG 9600UE-1 / DFG9600UE-2

Bild 3-20a: DFG 9600UE-1 mit der Schnittstelle X.21bis

Bild 3-20b: DFG 9600UE-2 mit der Schnittstelle X.21
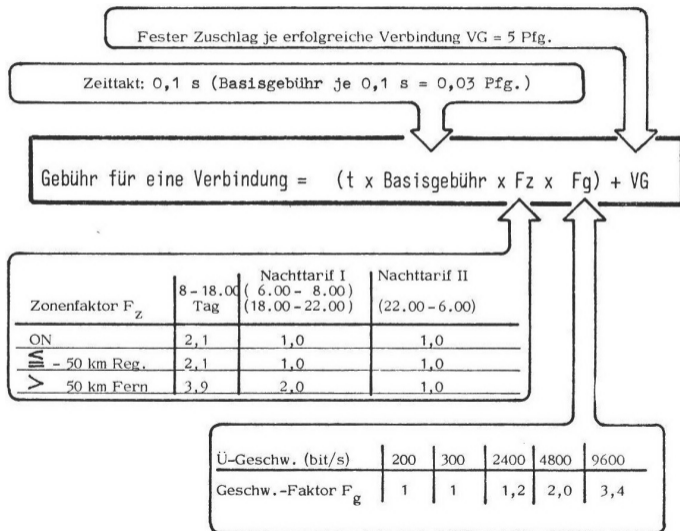
Subcriber Line in DATEX-L

- remember: subscriber line was **not** the public interface
- depending on distance, different technologies used
- predominantly pseudo-ternary coded base band transmission (UEB)
- occasionally (long distance to DUST) modem 2DPSK/4DPSK (UEM)
- 2-bit *envelope* added to every 8 user bits
    - 1 bit for synchronization purpose
    - 1 bit to differentiate user payload from signaling traffic
    - result: data rate on subscriber line 25% higher than at user interface

DATEX-L Charges: Monthly subscription

Service	Interface	Fee per month (DM)
DATEX-L300	X.20	100
DATEX-L300	X.20bis	120
DATEX-L2400	X.21	170
DATEX-L2400	X.21bis	200
DATEX-L4800	X.21	270
DATEX-L4800	X.21bis	300
DATEX-L9600	X.21	370
DATEX-L9600	X.21bis	400

DATEX-L Charges: Per connection/duration

Fester Zuschlag je erfolgreiche Verbindung VG = 5 Pfg.

Zeittakt: 0,1 s (Basisgebühr je 0,1 s = 0,03 Pfg.)

Gebühr für eine Verbindung = (t x Basisgebühr x Fz x Fg) + VG

Zonenfaktor F_z	8 - 18.00 Tag	Nachttarif I (6.00 - 8.00) (18.00 - 22.00)	Nachttarif II (22.00 - 6.00)
ON	2,1	1,0	1,0
$\leq$ - 50 km Reg.	2,1	1,0	1,0
$>$ 50 km Fern	3,9	2,0	1,0

Ü-Geschw. (bit/s)	200	300	2400	4800	9600
Geschw.-Faktor F_g	1	1	1,2	2,0	3,4

- Pfg = Pfennig (1/100 DM)
- fixed 5 Pfg for connection setup
- distance and speed dependent charges for ever 0.1 s duration

DATEX-L Charges: What did it cost per MB?

Inflation-corrected (1980->2022) charges in EUR per Megabyte:

Service	> 50km (day)	> 50km (night I)	> 50km (night II)
DATEX-L300	50.29	25.79	25.79
DATEX-L2400	7.52	3.87	1.93
DATEX-L4800	6.28	3.22	1.61
DATEX-L9600	5.35	2.74	1.36

DATEX-L International CSPDN interconnect

- 1970: France
- 1973: Belgium
- 1981: Denmark, Finland, Norway, Sweden (NPDN)

Datex-L DVST + DUST-D Floorplan
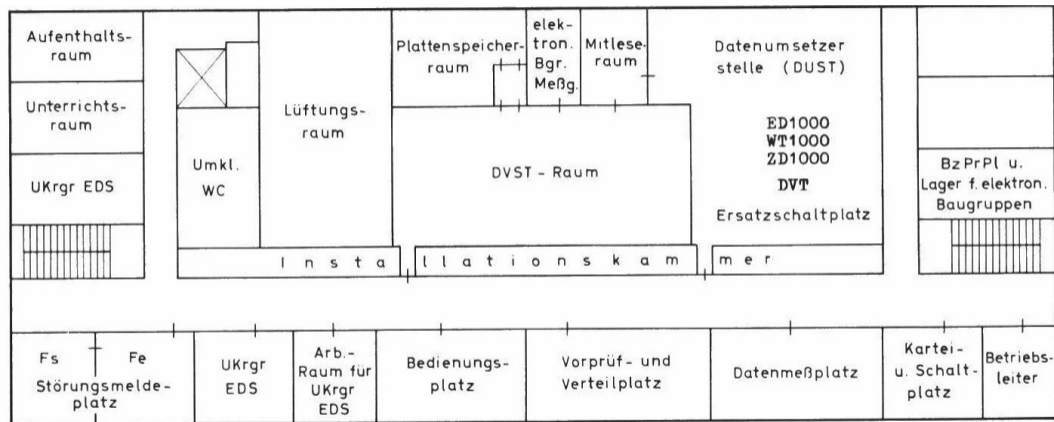
*Bild 25.1. Muster für die Raumanordnung von DVST und DUST*

Datex-L DVST + DUST Technical data

Maximum capacity	16384 connections
Maximum subscriber lines	10880 .. 11500
Maximum memory capacity	1 MByte (core memory)
Maximum call setup rate	30 per second / 60 per second
Power consumption	80 kW @ 60 VDC + 15kW @ 220 VAC + air conditioning
net floor space (just racks)	200 m^2
gross floor space	1200 m^2

EDS History

- need for higher bit rate (than 50 bps Telex) wide area data transmission
- conceptual development from 1965 onwards triggered by DBP
- cooperation between Siemens and SEL (Standard Elektronik Lorenz)
- production deployments as IDN at Deutsche Bundespost from 1975 onwards
- more than 60% of all Telex and Datex subscribers migrated to EDS in 1978
- de-commissioned in 1996 when Datex-L was switched off

EDS System Structure
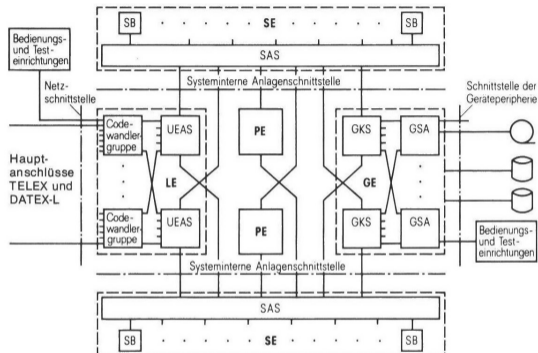
SE   = Speichereinheit
SAS = Speicher- und Anforderungssteuerung
SB   = Speicherbank
LE   = Leitungsanschlußeinheit
UEAS = Übertragungsablaufsteuerung
PE   = Programmsteuerungseinheit
GE   = Geräteanschlußeinheit
GKS = Gerätekanalsteuerung
GSA = Geräteschnittstellenanpassung
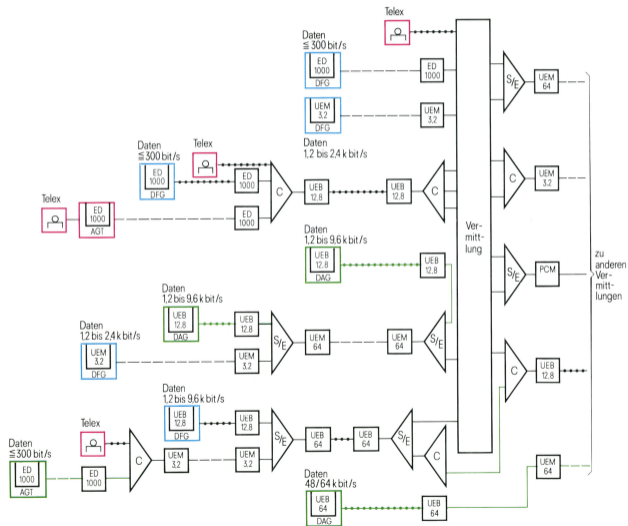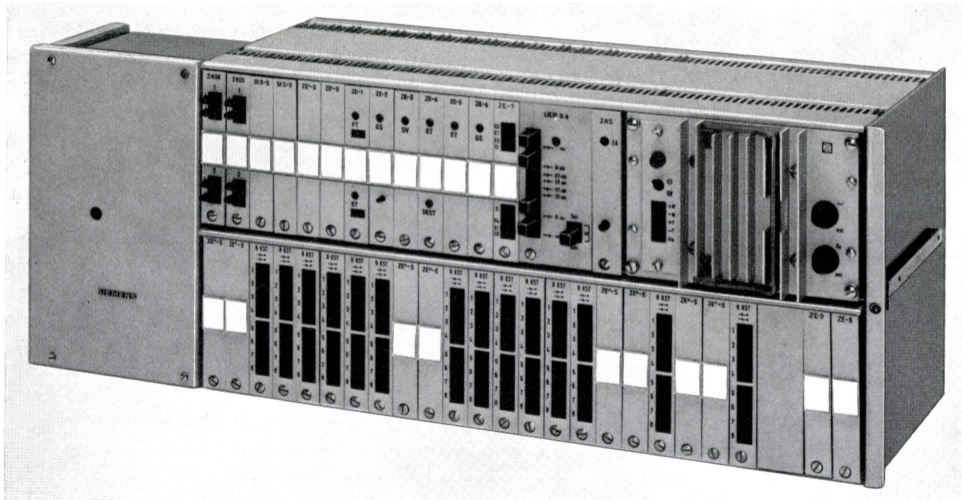
DUST using Siemens ZD1000

Bild 1
Struktur eines
integrierten
Fernschreib- und
Datennetzes
mit dem modularen
Übertragungssystem

DUST using Siemens ZD1000

DVST Hard Disk Storage

Bild 16.3. Plattenspeicher geöffnet

The End

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