

7 WAN Concepts

7.1 Purpose of WANs

- LAN: hohe Bandbreite, eigene Hardware, Endgeräte
- WAN: kleine Bandbreite, gemietete Dienste, verbindet LANs
 - Private WAN für einen Kunden: Guaranteed service level
 - Public WAN: vom Provider
- WAN-Topologies
 - point-to-point
 - hub-and-spoke
 - dual-homed: 2 home-router
 - fully meshed
 - partially meshed
 - Single-carrier
 - Dual-carrier: 2 ISPs
- Evolving Networks
 - Small Network
 - Campus Network
 - Branch Network
 - Distributed Network

7.2 WAN Operations

- WAN-Standards
 - TIA/EIA
 - ISO
 - IEEE
 - Layer1: SDH, SONET, DWDM
 - Layer2: Broadband (DSL, Cable), Wireless, Ethernet WAN, MPLS, PPP, HDLC, Frame Relay, ATM
- WAN Terminology
 - Subscriber
 - Provider
 - DTE
 - DCE
 - CPE
 - POP
 - Demarcation Point
 - Local Loop (or last mile)
 - Central Office (CO)
 - Toll network
 - Backhaul network
 - Backbone network

- WAN Devices
 - Modem (Voice, DSL, Cable)
 - CSU/DSU
 - Optical Converter
 - WAN Core devices
- Serial communication
 - 1 Bit nach dem anderen, da parallele Übertragung über lange Strecken schwierig
 - Circuit Switched: establish a dedicated circuit (Telefon)
 - Packet Switched: Metro Ethernet, MPLS, Frame Relay, ATM
 - SDH (Synchronous Digital Hierarchy): fiber-optic
 - SONET (Synchronous Optical Networking): Wie SDH, nur in Nordamerika
 - Dense Wavelength Division Multiplexing (DWDM)

7.3 Traditional WAN Connectivity

- Dedicated: Leased Line: T1/T3, E1/E3
 - Switched
 - Circuit-Switched: PSTN, ISDN
 - Packet-Switched: Frame Relay, ATM

7.4 Modern WAN Connectivity

- Dedicated: Broadband: Dark Fiber
- Switched: Packet-Switched: Ethernet WAN, MPLS
- Internet Based: Broadband VPN:
 - Wired: xDSL, Cable, Optical Fiber
 - Wireless: Municipal-Wifi, Cellular, Satellite Internet, WiMAX
- Ethernet WAN (Metro E, EoMPLS, VPLS)
 - IEEE 1000BASE-LX (5 km)
 - IEEE 1000BASE-ZX (70 km)
- MPLS (Multiprotocol Label Switching)
 - WAN routing technology
 - customer edge (CE) router
 - provider edge (PE) router
 - label switched routers (LSRs): Label für route im Frame-Header

7.5 Internet-Based Connectivity

- Internet Based: Broadband VPN:
 - Wired: xDSL, Cable, Optical Fiber
 - Wireless: Municipal-Wifi, Cellular, Satellite Internet, WiMAX
- DSL (Digital Subscriber Line)
 - Twisted-pair-telephone lines

- ADSL (Asymmetric DSL): downstream > upstream
- SDSL (Symmetric DSL): downstream = upstream
- Router - (PPPoE) - DSL-Modem - Telephone Line (PPP) - DSLAM (DSL Access Multiplexer) - ...
- Cable
 - Router - Cable-Modem - Coaxial-line - Optical-Node - Fiber - CMTS (Cable Modem Termination System)
- Optical Fiber: Fiber to the x (FTTx)
 - Fiber to the Home (FTTH)
 - Fiber to the Building (FTTB)
 - Fiber to the Node/Neighborhood (FTTN)
- Wireless Internet-Based Broadband
 - Municipal Wi-Fi
 - Cellular
 - Satellite Internet
 - WiMAX
- VPN
 - Site-to-site VPN
 - Remote Access
- ISP Connectivity Options
 - Single-homed: 1 ISP, 1 link
 - Dual-homed: 1 ISP, 2 links
 - Multihomed: 2 ISPs, jeweils 1 link
 - Dual-multihomed: 2 ISPs, jeweils 2 links