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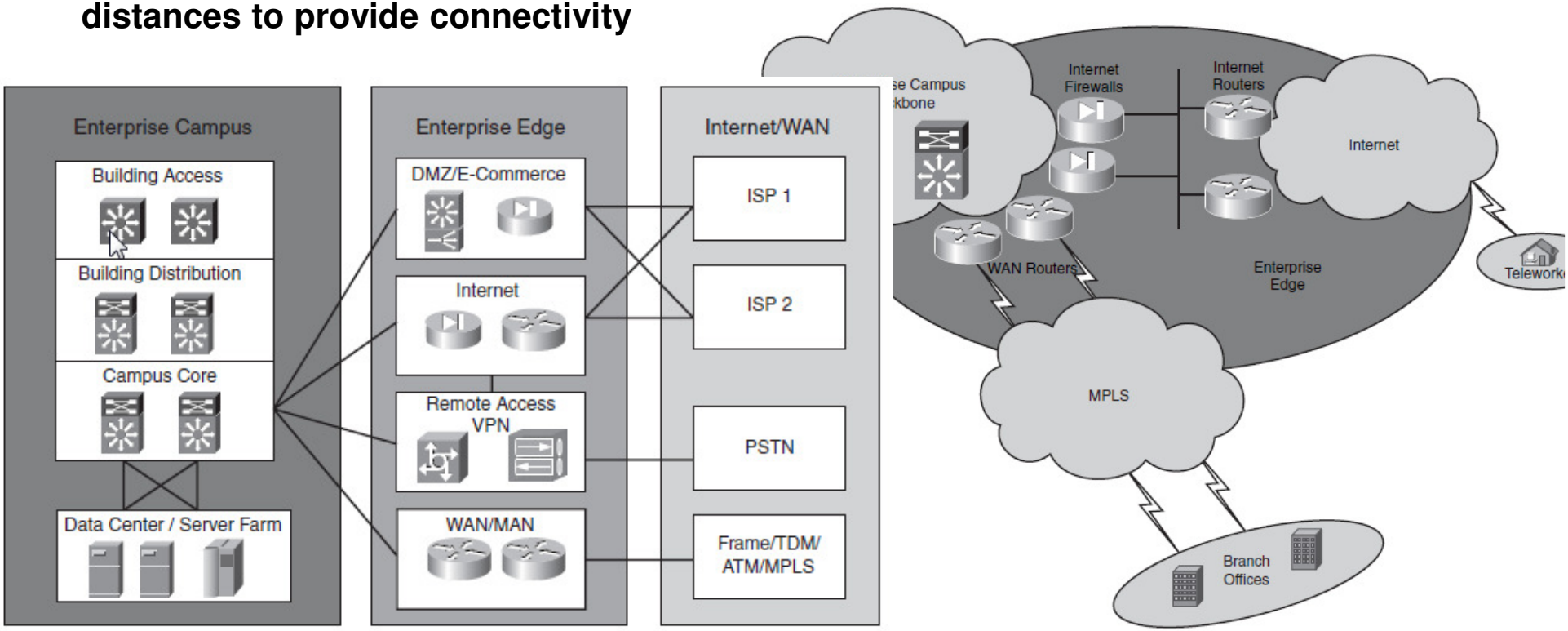
# Chapter 5

## WAN Technologies

•**Wide-area networks (WANs) are communication networks that can span great distances to provide connectivity**



# Chapter 5

## WAN Comparison

| WAN Technology | Bandwidth | Reliability | Latency | Cost |
|---|---|---|---|---|
| Dialup | Low | Low | High | Low |
| ISDN | Low | Medium | Medium | Low |
| Frame Relay | Low/Medium | Medium | Low | Medium |
| TDM | Medium | High | Low | Medium |
| SONET/SDH | High | High | Low | High |
| MPLS | High | High | Low | High |
| Dark fiber | High | High | Low | High |
| DWDM | High | High | Low | High |
| DSL | Low/Medium | Low | Medium | Low |
| Cable | Low/Medium | Low | Medium | Low |
| Wireless | Low/Medium | Low | Medium | Medium |

# Chapter 5

## xDSL Comparison

| Service | Maximum Distance to Central Office | Maximum Upload Speed | Maximum Download Speed | Notes |
|---|---|---|---|---|
| Full-rate ADSL | 18,000 ft (5500 m) | 1500 kbps | 9 Mbps | Asymmetrical. |
| ADSL G.lite | 18,000 ft (5500 m) | 384 kbps | 1.5 Mbps | No splitter is required. |
| RADSL | 18,000 ft (5500 m) | 384 kbps | 8 Mbps | Rate adapts based on distance and quality. |
| IDSL | 35,000 ft (10,070 m) | 144 kbps | 144 kbps | DSL over ISDN (BRI). |
| SDSL | 22,000 ft (6700 m) | 2.3 Mbps | 2.3 Mbps | Targets T1 replacement. Symmetrical DSL service. |
| HDSL | 18,000 ft (5500 m) | 1.54 Mbps | 1.54 Mbps | Four-wire, similar to T1 service. |
| HDSL-2 | 24,000 ft (7333 m) | 2 Mbps | 2 Mbps | Two-wire version of HDSL or four-wire at 2 times the rate. |
| VDSL | 3000 ft (916 m) | 16 Mbps | 52 Mbps | Few installations. |

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## WAN tecnologies

- Cable(DOCSIS)
- Wireless
  - GSM
  - GPRS
  - UMTS
  - Bridge wireless
- Dark Fiber
- Dense Wave Division Multiplexing

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# Chapter 5

## Ordering WAN Technology and Contracts

- **Standard pakke = ca. en månede**
- **Custom SLA = ca. 6 måneder.**
- **Kontrakt er typisk 1-5 år**
- **Dark Fiber er typisk 20 år??**

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## WAN Design Methodology

- Response Time
- Throughput
- Reliability
- Bandwidth Considerations
- Window Size
- Data Compression

| Bandwidth | Less Than 2 Mbps | 2 Mbps to 45 Mbps | 45 Mbps to 100 Mbps | 100 Mbps to 10 Gbps |
|---|---|---|---|---|
| Copper | Serial, ISDN, Frame Relay, TDM, DSL | Frame Relay, Ethernet, DSL, cable, T3 | Fast Ethernet | Gigabit Ethernet |
| Fiber | — | Ethernet | FastEthernet, ATM | Gigabit Ethernet, 10Gigabit Ethernet, ATM, SONET/SDH, POS, dark fiber |
| Wireless | 802.11b | 802.11b, wireless WAN (varies) | 802.11a/g | 802.11n |

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## Optimizing Bandwidth Using QoS

- **Queuing**
  - **–Priority Queuing (Queue starvation)**
  - **–Custom Queuing**
  - **–Weighted Fair Queuing**
  - **–Class-Based Weighted Fair Queuing**
  - **–Low-Latency Queuing**

- **Traffic Shaping**

- **Traffic Policing**

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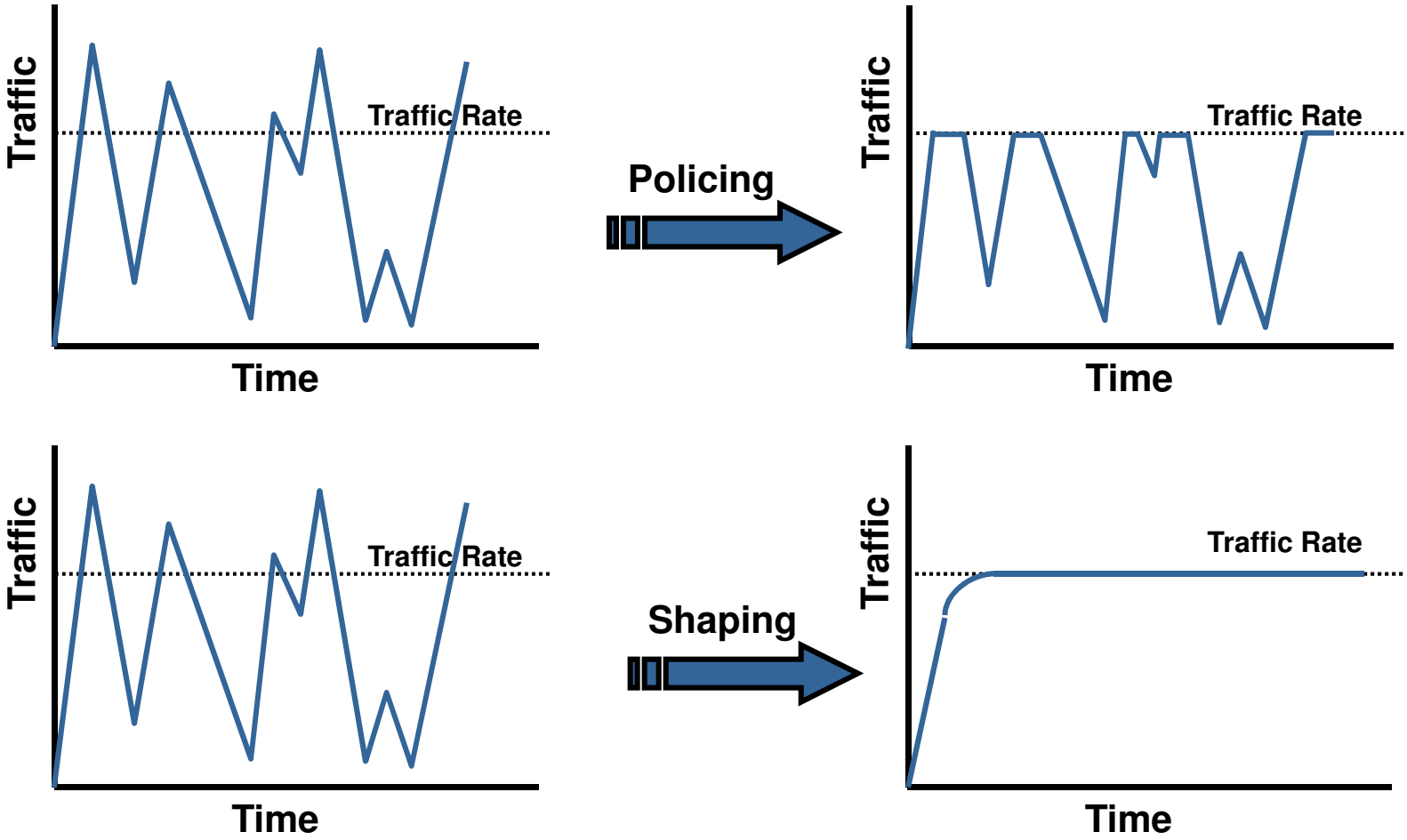

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