

WAN Technologies – Introduction (1/3)

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- **WANs – Wide Area Networks** – make it possible to link multiple LANs into one network group
- The number of connected computers, or LANs, and the spatial expansion can be customized to meet the requirements
- The goal of a coupling in a WAN is to create a seemingly unified network - **virtual network** or **Internet**, in which all end systems of the different LANs connected can communicate with each other freely → **Internetworking**

Requirements for **Internetworking**:

- Intermediate systems, e.g.
 - Switches, bridges, routers, ...
- Uniform addressing scheme
- Common communication protocol (not necessary at all the layers of the protocol stack)

For the **worldwide Internet** the

- **IP addressing scheme** and
- **TCP/IP protocol suite**

are used

WAN Technologies – Introduction (3/3)

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- Besides the end devices, a WAN consists of the
 - Transmission medium
 - Switching elements to connect individual switching networks
- In the WAN, messages are sent from the sender to the receiver via a number of intermediate systems – each message is received, stored, evaluated and forwarded accordingly
→ **store-and-forward switching**
- Intermediate systems thereby fix the data transport path from the sender to the receiver → **routing**

Packet Switching in the WAN

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Packet Switching – Basic principle of data transmission in the WAN:

- Data to be transmitted is broken down into individual packets and these are delivered independently of one another

LANs are connected to a WAN via an intermediate system –
packet switch

- Packet switches are special computers that can quickly receive data packets, store, analyze and forward them
- In order to achieve a high data transmission rate, **routing algorithms** for forwarding data packets are usually implemented in the hardware

Structure of a WAN (1/2)

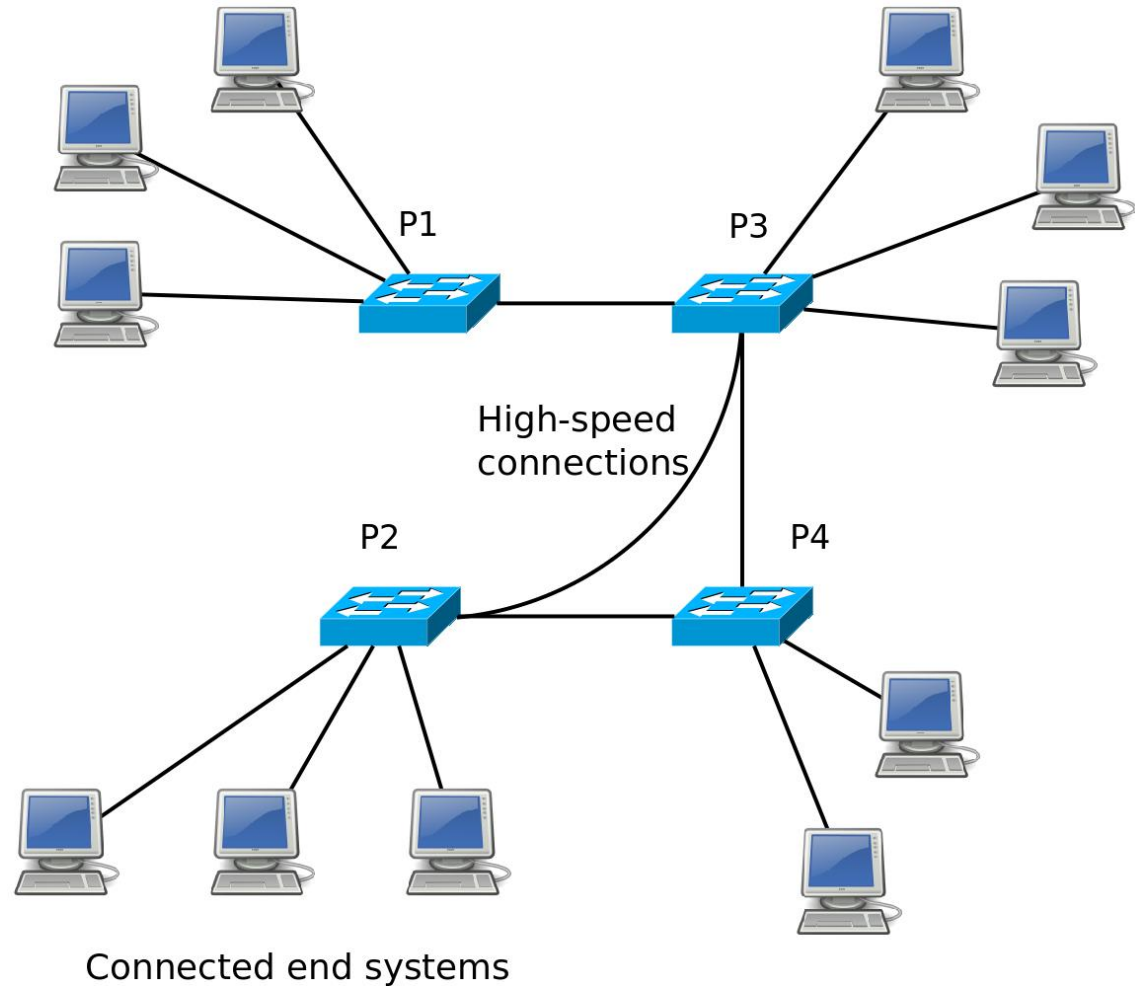
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- WANs are constructed from single LANs or individual computers at different locations. Each location needs a packet switch that is directly connected to the LAN/computer
- Packet switches at the individual locations are connected to each other via a separate, usually public, network. Bandwidth between the packet switches is adapted according to the expected data traffic, or the redundancy desired in case of malfunction
- WANs are dependent on network operators, who operate and maintain remote networks. If lines are rented and if the WAN is operated privately, it is referred to as a corporate network

Structure of a WAN (2/2)

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Packet switch



Addressing in the WAN (1/5)

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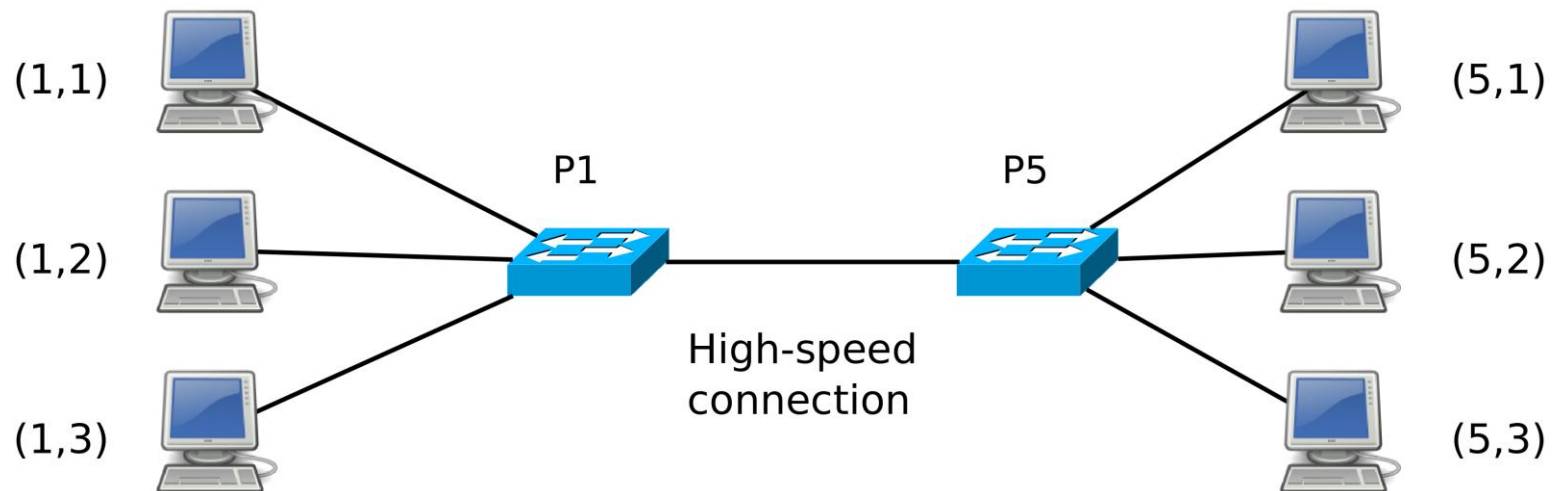
So that packet switches can decide via which output a packet should be forwarded, every end system needs its own address in a uniform format

Hierarchical addressing schemes are used in WANs:

- **Address prefix** – Address of the network
- **Address suffix** – Address of the connected end system

Addressing in the WAN (2/5)

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Addressing in the WAN (3/5)

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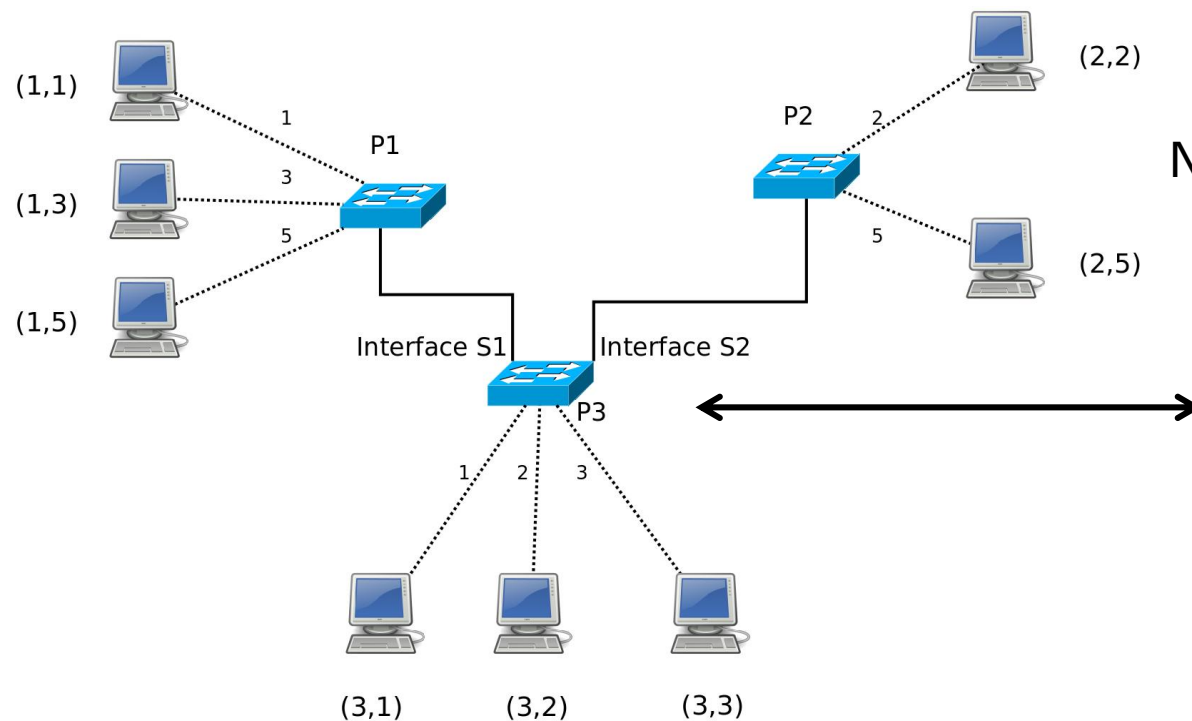
If the target address of a computer is a directly adjacent packet switch, the packet is forwarded there, otherwise it is sent to a packet switch that is located on the right way to the destination address – the choice depends on the destination address

- The packet switches have no information about the complete route but only about next possible section (“hop”)→ **Next-Hop-Forwarding** – forwarding is carried out independent of origin
- For a data packet to be able to determine the next hop, every packet switch maintains a → **next-hop-table**

Addressing in the WAN (4/5)

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Next-Hop-Forwarding in the WAN



Next-hop-table from P3:

Goal	Next hop
[1,1]	S1
[1,3]	S1
[1,5]	S1
[2,2]	S2
[2,5]	S2
[3,1]	1
[3,2]	2
[3,3]	3

Addressing in the WAN (5/5)

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Forwarding algorithms:

- Evaluate destination address
- Search for the entry in the next-hop table
- Forward packets via the output listed

Forwarding algorithms can be implemented very efficiently in hardware