

Verteilte Systeme SS2002:

Gruppenkommunikation

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Übersicht

- *Paare und Gruppen*
- *Vor-/Nachteile von Gruppen*
- *Protokolle*
 - *Multicast etc.*
- *Applikationen*
 - *News*
 - *Zeit*

Kommunikationsarten

■ *Paarweise*

- *Client-Server*
- *Peer-to-Peer*

■ *Gruppenweise*

- *Peer-to-Peer*
- *Mit Koordinator*

Client-Server-Paar

■ Anzahl Klienten

- **Dedizierte Verbindung**
 - *Polling, Sensor*
- **Variabler einzelner Klient**
 - *X11 Window Manager*
- **Konstante Anzahl Klienten**
 - *Messzentrale*
- **Variable Anzahl Klienten**
 - *Typischer Fall*

■ Koordination beim Server

- **Einzelner Worker-Prozess**
- **Mehrere: Gegenseitiger Ausschluss**

Peer-to-Peer-Paar

■ *Beispiel*

- *Primary-/Backup-Server*
- *Protokolle: TCP, ...*

■ *Gegenseitiger Ausschluss nötig?*

- *Koordination?*
- *Zuverlässigkeit?*

■ *Authentisierung*

- *IP-Adresse*
- *Kryptografisch*

Wieso Gruppen?

■ Vorteile

- **Metcalfe's Law:**
Der Nutzen von Kommunikationsdiensten steigt quadratisch mit der Anzahl Benutzer (und damit proportional zu den möglichen Verbindungen)
- *Geschlossene vs. offene Standards; Beispiel WWW*
- **The Computational Grid**
- **Skalierung!**

■ Nachteile

- **Koordination**
- **Netzwerk (Bandwidth, Delay, Loss)**
- **Mehrere Rechner (Administration, Ausfall, ...)**

Kategorien von Gruppen

- *Welche Probleme tauchen auf bei mehreren*
 - *Klienten?*
 - *Servern?*
 - *Peers?*
- *Abhängig von Applikation?*

Skalierung

- **Parallelität**
 - *Analog zu Parallelrechnern*
- **Enge vs. lose Koppelung**
 - *distributed.net*
 - *Client-Server*
 - *Datenbanken*
 - *Peer*

Mechanismen

■ **cast*

- *Unicast*
- *Broadcast*
- *Multicast*
- *Anycast*

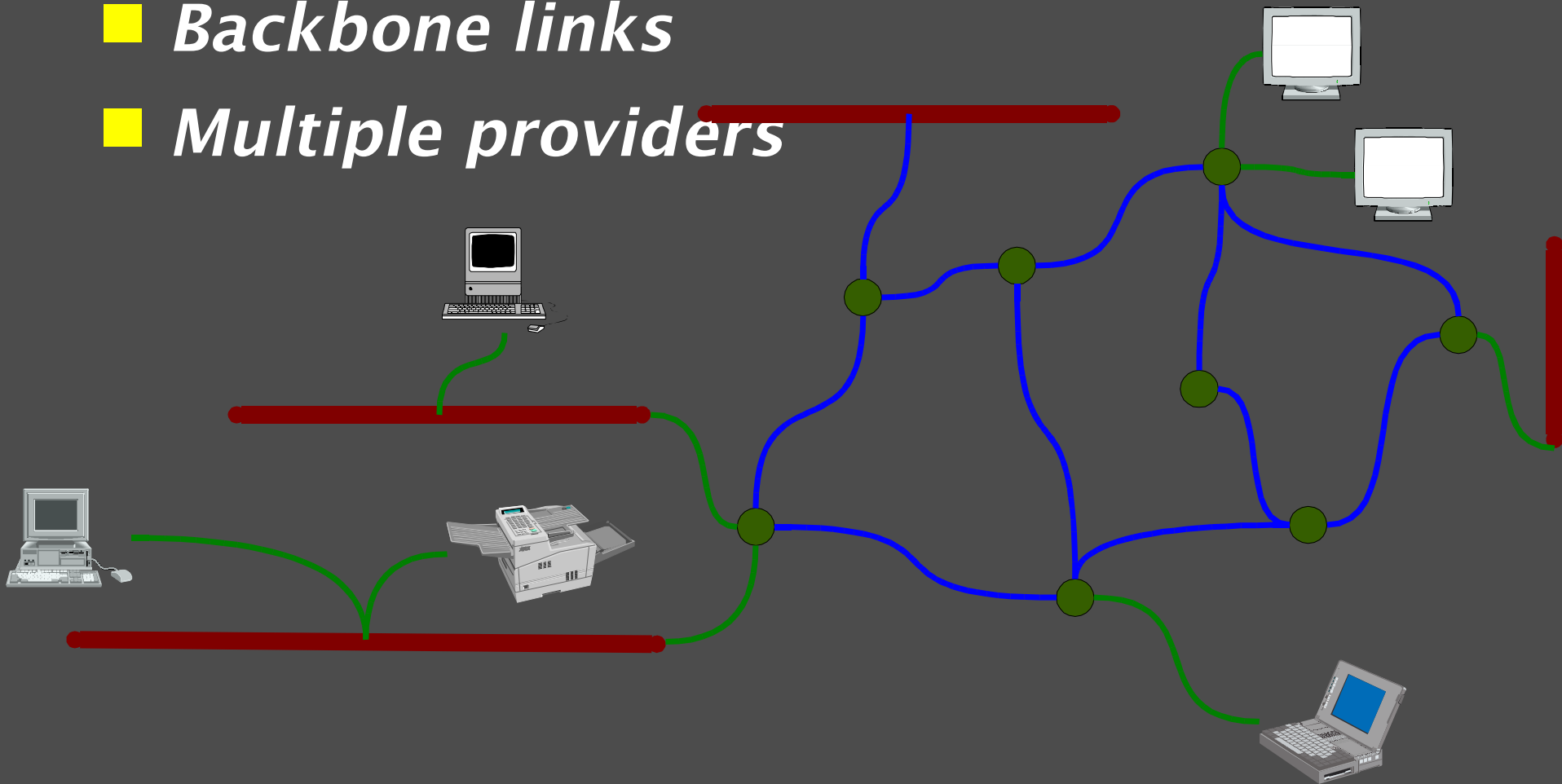
■ *Ringe*

■ *Bäume*

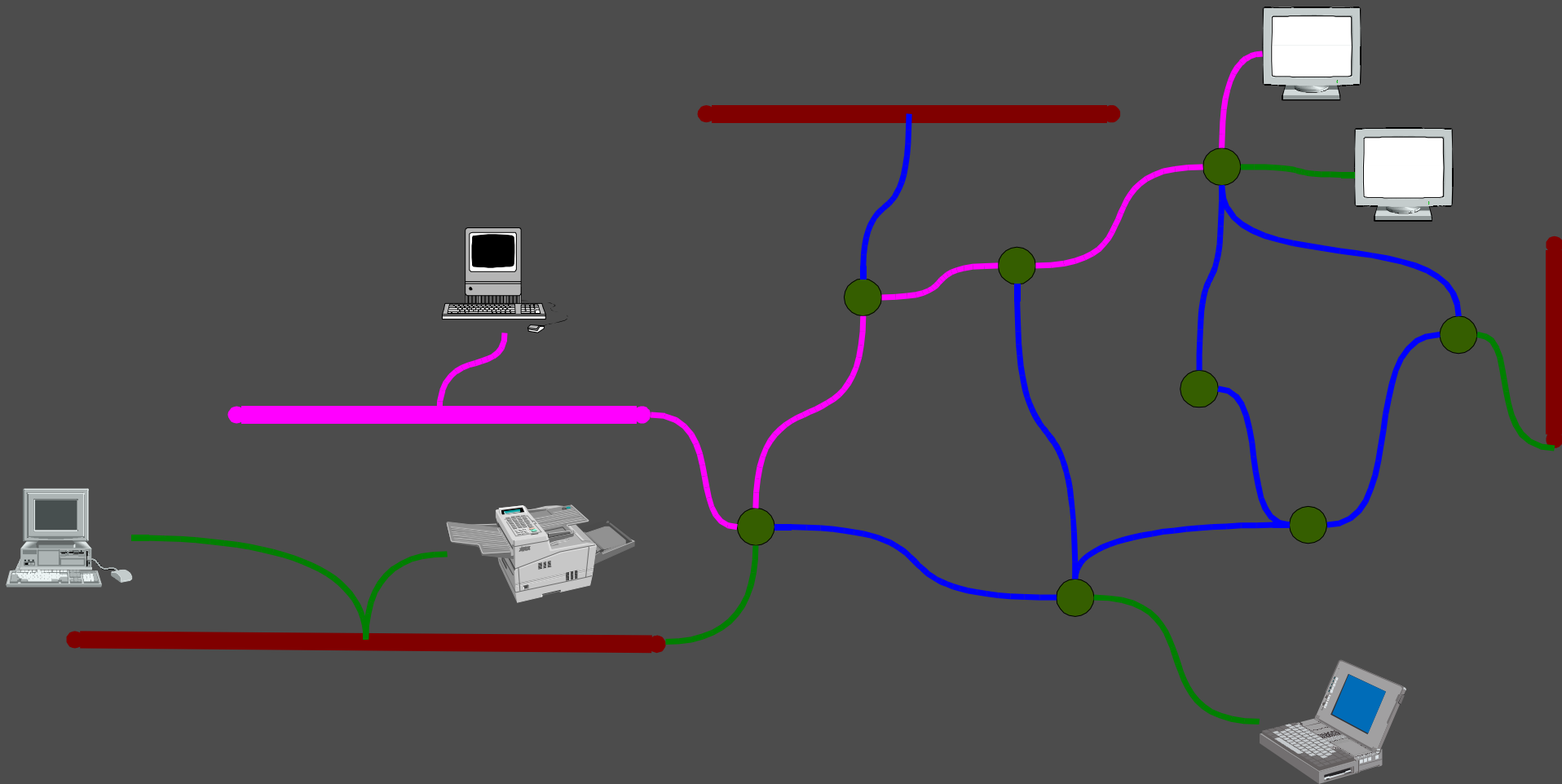
■ *Netze*

Internet: A Peek Inside

- *Computers and LANs*
- *Backbone links*
- *Multiple providers*



Single Server and Single Client



Many Clients

■ *Issues*

- *>50 Million Hosts*
- *»Slashdot Effect«*
- *Popular Broadcasting Events*

■ *Effects*

- *Server overload*
- *Network overload close to the server*

General Solutions

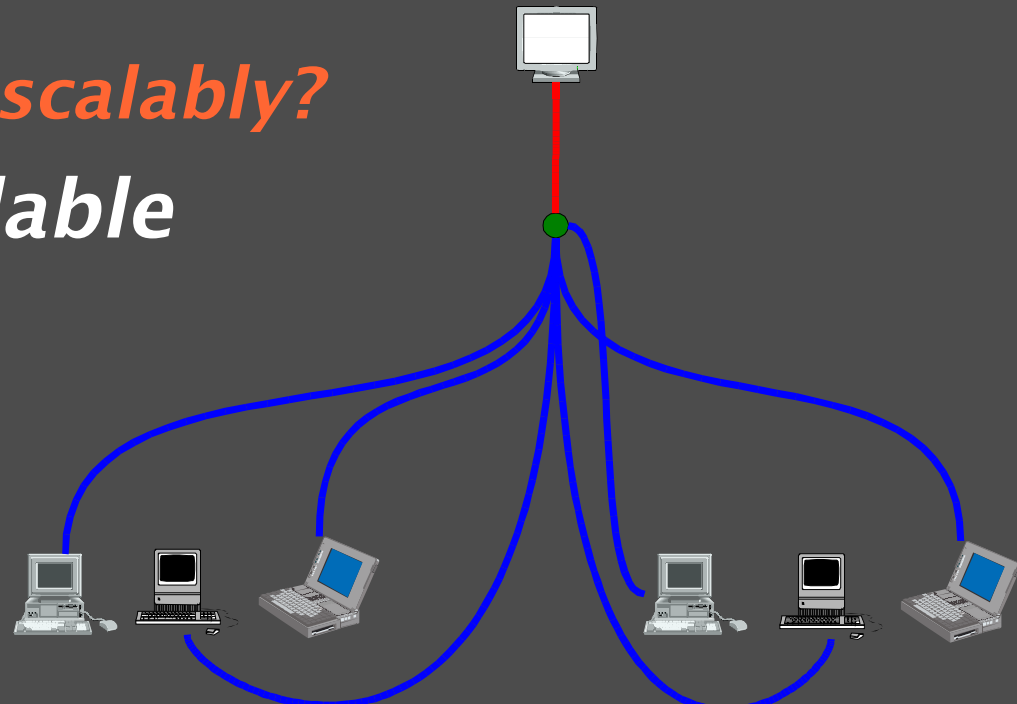
- *Raw power*
 - *Bigger Servers*
 - *Faster Network*
- *Decentralization*
 - *More Servers*
- *Network support*
 - *Caches*
 - *Broadcast/Multicast*
- *New paradigms*

Raw Power

- *Bigger, faster computers and networks*
- *Split the problem*
 - *Distribute the requests*
 - *Client side: Randomly pick a server from a list*
 - *Server side: Virtual server, distribute requests to real servers*
- *Costly*
- *Does not scale well*
- *Servers and network bandwidth need to grow linearly*

Multicast Problems

- **Packet loss and retransmission**
 - *»Sender implosion«*
 - *Guaranteeing delivery*
- **Fair rate at each link**
 - *How to determine scalably?*
- **Make routing scalable**



Distribute Servers

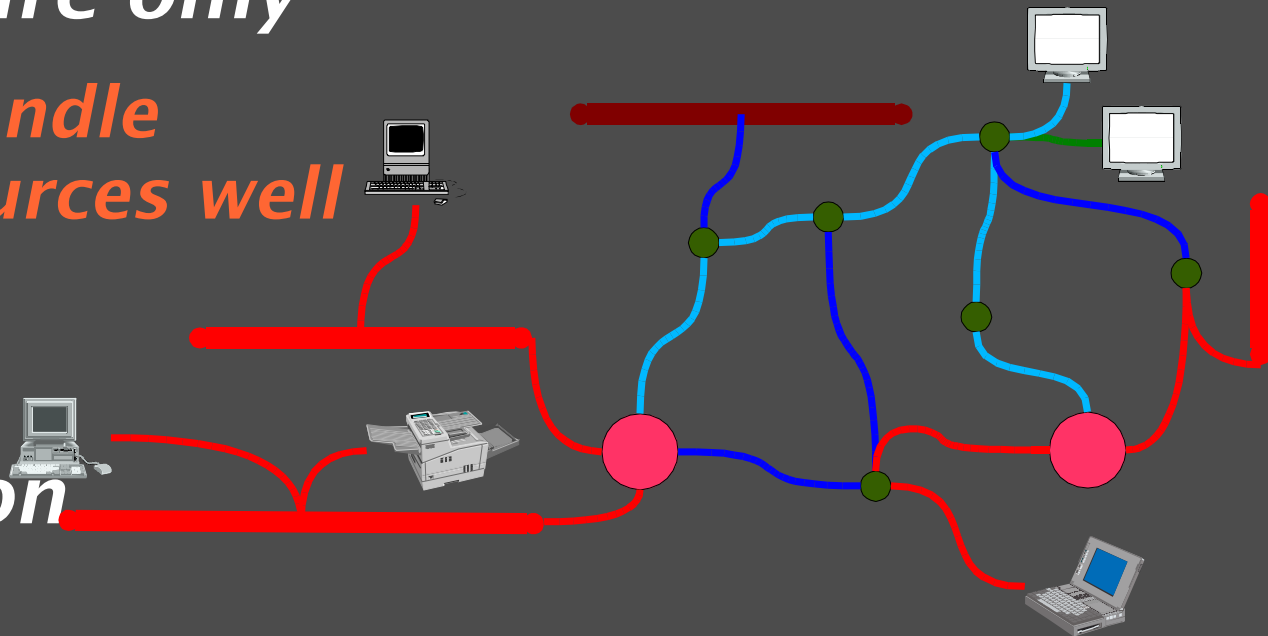
- *Have servers all over the world*
- *Network bandwidth no longer a bottleneck*
- *Better latency*
- *Issues*
 - *Machines still need to grow linearly*
 - *Synchronization*
 - *Management nightmare*
 - *How do clients find the closest server?*

Caching

- *Well-known and widely used for WWW*
- *Static content only*
- *User tracking hard (e.g., shopping basket)*
- *Tree structure only*

– *Does not handle multiple sources well*

- *Needs manual configuration*

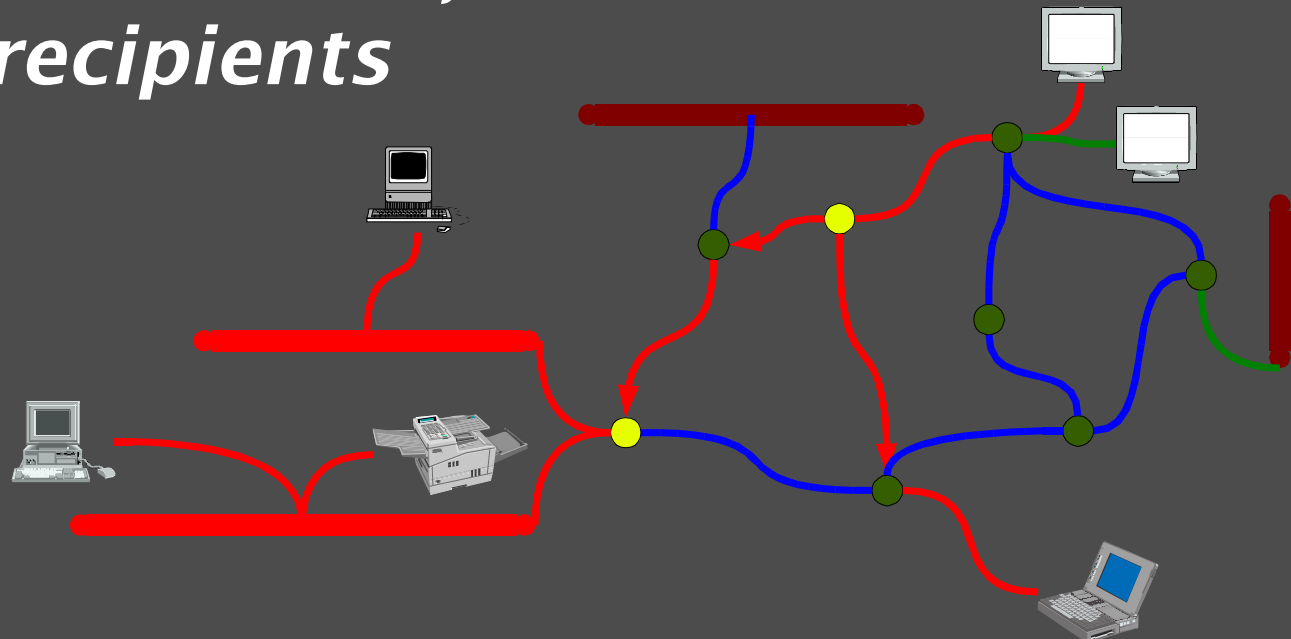


Broadcast

- *Well-known from TV and Radio*
- *Frequencies (=bandwidth) used in entire reception area*
 - *Independent of interested receivers*
- *Does not scale to global reception of many stations*
- *Broadcast: »dumb« air waves*
- *Network: »intelligent« routers*
 - *Improvements worth the cost?*

Introducing: Multicast

- *Unicast: Every router sends data out on a single link to get it closer to the single destination*
- *Multicast: Data goes out on more than one link, if multiple recipients exist*



Multicast

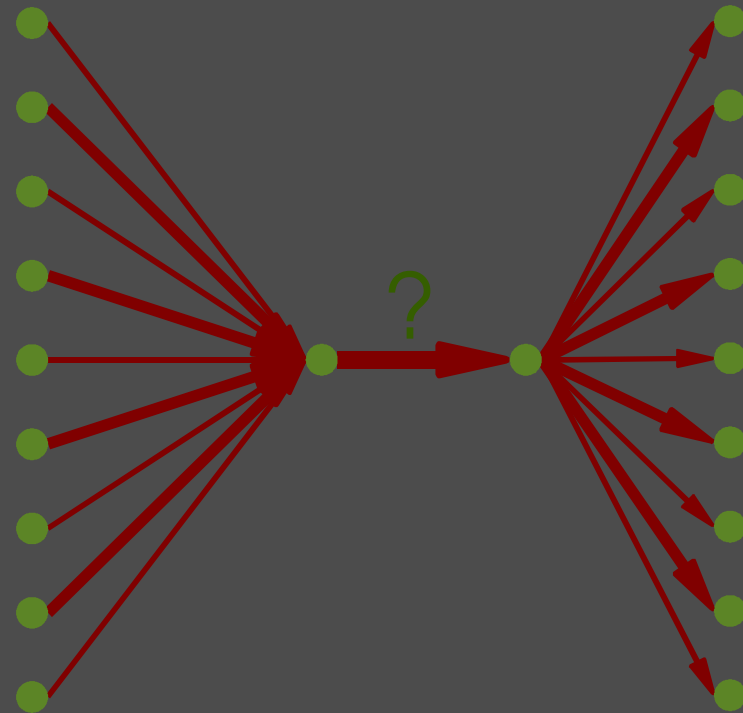
- *Perfect solution?*
 - *Defined for Internet since 1991*
 - *Extremely limited availability*
- *Routing protocol expensive*
 - *Routing traffic*
 - *Router memory*
- *ISPs are afraid*
 - *Data traffic*
 - *Reliability*
 - *Charging*

Internet Policy

- *Fair bandwidth sharing*
 - *No enforcement*
- *Routers still relatively dumb*
 - *Cost/performance*
 - *Only tries to forward packets*
 - *No retransmits*
 - *No information processing*
 - *Overload notified as packet loss*

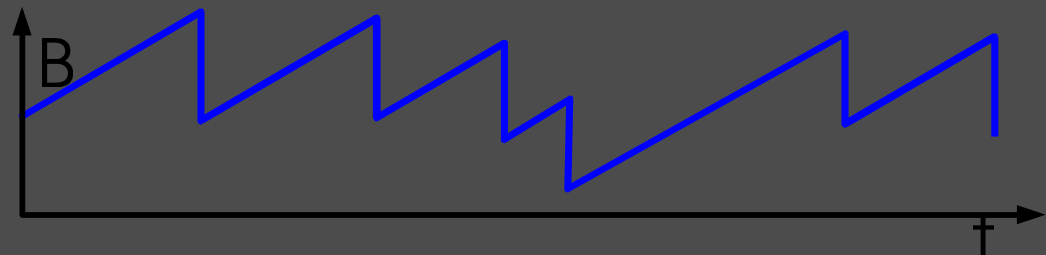
Congestion Control

- *Why fairness?*
- *How to achieve?*
- *How to find out about fair share?*



Congestion Control: TCP/IP

- Router »dumb«
- Router provides random packet losses on overutilized links
 - Receiver reports loss to sender
 - Sender reduces transmission rate at every loss
- Large flows see more losses
- To use available bandwidth, senders increase data rate slowly



Congestion Control: Multicast Issues

- *Worst case congestion as basis*
 - *As with unicast*
 - *Policy cut-off*
- *Packet loss feedback not scalable*
 - *Implosion*
- *Drop-to-zero problem*
 - *Loss rate, not loss events*

SRM/CC

- *Only small number (~ 1) of receivers provide feedback*
- *Dynamic election process*
 - *Worst candidate*
 - *Piggybacked on retransmission request*
 - *Aggregated*
 - *Probabilistic*
 - *Most losses*
 - *Low-pass filter*

Anycast

- *IPv6*
- *Global Internet Anycast*
- *Adresse eines möglicherweise replizierten Dienstes*
- *Routinginformation zur Lokalisierung*

Applikationen

- *Zeitsynchronisation (NTP)*
- *NNTP*
- *Datensynchronisation*
- *AFS*

Zeit

- *Synchrone Zeit wichtig*
- *Lichtgeschwindigkeit endlich*
 - *1GHz ~ 1ps ~ 20cm*
 - *1kHz ~ 1ms ~ 200km*
- *Global Position System (GPS)*
- *Network Time Protocol (NTP)*
 - *Netzwerke weder deterministisch noch symmetrisch*
 - *Frequenz und Phase*
- *Ordnung*

NNTP

- ***Network News Transport Protocol, 1986***
 - ***Globales Diskussionsforum***
 - ***Replikation***
 - ***Grosse Datenmengen***
- ***Redundantes Netz***
- ***IHAVE/SENDME mit Message-IDs***
 - ***Ineffizient***

Massensynchronisation

- *Effizienz steigern, aber wie?*
- *Annahmen:*
 - *Viele Nachrichten*
 - *Relativ wenige Quellen (Hunderte)*

Andrew File System (AFS)

- *Verteiltes Dateisystem (CMU, IBM, Open)*
- *Baum von (replizierten) Server*
 - *2PC*
- *Aggressives Caching der Clienten*
 - *Callbacks mit Limiten*
 - *Nach Dateimodifikation: Client als Server*

Weitere Applikationen