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Evolution of Internet Traffic

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Petri Helenius - biography

- Internet and ICT pioneer
- Eunet Finland 93-
- Santa Monica Software 95-
- KPNQwest 99-
- ROMmon 2001-
- Serious business with leading, but not bleeding technology edge

ROMmon Oy as a Company

- High class network:
  - Measurement
  - Reporting
  - Real-time monitoring
  - Analysis and forecasting

- Company founded in 2001
- First product customers Feb 2002
- Rapidly growing and profitable
- Headquarters at Innopoli 2, Espoo, Finland

Internet design criteria

- Multiplexed utilization of existing networks
- Survivability in the face of failure
- Support multiple types of communications service
- Accommodate a variety of network types
- Permit distributed management of resources
- Cost effective
- Low effort to attach a host
- Account for use of resources

The foundation paper

- Seminal 1981 Saltzer, Reed & Clark paper:
  - End-to-End Arguments in System Design
  - http://people.qualcomm.com/karn/library.html

Internet evolution

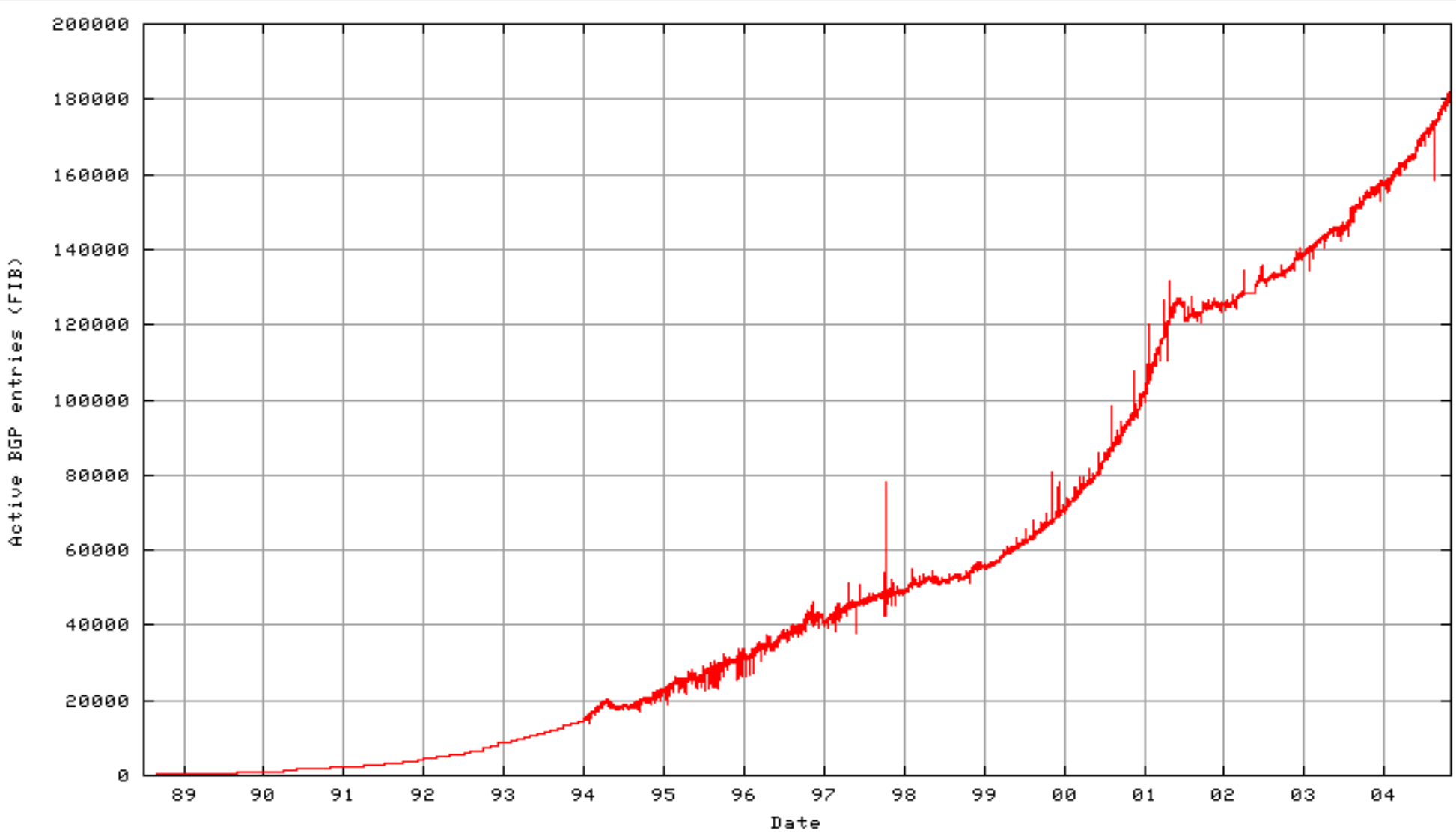
- The Internet (and the rest of the networking industry) will most likely endlessly take steps backwards and forwards in regards of technology
  - People will promise good things if we break the end-to-end model (most security-related today)
  - Mistakes will be realized and they will fade away:
    - NAT
    - OSI
    - Everything over HTTP
    - Unidirectional Internet
    - etc...

The current state of affairs

- “It has become trendy, in some circles, to lament the Internet's poor
  - Performance
  - Congestion
  - Non-deterministic nature
  - Lack of security
  - <insert issue here>
- After firmly denouncing the Internet, the company or individual then touts their product, which will fix/replace/augment the Internet.“

Daniel Golding

Number of routes globally



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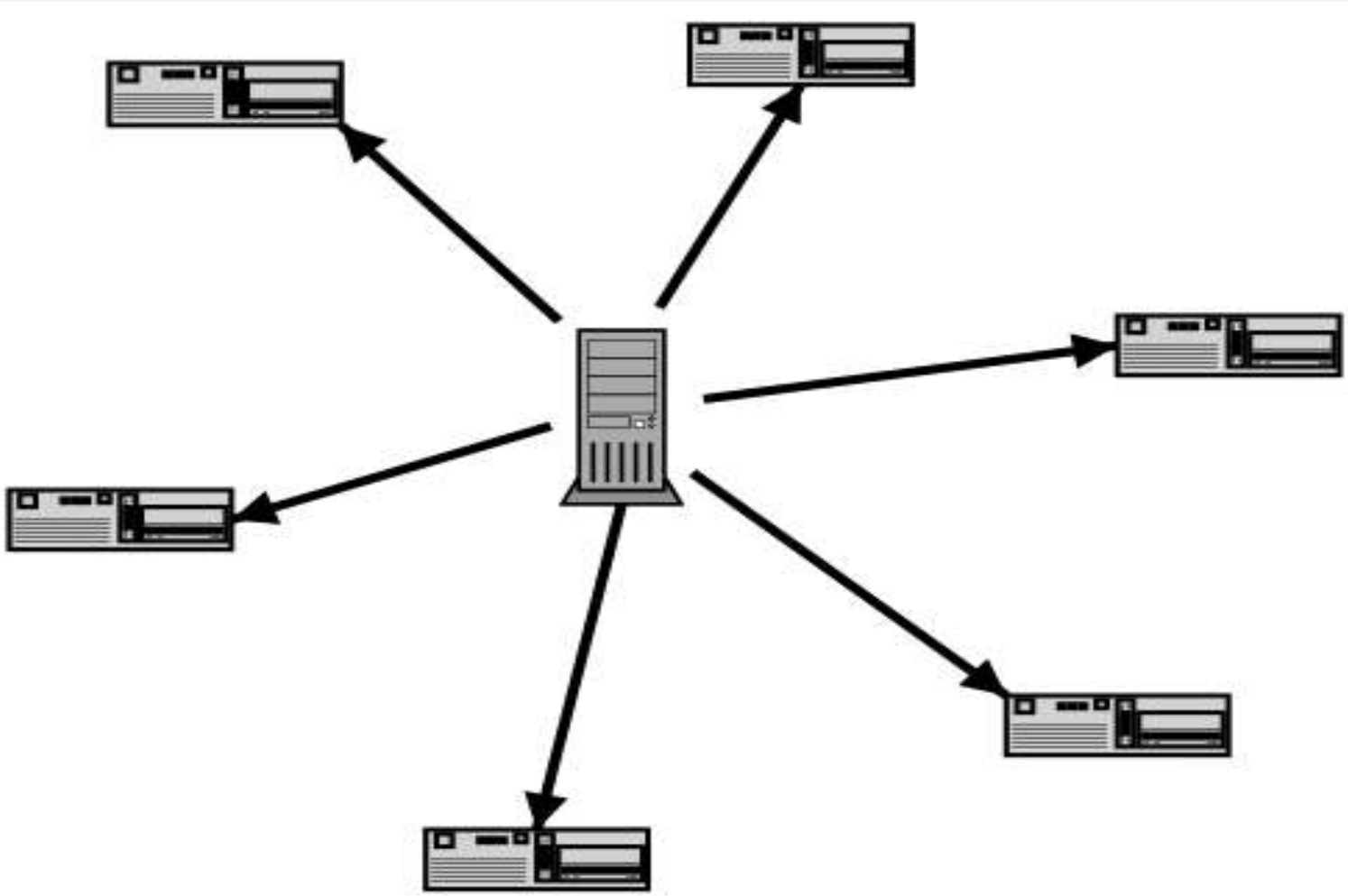
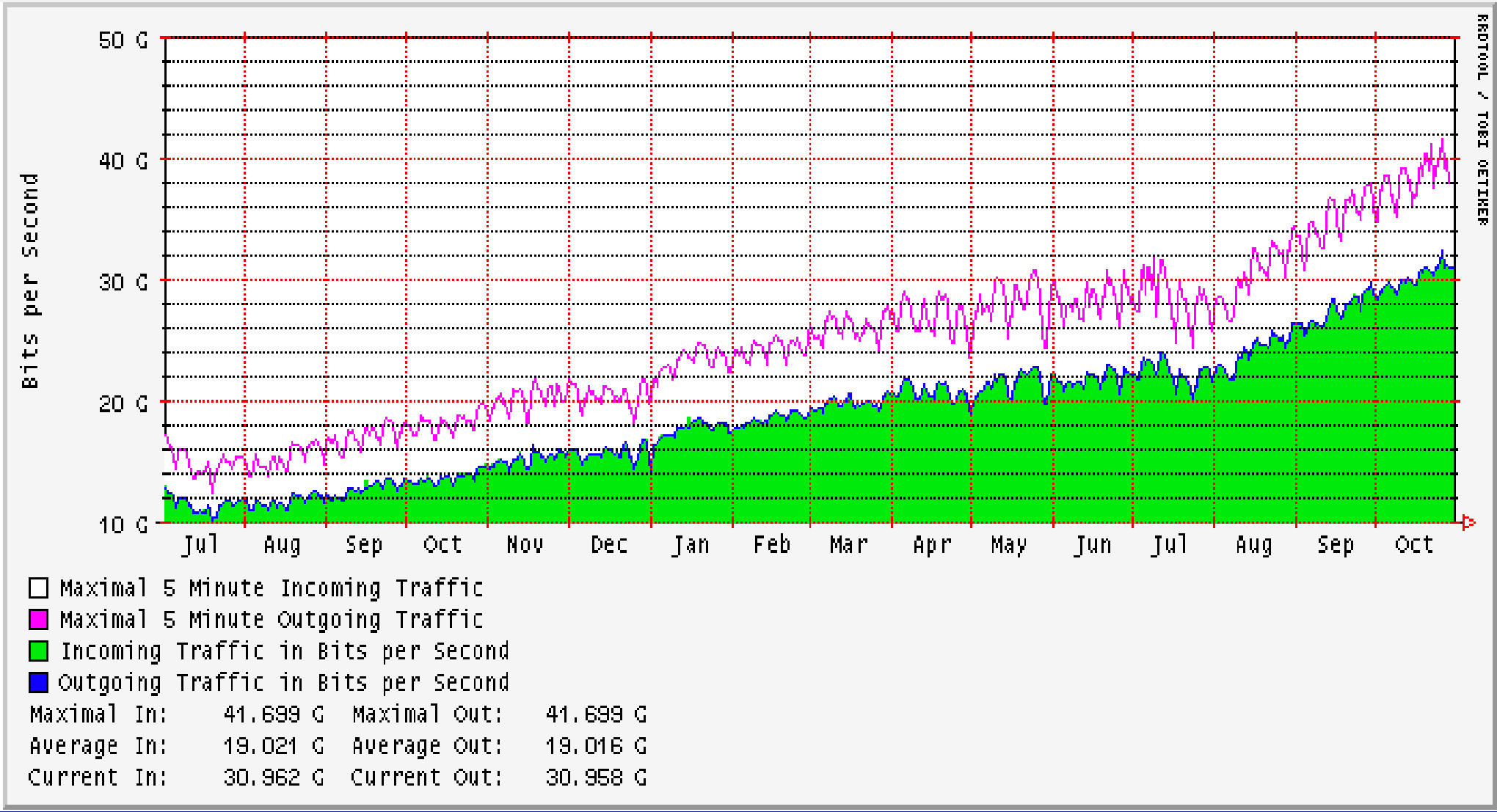
Growth factors

- In the early years (before 1995) Internet growth was fueled by the network effect, more people joining the network
- In the bubble years (1996-2000), growth was mainly fueled by content getting fatter (more graphics on websites)
- In the late years (2001-) growth is fueled by peer-to-peer applications which usually consume all available access bandwidth
- Growth today is limited by user-to-network bandwidth

Until 1998



AMS-IX traffic 16 months



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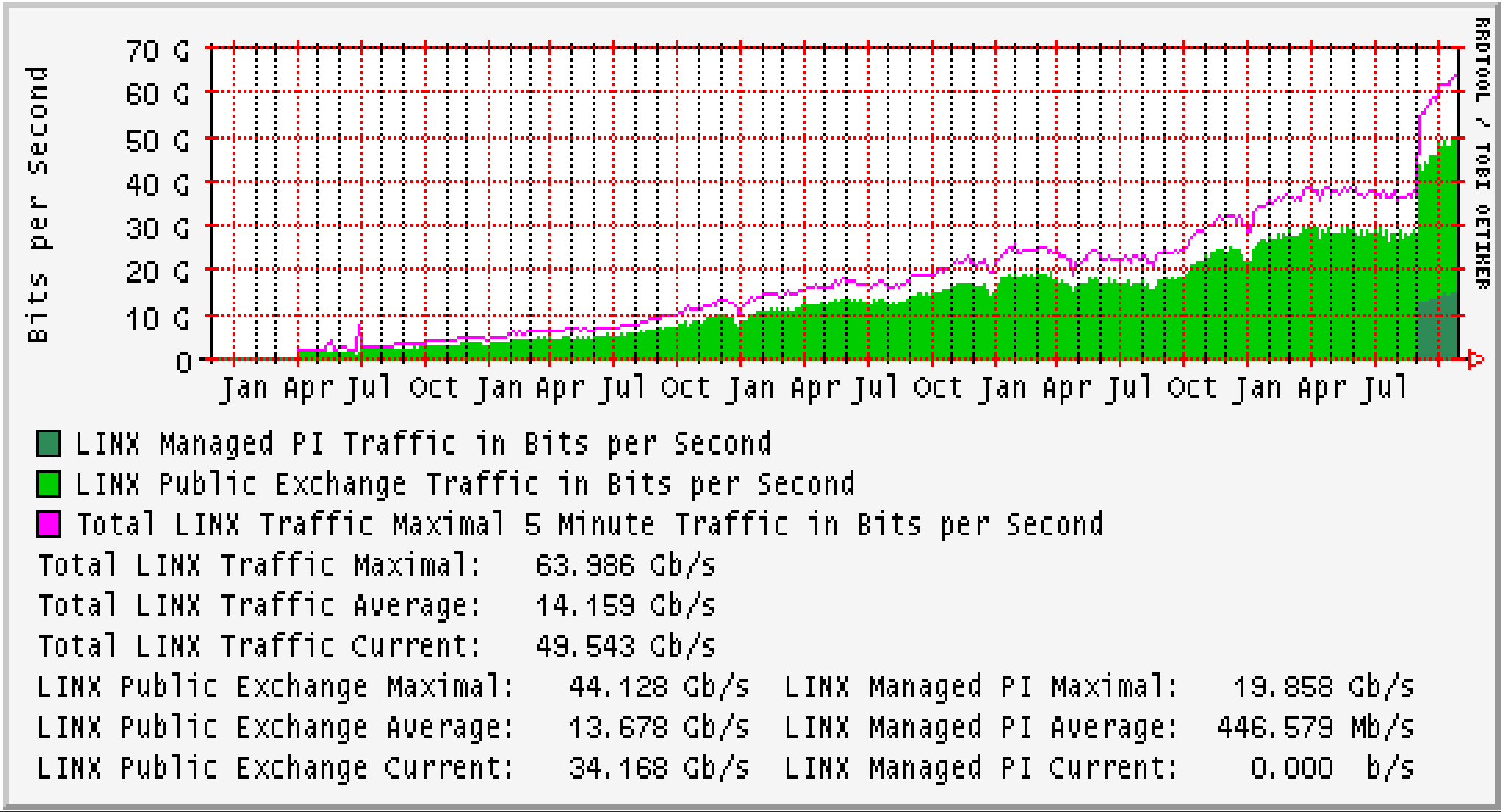
LINX traffic 5 years



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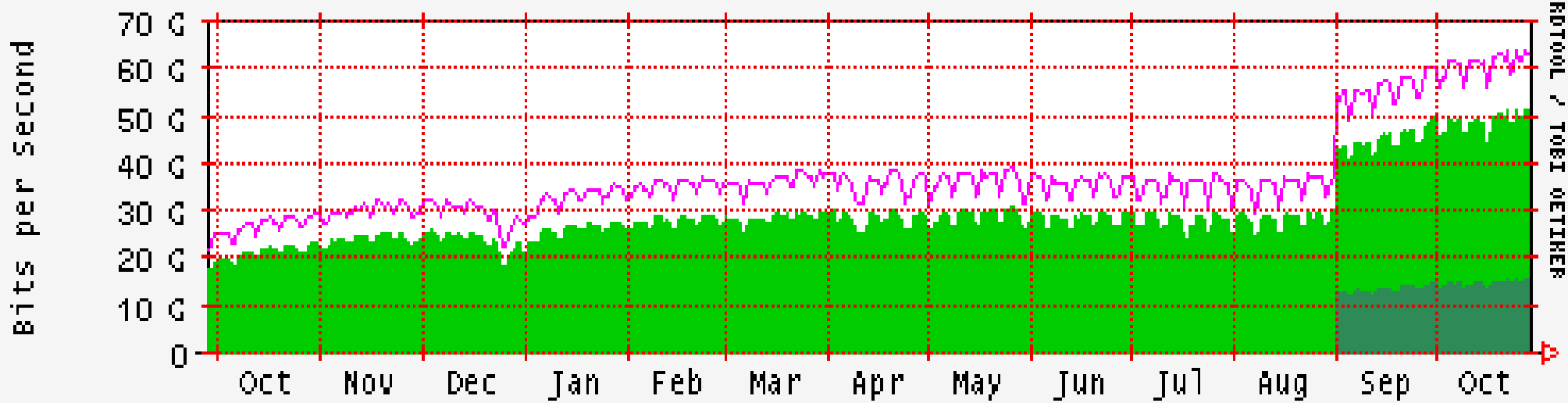
LINX traffic 12 months



LINX Managed PI Traffic in Bits per Second
LINX Public Exchange Traffic in Bits per Second
Total LINX Traffic Maximal 5 Minute Traffic in Bits per Second

Total LINX Traffic Maximal:	63.986 Gb/s		
Total LINX Traffic Average:	29.355 Gb/s		
Total LINX Traffic Current:	50.873 Gb/s		
LINX Public Exchange Maximal:	44.128 Gb/s	LINX Managed PI Maximal:	19.858 Gb/s
LINX Public Exchange Average:	27.210 Gb/s	LINX Managed PI Average:	2.145 Gb/s
LINX Public Exchange Current:	35.085 Gb/s	LINX Managed PI Current:	15.788 Gb/s

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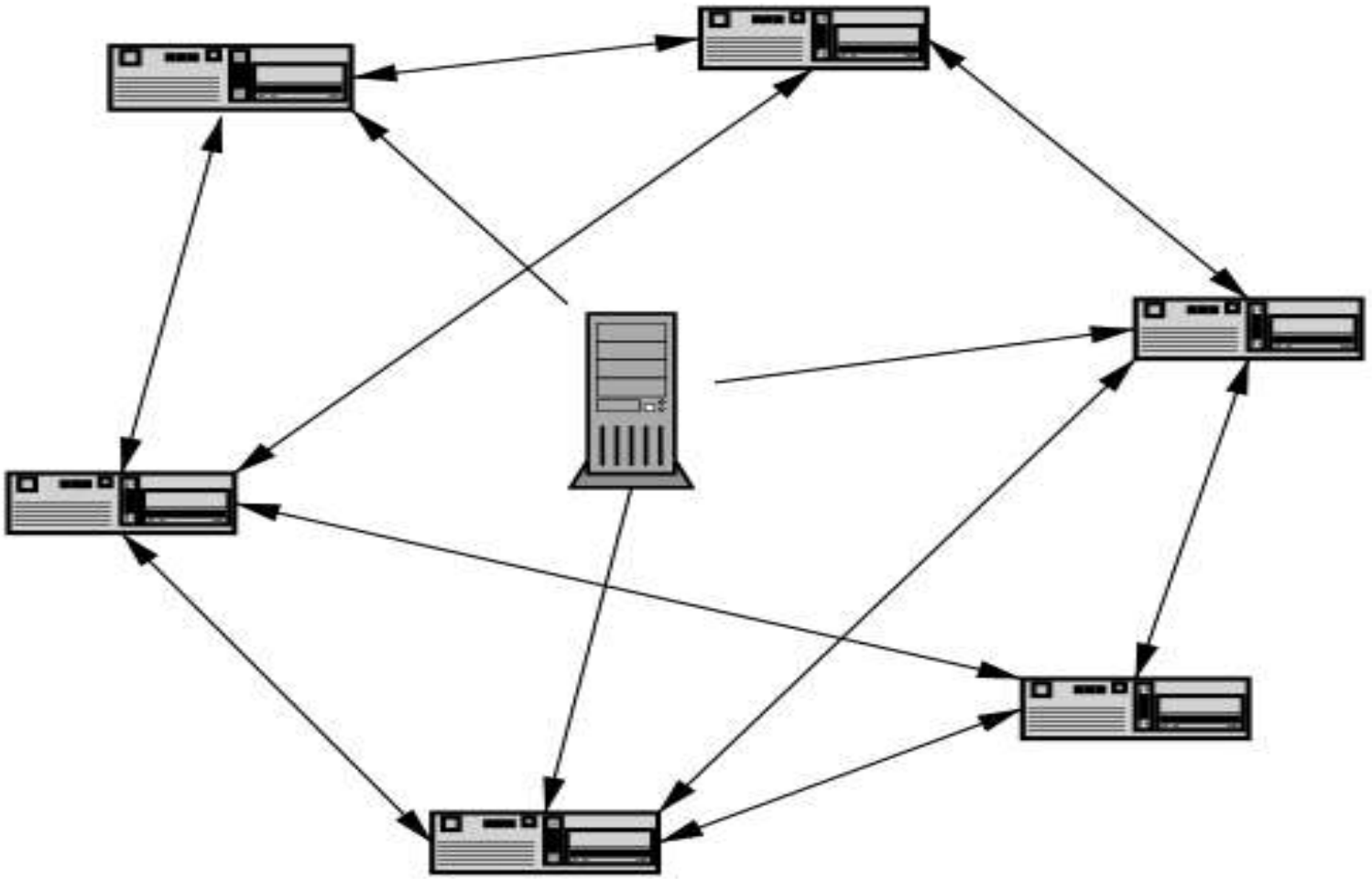
State of the bits

- Well over 50% peer-to-peer traffic
  - Some sources state “90% at times”
  - This holds true for traffic in the early hours
- Under 1% of traffic (TCP) flows make over 80% of the bits
- Approximately 10% of the users at any given time use P2P
  - This percentage is growing, although not that fast
  - Upstream bandwidth limits the utilization to some extent

1999 onwards (and the original intent)



Where?

- The internet is divided quite equally (in 2003) between
  - US
  - Europe
  - Asia-Pacific (including Australia and New Zealand)
- Africa, Middle-East and Latin America contribute less than 10% combined
- Growth currently greatest in Asia-Pacific

Lessons learned

- “the lesson of the Internet is that efficiency is not the primary consideration. Ability to grow and adapt to changing requirements is the primary consideration. This makes simplicity and uniformity very precious indeed.”

Bob Braden

Doomsday is imminent (not)

- Almost all of the many predictions now being made about 1996 hinge on the Internet's continuing exponential growth. But I predict the Internet will soon go spectacularly supernova and in 1996 catastrophically collapse.

Bob Metcalfe

Why end to end is so important?

- how about Internet Telephony with:
  - smart voice terminals
  - downloadable applications
  - open to the Internet
  - standard open protocols
- actually this is not innovation
- but would (does) enable innovation

Why the Internet will survive?

- Security related incident numbers leveling
  - It's not getting better, but it's not getting worse either
  - Eventually we'll run out of people new to technology
- There is enough money invested
  - No shortage of infrastructure
- No viable alternative
  - Only voice services have more coverage and going back to pay-per-minute is not feasible

The challenges of peer-to-peer

- Quality of Service
  - Peer-to-peer consumes all available access bandwidth unless the user sets limits in the application
    - For real-time guarantees, investments must be made
    - Home-made connection sharing gets more challenging
- Traffic balance
  - Traffic “upstream” towards the network increases
  - If upstream is limited, transit traffic increases

History repeats itself

- McGill University, which hosted the first Archie, found out one day that half the Internet traffic going into Canada from the United States was accessing Archie. Administrators were concerned that the University was subsidizing such a volume of traffic, and closed down Archie to outside access.

P2P futures

- Self-organizing p2p networks are very good on achieving local data availability for high-demand content
- P2P does not generate added value as-is because demand is scattered and official content is usually distributed hierarchically by the content provider
  - P2P client data will go by large servers anyway
  - Most connections are asymmetric so they are not optimal for providing content
- P2P continues both to fuel traffic growth and be felt as a problem by most of the ISPs

IPv6

- Major backbone networks will deploy v6 when it makes economic sense for them to do so. Right now, there is no demand and no revenue upside.
- Don't expect this to change in the near future.
- V6 is, currently, a solution in search of a problem. v4 space is being consumed slowly, but we are quite some time from a crisis. Of course, even when we "consume" all such ipv4 space, there are still expedients that can be used, including making v4 assets tradable and fungible.

Agents 'R' US

- The Internet traffic growth will continue to be fueled by machine-to-machine communications
- There will be agent programs to “download” and browse through user's interest
- The amount of machine-readable content on the Internet will increase and see the upslope of a S-curve soon
  - Modeled after old approaches:
    - “I might buy a car in 6 months”
    - “This is my grocery list”
    - “My flight is late, hold my rental car”
- Dynamic information dispersal (federated trust)

Future outlook

- For foreseeable future the Internet traffic will grow at an average 100% annual rate
- Media convergence can bring a jump upwards
  - Network-based digital television
- Charging models can bring a fall
  - Unlikely that currently predominant and successful models will change
- Mobile traffic is insignificant compared to wired networks
- Trust issues will continue to be issues

Question time

Questions, Suggestions, Concerns?
Ask away!
(now or later)

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