

*None of us really knew
what we were doing,
we just made it up as
we went along.*

(Part 2 – You were threatened with this)

*A further wander down
memory lane stopping off at
the UK Internet in 1998
(give or take a bit)*

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*UKNOF37
Manchester
20 April 2017*



Previously at UKNOF34

What did the ISPs of the day offer?

Leased Lines – Older PoPs had Cisco AGS+ routers with about 25 serial ports each, one per X.21 connection.

How did they do it?

Whose kit did they use?

Did it even work?



New and improved for this year:

Infrastructure!

How the LINX scaled to 1G.

The important buildings of the day.

The headaches...

But a small aside before that...

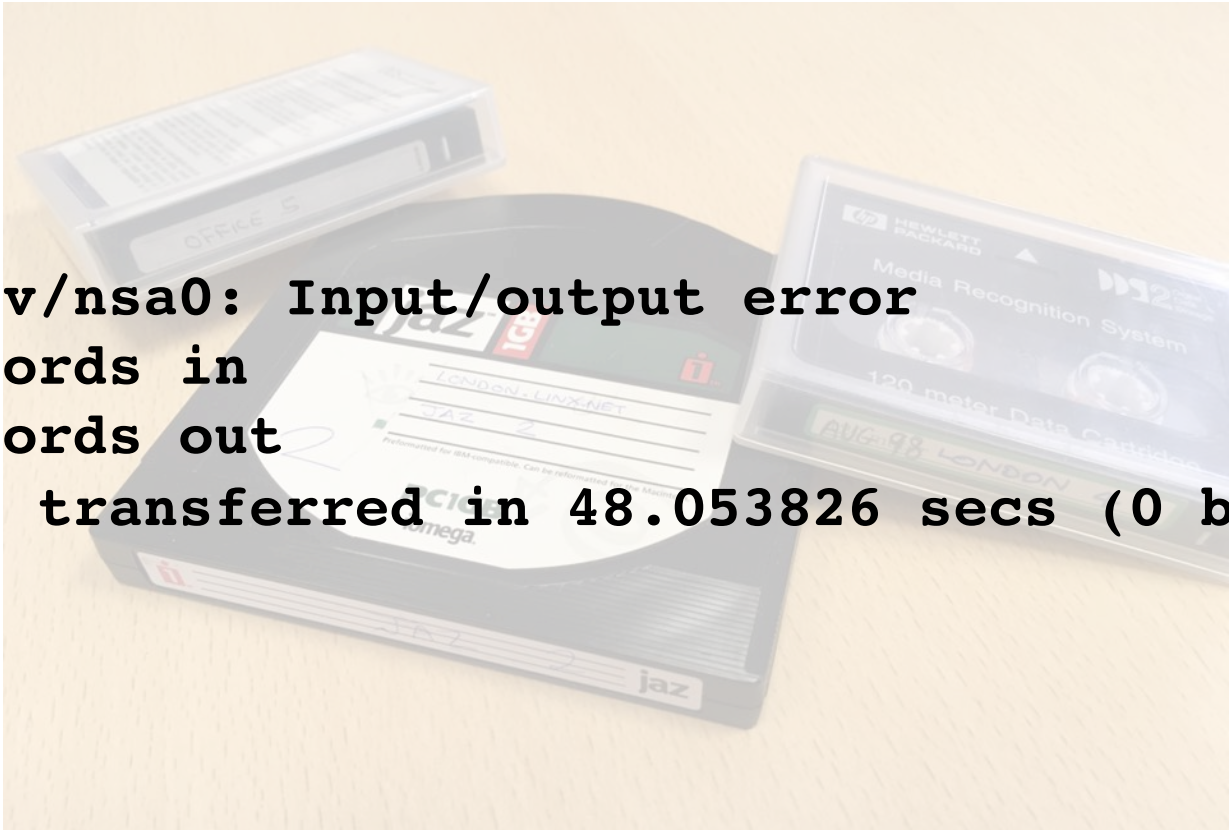
Digital archaeology is hard ☹



But a small aside before that...

Digital archaeology is **hard** ☹

```
dd: /dev/nsa0: Input/output error
0+0 records in
0+0 records out
0 bytes transferred in 48.053826 secs (0 bytes/sec)
```



“There is no sensible way that the LINX can grow to much more than around 100 members.”

Paul Thornton (1998)

Lets put this into perspective: Thomas Watson from IBM said there was a market for maybe 5 computers worldwide!

Interconnection

Exchange points were few and far between.

MAE-EAST and MAE-WEST in US.

NetNod, LINX and AMS-IX the only choices in Europe.

Everything was expensive!

LINUX in 1998

Present in Telehouse North only.

7 switches interconnected with 100M FDDI:

2x Catalyst 5000

2x Plaintree 4800

3x Catalyst 1200

These switches were 10/100 + FDDI.

LINUX in 1998



the North only.

connected with 100M FDDI:

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3x Catalyst 1200

These switches were 10/100 + FDDI.

LINX in 1998



2x Plannet 4800

3x Catalyst 1200

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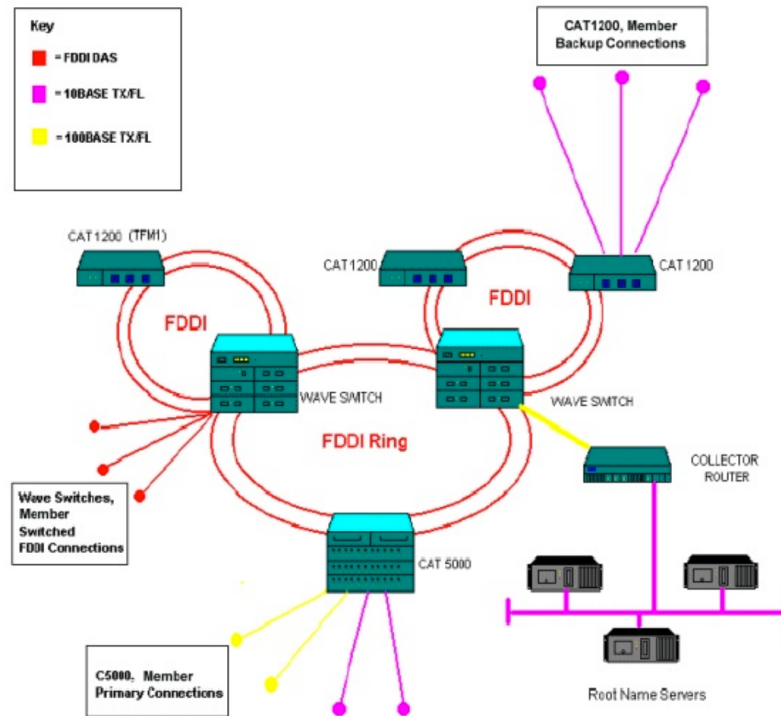
LINUX in 1998



LINX in 1998



Old LINX Topology



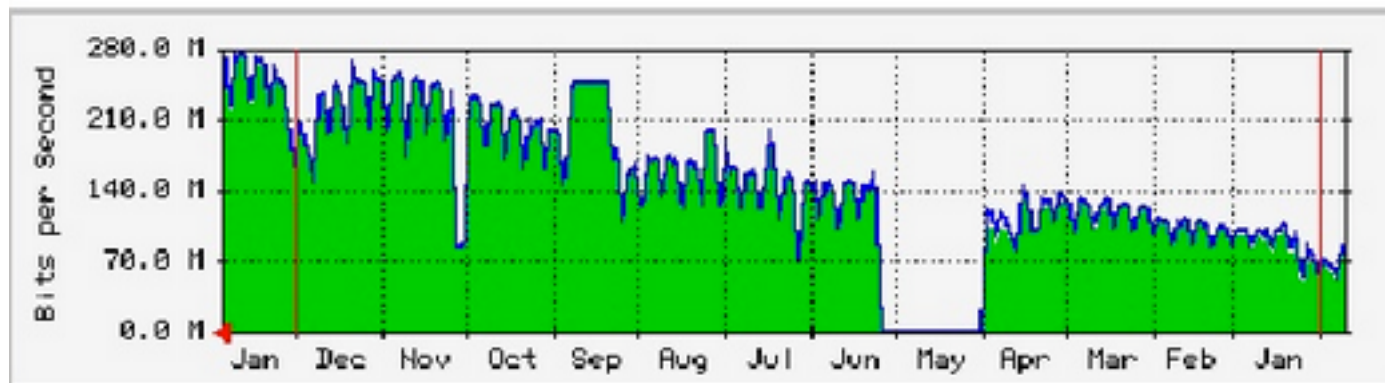
*Shamelessly
borrowed
from Keith's
NANOG15
presentation*

<http://www.linx.net/>

LINUX in 1998

53 members (October)

300Mbit/sec average traffic, 400Mbit/sec peak.



9,000 routes out of a global table of 55,000

LINUX in 1998

LINUX joining process was convoluted, and somewhat counter-productive. Contained the infamous “Three Traceroutes” requirement.

Excluded content providers and smaller ISPs.

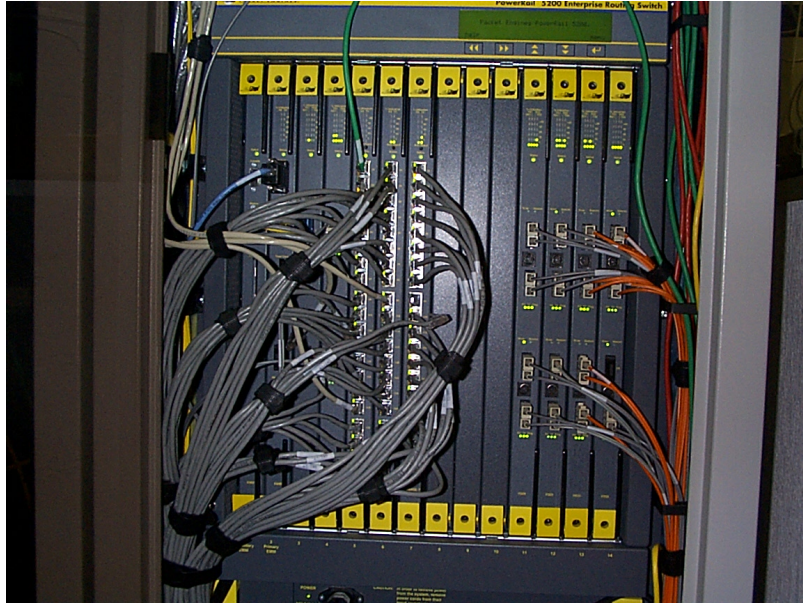
Led directly to formation of LoNAP.

LINUX upgrade to 1G

100M FDDI interconnect too limiting, and members were asking about 1G connections.

New LINUX topology involved 1G capable switches – Packet Engines PowerRail and Extreme Summit series.

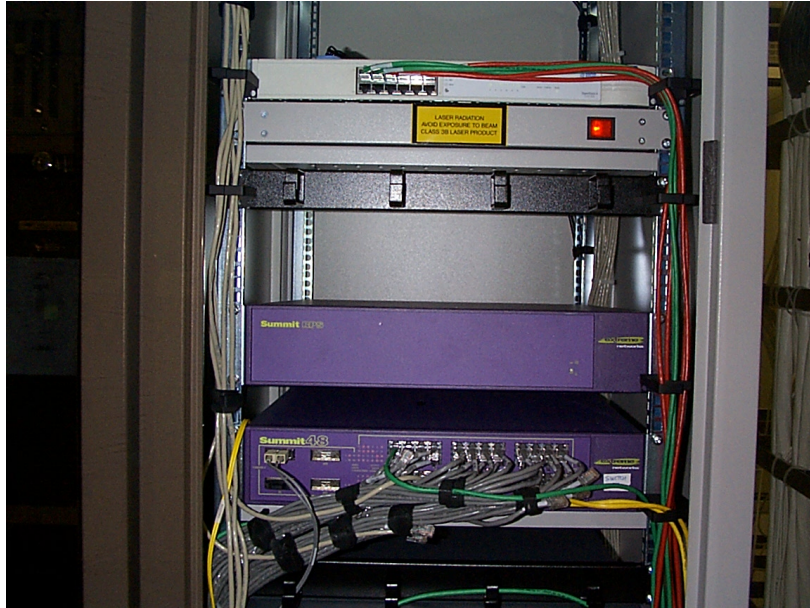
LINX upgrade to 1G



This was the first PR5200 switch at LINX – mixture of 10/100, 1G and FDDI ports.

Shortly afterwards, Packet Engines acquired by Alcatel.

LINX upgrade to 1G



Extreme are still going strong and still have a presence at LINX.

This particular Summit 48 was the first Extreme switch added into the LINX LAN.

LINUX upgrade to 1G

FDDI had inherent protection, but gig-E didn't – we had much debate about the merits of STP.

This was one of the occasions where Keith and I had a 'full and frank exchanges of technical viewpoints'!

These normally resulted in a good architectural compromise though.

LINUX upgrade to 1G

I remember the initial migration well. It wasn't a fantastic success.

The first weekend of November: long nights and packet-loss filled days – a number of issues with LINUX network and member connections.

The maintenance work and subsequent downtime made the UK national press...

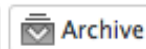
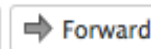
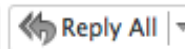
LINUX upgrade to 1G

... but not the tech newsletter of the day.

From Paul Thornton <prt@prt.org> ★

Subject Woo Hoo!

To staff@linux.net★



06/11/1998 23:16

I don't know whether to laugh or cry... I break half the country for twelve hours and it doesn't even make Need To Know 😊

--

Paul

-- Paul Thornton, 2 Durnford Way, Cambridge, CB4 2DP, UK. +44 1223 575384 ==

LINUX upgrade to 1G

This underlined a bit of a recurring theme.

Switch vendors didn't understand the load that IXPs placed on their equipment.

LAN-centric flow expected: Servers to lots of lower speed clients. Meshy nature of IXPs quickly shows up shortcomings.

Addressing challenges

LINX originally had a /23 of IPv4 PI space

This was soon deemed to be much too small.

So we became a RIPE LIR and acquired a /19 of PA space.

Which was duly carved up, and the peering LAN renumbered...

Addressing challenges

New LINX address space allocation.

8 May 1998 prt.

THIS FILE OBSOLETEs *ANY* EARLIER 195.66.224/19 ALLOCATION FILE!

Network	RIPE?	Use?
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195.66.224.0/23	Y	London Peering LAN (netname: LINX-PEER-1)
195.66.226.0/23		Reserved for overflow

195.66.228.0/24		Reserved for second peering LAN
195.66.229.0/24		Reserved for second peering LAN
195.66.230.0/24		
195.66.231.0/24		

195.66.232.0/24	Y	LINX 'dot org' kit - ie: friendly, inside firewall. (LINX-INT-1)
195.66.233.0/24		Reserved to expand LINX 'dot org' kit.
195.66.234.0/24		
195.66.235.0/24		

Addressing challenges

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195.66.235.0/24
```

*The peering LANs had a /21 reserved for them from day one.
It wasn't my fault you had to renumber again after all.*

Key Infrastructure

LINX also hosted the original *k.root-servers.net* machines for the RIPE NCC.



Key Infrastructure

And the .UK primary nameserver, *ns0.nic.uk* for Nominet.



Key Infrastructure

DNS traffic was interesting.

Levels were quite low (average of 2Mbit/sec out from k.root, and 150Kbit/sec out from ns0.nic.uk in November 1998).

Looking at queries / responses (for operational reasons, of course) was enlightening.

Key Infrastructure

Snapshot of 100K queries every 10 mins in August 1998 to k.root yielded the following averages over an hour:

19% of requests led to an NXDOMAIN – mostly due to queries for things like 'WORKGROUP.' from Windows machines.

6% of queries originated from RFC1918 space.

LINUX has left the building

LINUX also built a PoP in the new Redbus Interhouse building on Millharbour, now known as ~~Telecity LON1~~ ~~Equinix LD~~ Digital Realty LHR19

Dark fibre between there and Telehouse North.

LINUX and AMS-IX both went multi-site at about the same time.

Speaking of DCs...

The London scene was thin:

Telehouse North (of course) – but still a lot of DR DR space.

Telehouse Metro recently opened (1997) in City.

Redbus Interhouse Millharbour (1998).

Speaking of DCs...

And there wasn't much elsewhere either...

Manchester – original Telecity Williams House

Some other provider-specific facilities, but still thought of more as single-occupancy 'computer centres' than a datacentre as we'd consider it today.

Connectivity Technology

Ethernet had yet to win the “use me for everything” race.

ATM, frame relay, PoS used for WANs.

Typical speeds still 155M / 622M for backbones. 2M down for customers.

Connectivity Technology

Even on the LAN, Ethernet/IP wasn't a given.

FDDI / Token Ring still very much in use for physical communication – but expensive.

IPX / Appletalk were still protocols of choice.

And finally...

There were the light-hearted moments.

Paul's tip to IXPs:

A sure-fire way to stop people from transmitting MoU violating frames on the peering LAN is to run a live *tcpdump* on the projector in the background whilst presenting at a member meeting.

And finally...

One member who shall remain nameless, and didn't remain a member long afterwards, was caught with GRE tunnels to the US over other members' connections.

Claimed I'd plugged a Cat5 cable into the wrong port on their router to cause this, and issued a press release explaining how the packets therefore went the wrong way!

And finally...

LINX hosted RIPE31 in Edinburgh.

The connectivity was provided by LINX, via a GRE tunnel across JANET. Routing used BGP and carried a full table.

The next-hop to the neighbor address in London was learned via the BGP peering session with it. The router had an existential crisis if restarted.

And finally...

One enterprising startup tried to capitalize on both the Telehouse and LINX name, causing consternation to both; and the engagement of lawyers on all sides.

telelinks

And finally...

Luckily for both parties, PSINet came along and bought them out - both the name and the problem went away.

That project is a story for another year though...

telelinks

Any Questions?

This series of presentations, diagrams, router configurations and other tidbits I managed to locate can be found at:

<http://www.prt.org/history>



I know that the LINX marketing department simply adore the 1997-era logo.

Thank you



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*UKNOF37
Manchester
20 April 2017*

