



Zen Internet

Building For Ultrafast

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Technical Architect

Zen Internet

About Zen



OVER
110K
BROADBAND
CONNECTIONS

450
WHOLESALE
& CHANNEL
PARTNERS

INDEPENDENT
PRIVATELY
OWNED ISP
1995
ESTABLISHED

25
EMPLOYEES
1999

OVER
10K
CUSTOMERS
2002

MOVED TO
SANDBROOK
HOUSE
2008

£3.5M
NETWORK
INVESTMENT
2013

£4M
NETWORK
INVESTMENT
2016

2017



2001
PARTNER
PROGRAMME
LAUNCHED

FY 15/16
£57M
TURNOVER

ISP Network Capacity 101



What our customers think we should do



What our FD thinks we should do

ISP Network Capacity 101



What our customers think we should do



What our FD thinks we should do



What the engineering team think we should do

ISP Network Capacity 101



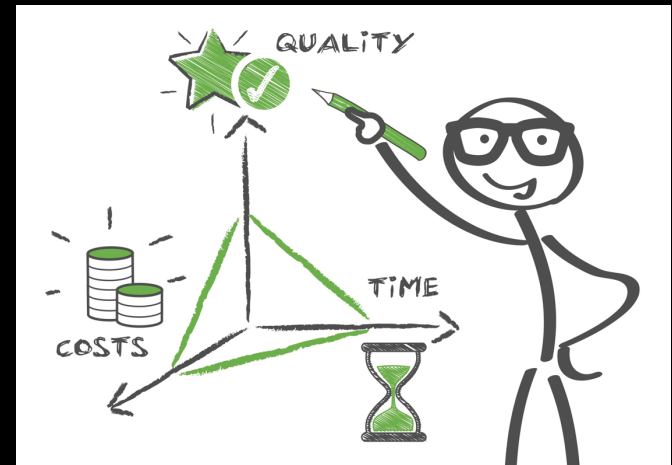
What our customers think we should do



What our FD thinks we should do



What the engineering team think we should do



What we actually do

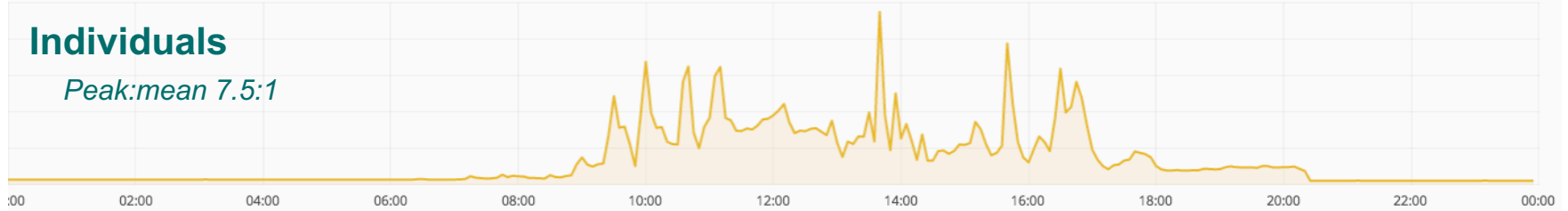
Managing Capacity

1. Know Your Users



Individuals

Peak:mean 7.5:1



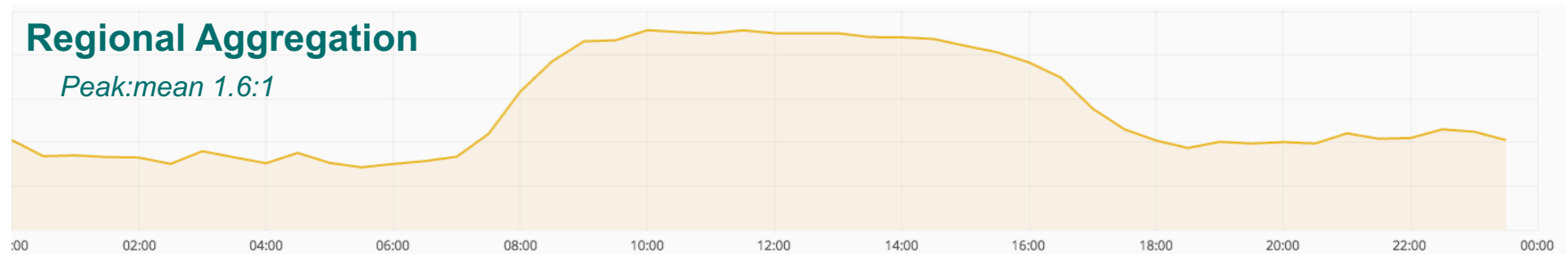
Local Exchange

Peak:mean 4:1



Regional Aggregation

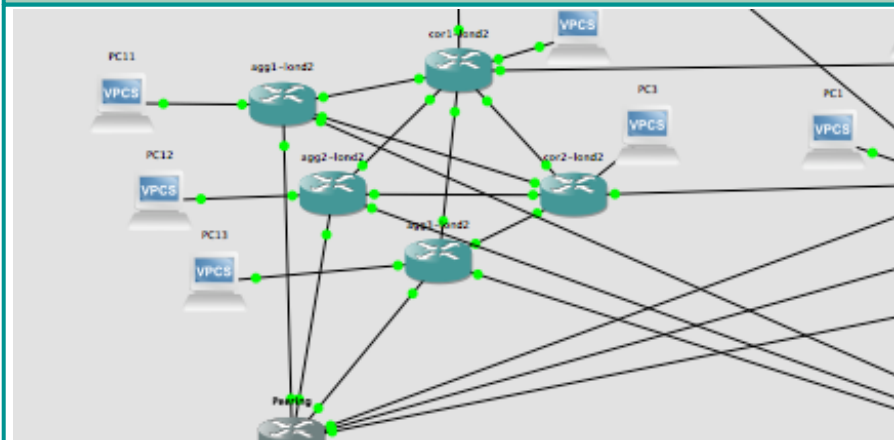
Peak:mean 1.6:1



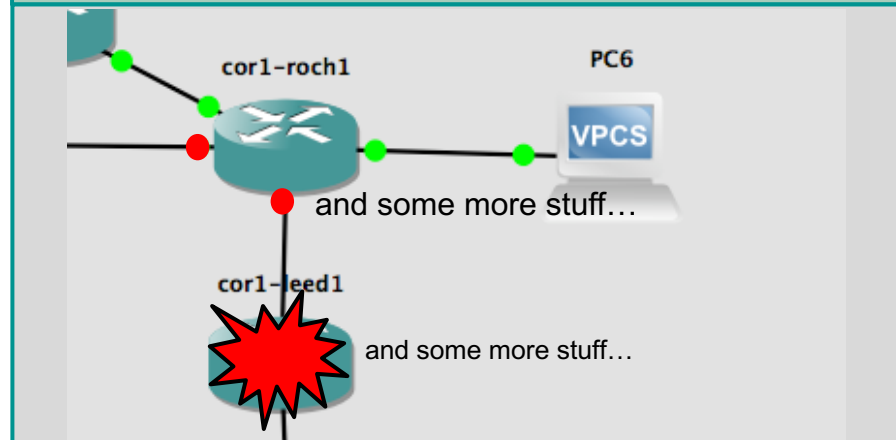
Managing Capacity

2. Know Your Failures

Step 1. Model your network



Step 2. Break some stuff



Step 3. Record how it broke

	A	B	C	D	E	F	G	H
Source ID	Sink ID	a1l1-c1l1	a1l1-c2l1	a2l1-c1l1	a2l1-c2l1	a3l1-c1l1	a3l1-c2l1	
a1l1	a2l2	0.5	0.5	0.5	0.5	0	0	
a1l1	a3l1	0.5	0.5	0	0	0.5	0	
a1l1	a1l2	0.5	0.5	0	0	0	0	
a1l1	a2l2	0.5	0.5	0	0	0	0	
a1l1	a2l2	0.5	0.5	0	0	0	0	
a1l1	c1l1	1	0	0	0	0	0	
a1l1	c2l1	0	1	0	0	0	0	
a1l1	c1l2	1	0	0	0	0	0	
a1l1	c2l2	0	1	0	0	0	0	

Step 4. Find your high watermarks

Link	Traffic coefficient	Triggered by
a1l1-c1l1	0.41	L2
a1l1-c2l1	0.37	L2
a2l1-c1l1	0.43	L2

More details coming soon at <https://engineering.zen.co.uk/>

Managing Capacity

3. Predict The Future

Internet Users: % of Population	Devices and Connections per Capita	Average Speeds	Average Traffic per Capita per Month
86% (2015) → 93% (2020)	5.7 (2015) → 9.9 (2020)	24.7 Mbps (2015) → 51.3 Mbps (2020)	45.0 GB (2015) → 113.3 GB (2020)

Source: Cisco VNI <http://www.cisco.com/c/en/us/solutions/service-provider/visual-networking-index-vni/index.html>

Mar-2015

+80% year on year growth

Mar-2016

Mar-2017

Mar-2018



Future bandwidth = Subscriber growth * Peak avg growth * Fudge factors

QUALITY



TIME



COSTS

Peak average demand

QUALITY



TIME



Vendor reality distortion

Design inefficiencies

Peak average demand

COSTS



QUALITY



TIME

Vendor reality distortion

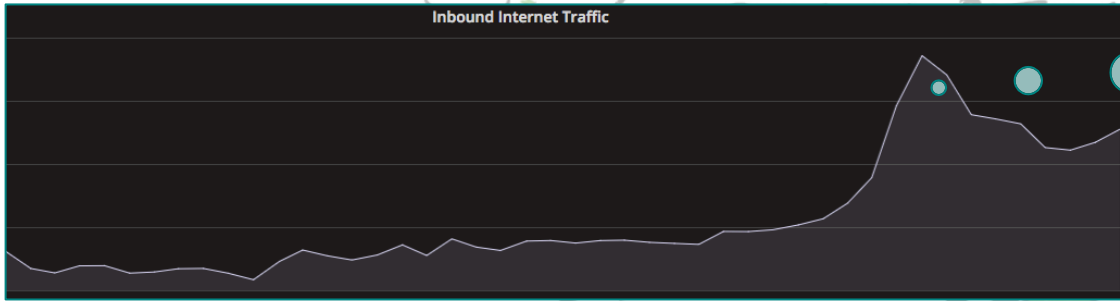
Design inefficiencies

Peak average demand

Resiliency

COSTS





4.5mbit here

Exceptional peaks

Peak max demand

Vendor reality distortion

Design inefficiencies

Peak average demand

Resiliency

COSTS

1mbit here

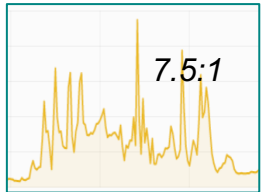
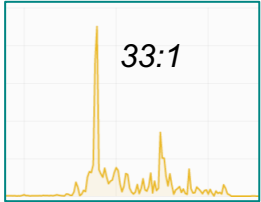


QUALITY

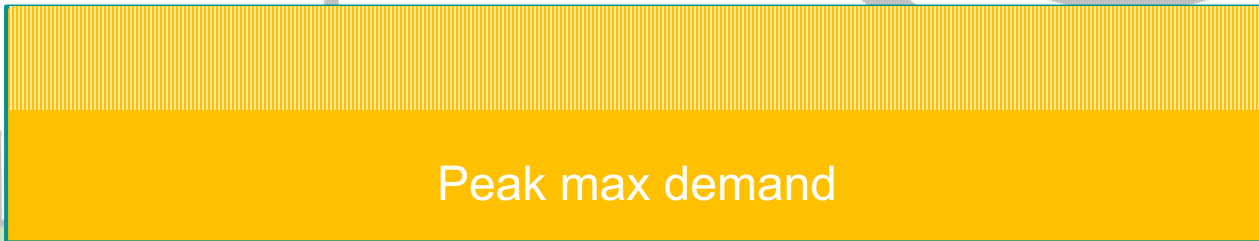
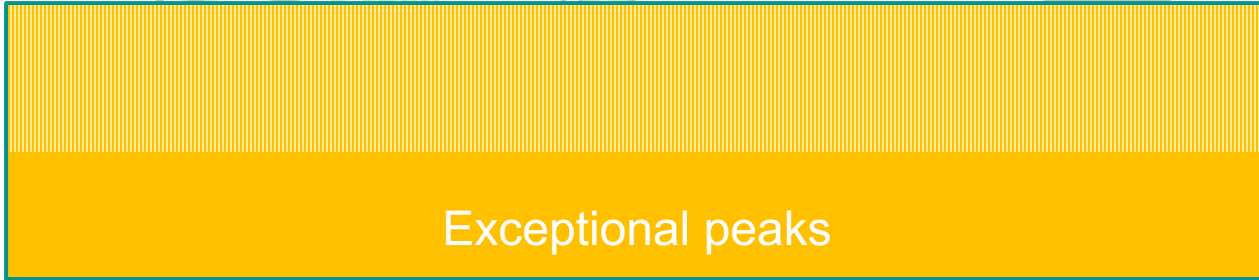
4.5mbit
7mbit here



FTTP 330/30



FTTC 80/20



Vendor reality distortion

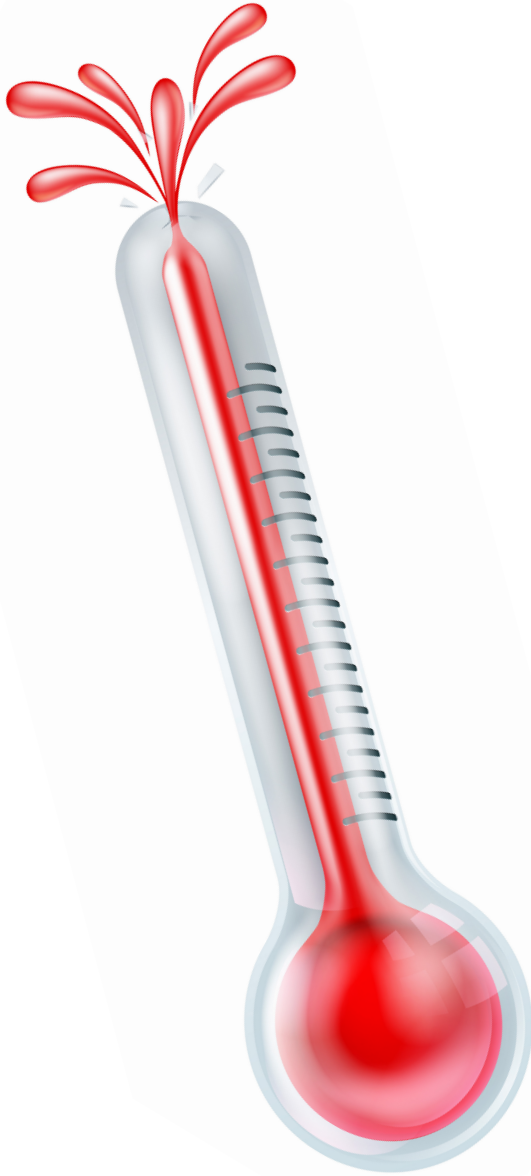
Design inefficiencies

Peak average demand

Resiliency

COSTS

1mbit here



Oops, We Broke The Network!



A £4M investment to meet the growing needs of our customers:

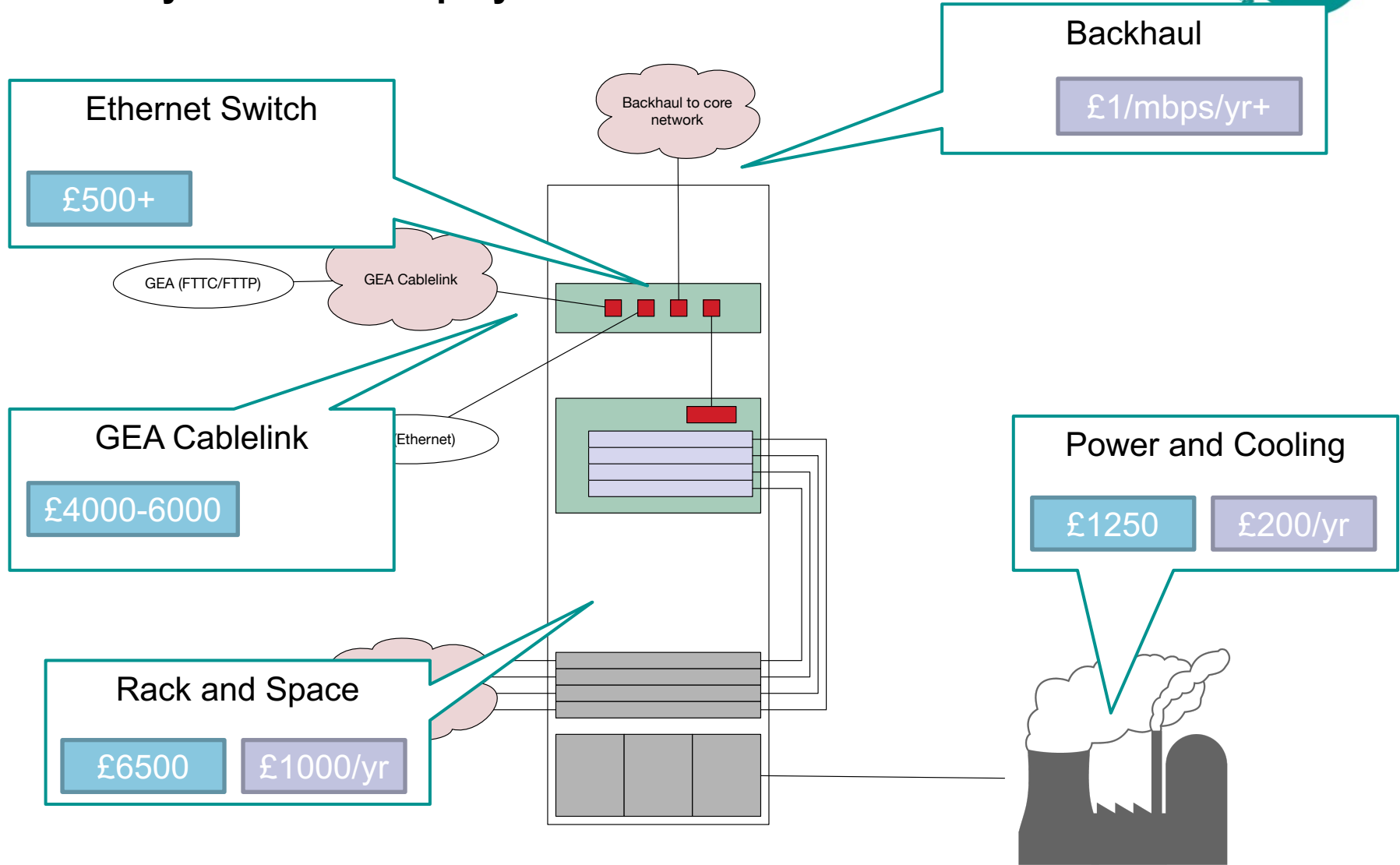
- Expand and refresh our LLU footprint
 - 201 → 400 exchanges
 - Deeper integration with Openreach
 - Support service quality improvements, greater operational ownership
 - Cost savings

Refresh our core network technology

- Significant scaling challenges ahead
- 40G/slot generation kit becoming long in the tooth
- 21 years of accumulated legacy awesome

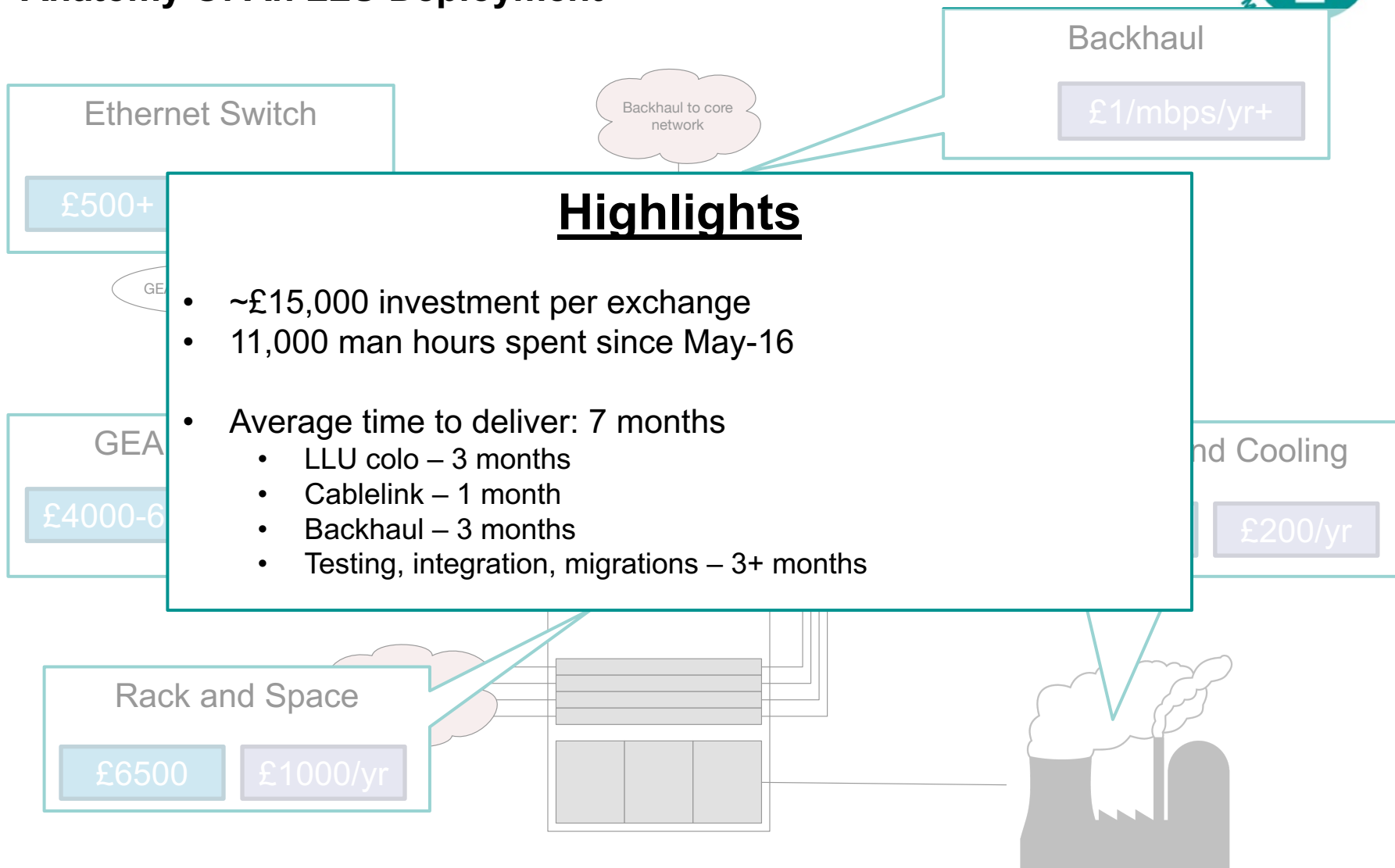
LLU Expansion

Anatomy Of An LLU Deployment



LLU Expansion

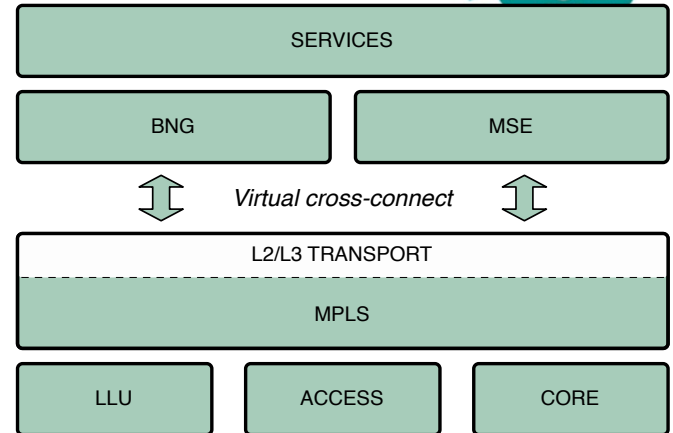
Anatomy Of An LLU Deployment



Core Network Refresh

What Did We Build?

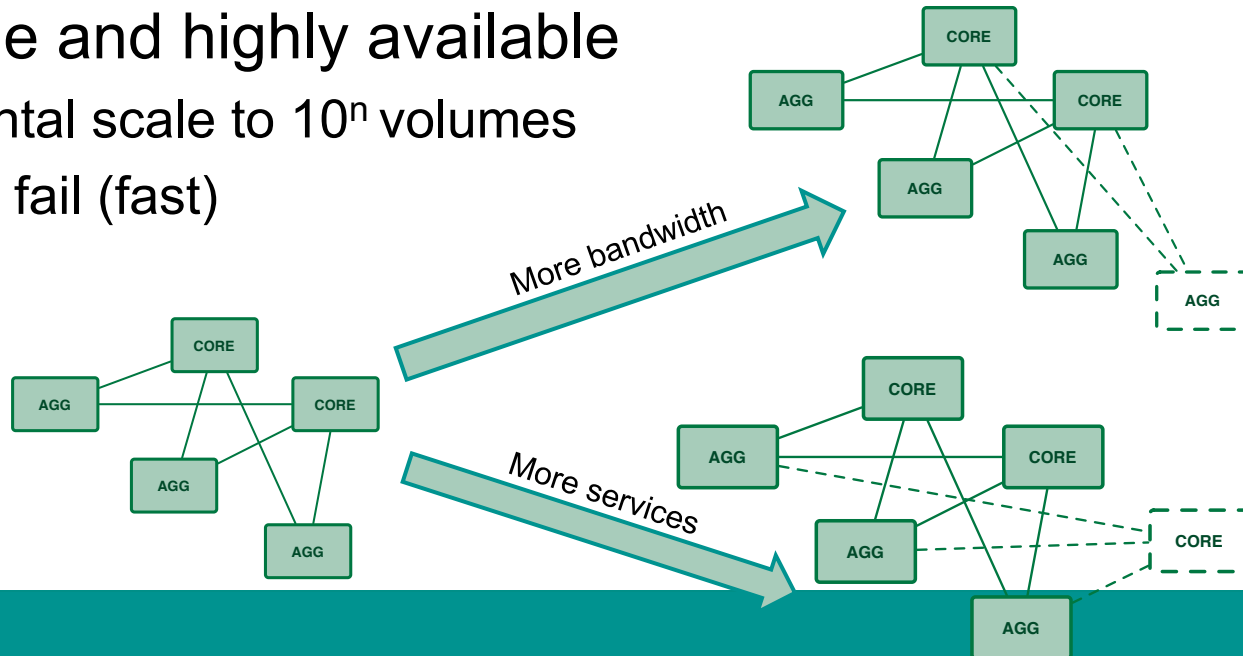
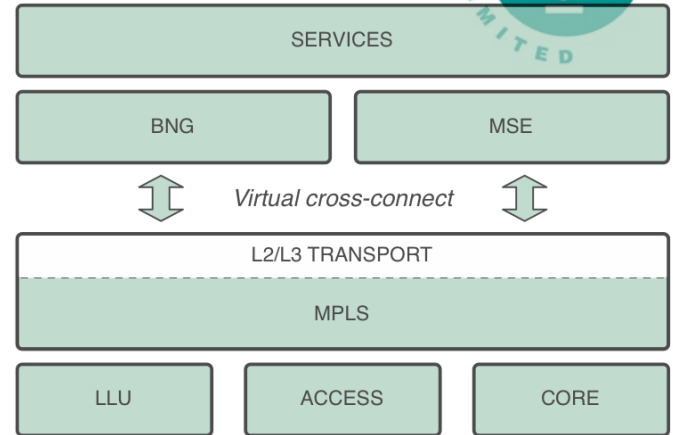
- Completely virtualised network
 - MPLS end to end
 - Decoupled service and transport layer
 - Modular approach



Core Network Refresh

What Did We Build?

- Completely virtualised network
 - MPLS end to end
 - Decoupled service and transport layer
 - Modular approach
- Scalable and highly available
 - Horizontal scale to 10^n volumes
 - Built to fail (fast)



The 5th Largest LLU Operator In The UK

- 400 unbundled exchanges
- 7.9M properties passed
- 110k DSL/FTTx tails
- 770G GEA capacity
- 500G LLU backhaul capacity
- 2.7T core network capacity



Core Network Refresh Reflections



Right size your choices

TRENDS 2016

- Satellite switches
- Custom silicon
- Unified OS/HW
- 200G~800G scale

It's not (just) about the technology

Name/ID	Tx Port Name	Rx Port Names	Tx Count (Frames)	Rx Count (Frames)	In-order Rate (fps)	Dropped Count (Frames)
1-test-1-1/65686	Port //5/1	Port //...	19,984,882	19,992,589	49,952	0
1-test-2500-1/65688	Port //5/1	Port //...	19,984,882	19,990,586	49,952	2,002
1-test-1-2/131222	Port //5/2	Port //...	19,978,699	19,994,949	49,954	0
1-test-2500-2/131224	Port //5/2	Port //...	19,978,699	19,915,179	49,954	79,771
1-1-test-1800-1/655...	Port //5/1	Port //...	19,984,882	19,992,596	49,953	0
1-1-test-1800-2/131...	Port //5/2	Port //...	19,978,700	19,994,947	49,954	0

Test, test, and test again
(and find someone who will support you with that)

Observations



TalkTalk BT who

Right size your choices

*Not to scale



It's not (just)
about the
technology

We believe that CSR principles should be embedded, wherever appropriate, into policies and practices throughout our business. We are determined to be a good neighbour and work together with our employees, our customers, our suppliers and the community around us to ensure that any impact we make on the world is for the better.

Happy Staff

Read about our Happy Staff ethos

[Find out more](#)

Happy Customers

We are committed to customer service

[Find out more](#)

Happy Suppliers

We like to work closely with our suppliers

[Find out more](#)



Test, test, and test again
(and find someone who will support you with that)

And Now For The Hard Sell...



- One of the largest and most sophisticated networks in the UK
- Metered and unmetered, managed and layer 2 wholesale ADSL/FTTC/G.Fast/FTTP offerings
- Committed to ultrafast broadband since 2012 launch
- Thoroughly nice people 😊



Thankyou