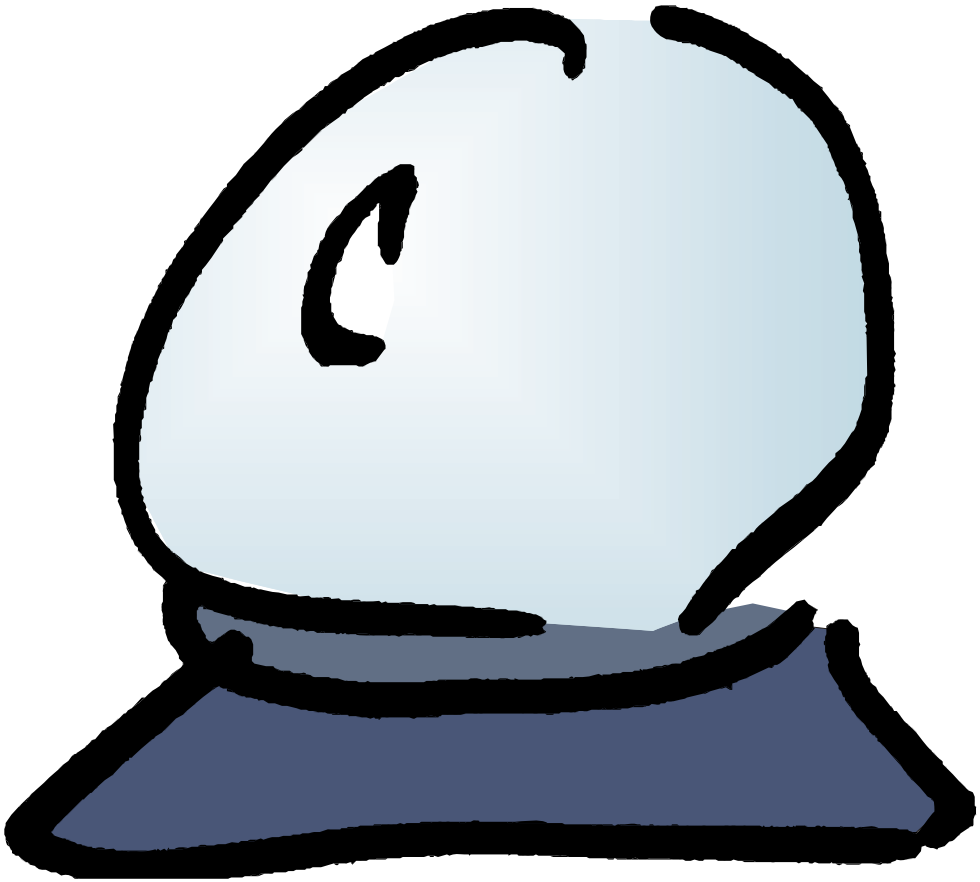
Internet Futures



Acknowledgement to Anders Rockstrom of Telia Sonera, whose presentation on this topic had a profound impact on me – he presented his arguments so clearly and simply it was just an irresistible message.

Thanks Anders!

Geoff

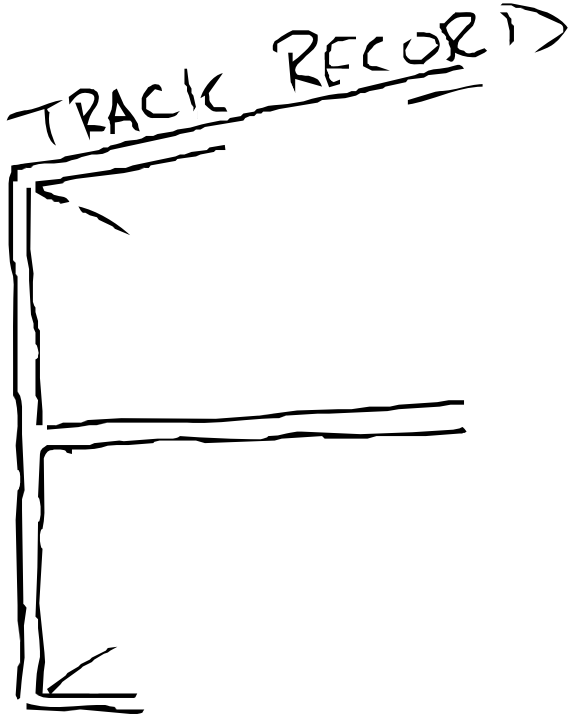
purpose:

share some thoughts about the Internet and its future

think about some of the major factors that will shape our future

why

The mainstream telecommunications industry has a rich history



why

The mainstream telecommunications industry has a rich history

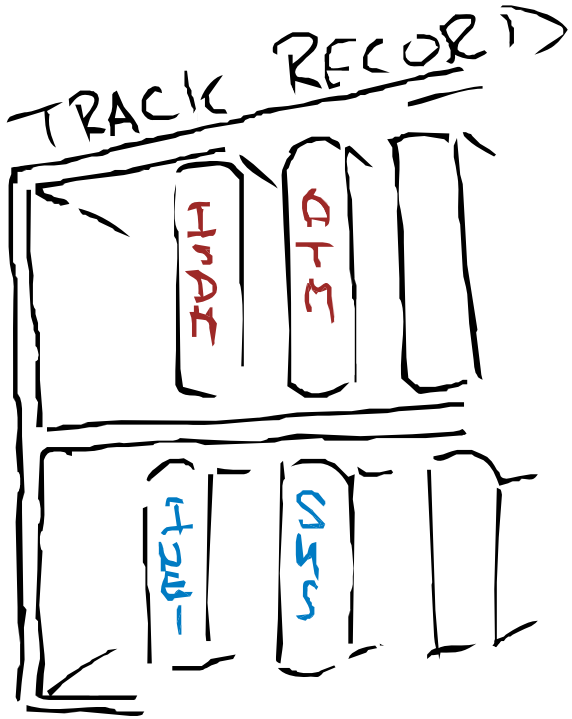
…of making very poor technology guesses

why

The mainstream telecommunications industry has a rich history

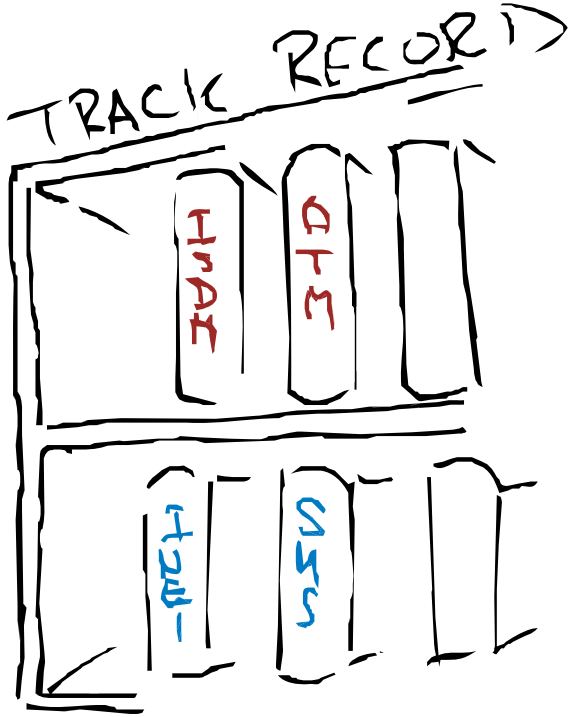
…of making very poor technology guesses

and regularly being taken by surprise!



why

could we do a
better job?



One approach:

1. Observe the situation and what's happening

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3. Understand where this may lead us and what options may be presented on the way

One approach:

1. Observe the situation and what's happening

2. Believe what we see (the most difficult one!)

3. Understand where this may lead us and what options may be presented on the way

What's Happening Today: User Preferences and the Market for Services

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From radio to tv to ?

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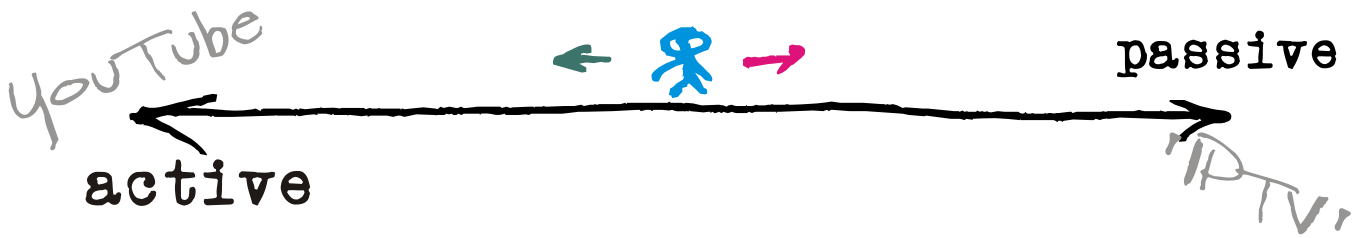


Service Profile Choices

open collaboration framework

open vs walled garden

Bundled services

Service Profile Choices

open collaboration framework — open vs walled garden — Bundled services

role specialization — open delivery infrastructure vs Service / content distribution networks — Vertical integration

Service Profile Choices

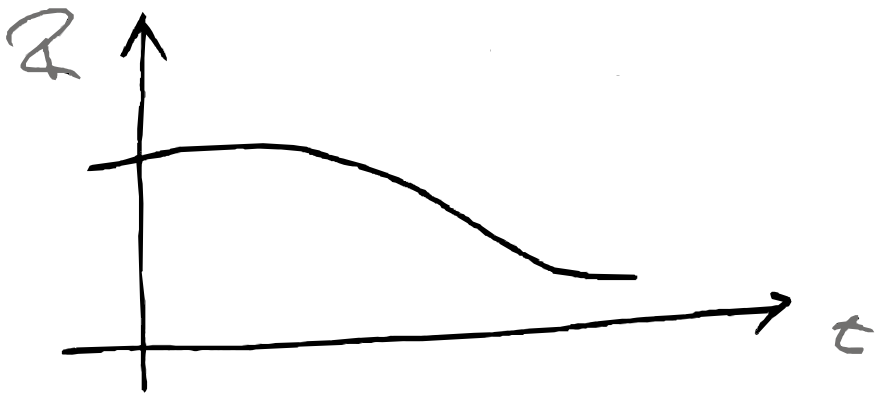
Open collaboration framework	open	vs	walled garden	Bundled services
role specialization	open delivery infrastructure	vs	Service / content distribution networks	Vertical integration
Active user networks	user produced	vs	externally produced	Passive users

What's Happening Today: User Preferences and the Market for Services

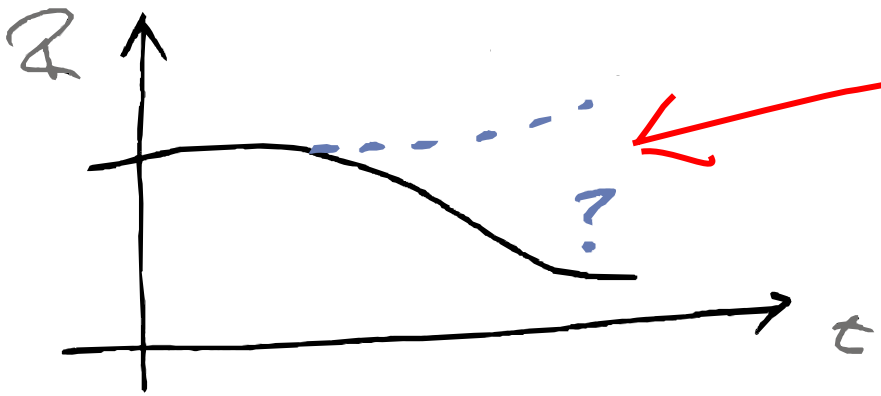
From telephony to chat
to mashups to p2p to ?

From radio to tv to ?

What's Happening Today: Declining Revenue Profile for incumbent telcos



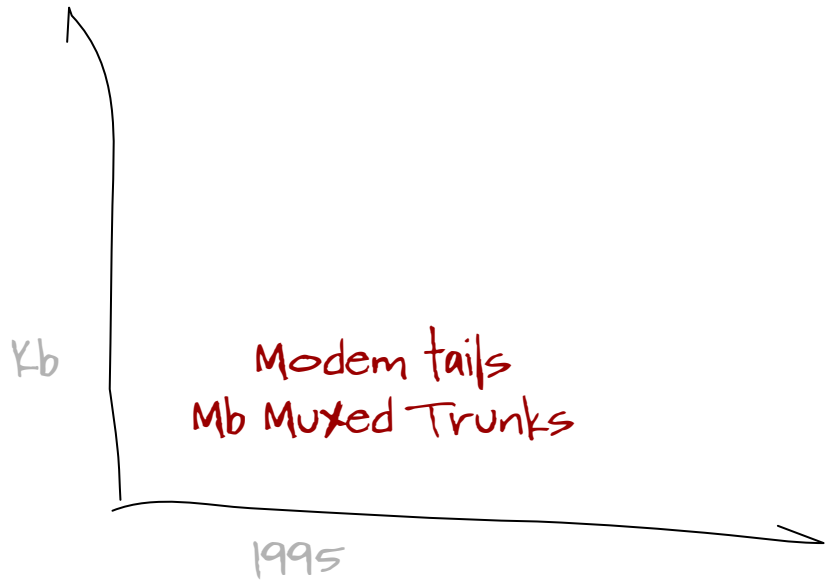
Whats Happening Today: Declining Revenue Profile for incumbent telcos



How to fill the gap of the Internet's revenue leak?

Whats Happening Today: Demand for Bandwidth

what mass market customers want for $25 per month !



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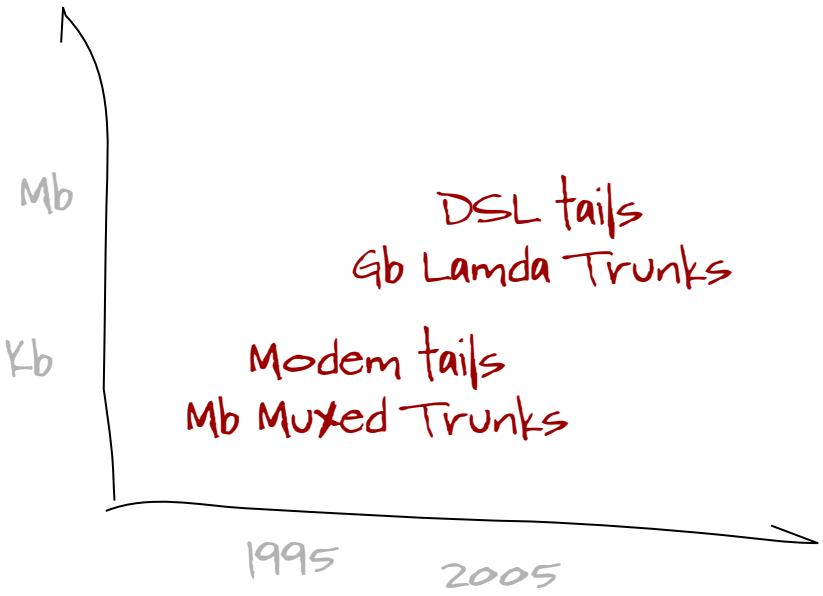

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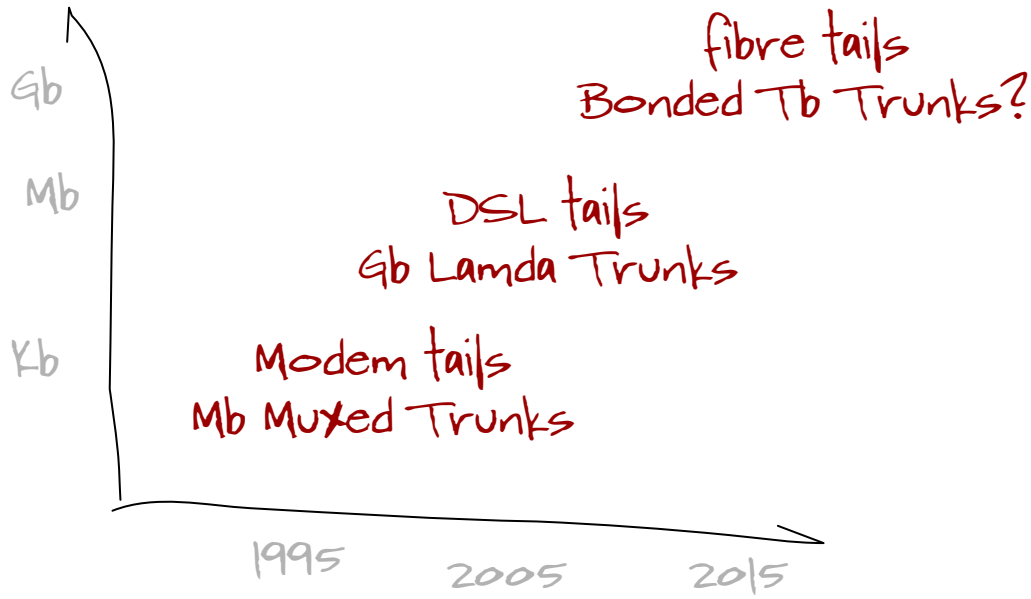
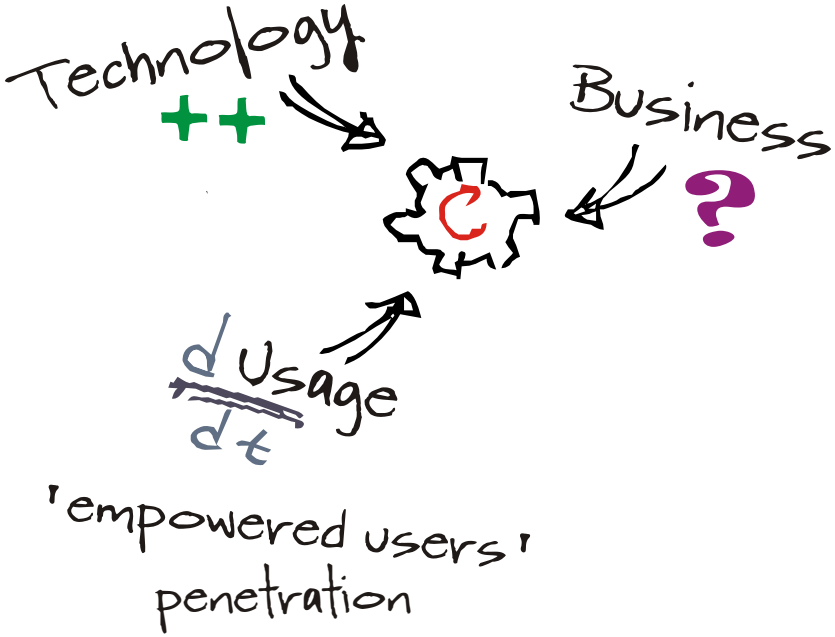


driver dimensions

driver dimensions



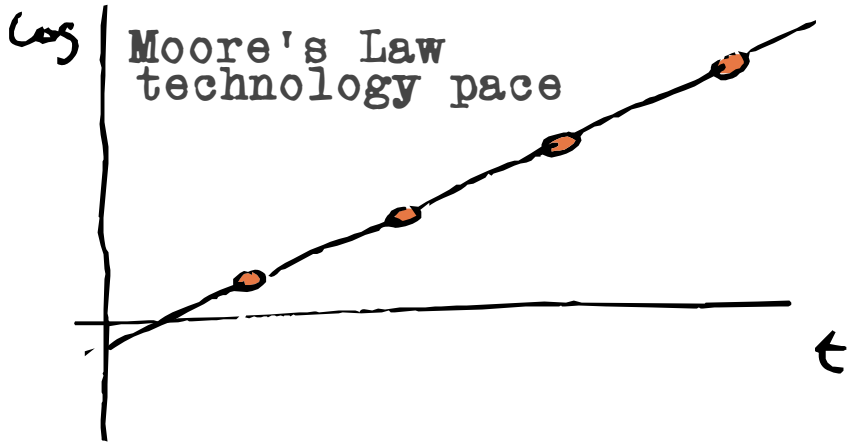
technology

++

surplus

fast refill

enabling windows



technology

++

surplus

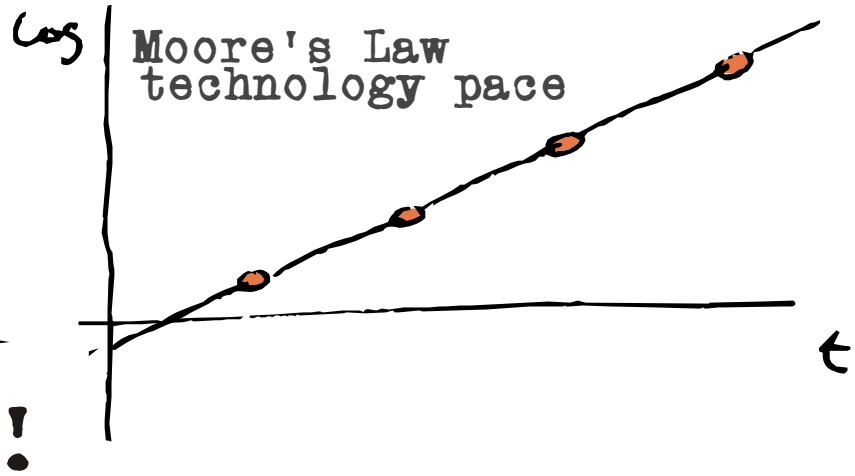
fast refill

enabling windows

---

see it ...

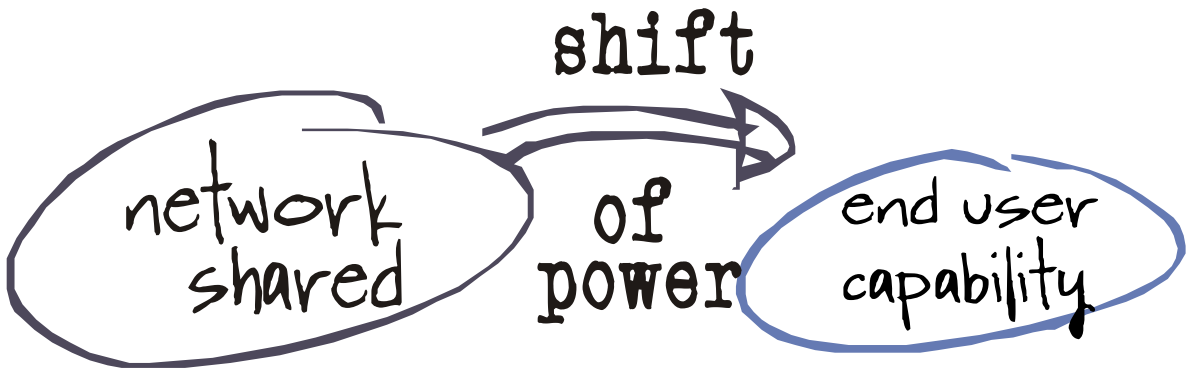
... seize it !



technology

++

technology push and network architecture



technology

new production paradigms

"Over the top"
applications

a 'network—service'
produced outside
of the 'network'

technology

new production paradigms

"Over the top" applications

a 'network—service' produced outside of the 'network'

Content production is a commodity application that users sustain through sharing, rather than a valuable service that is produced externally through dedicated production channels

technology

surplus enables divergence

for

simplicity and performance

technology

surplus enables divergence

for

simplicity and performance

~~QoS~~ ~~IMS~~ ~~Network VPNs~~

technology

surplus enables divergence

for

simplicity and performance

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no need for IP convergence

technology

surplus enables divergence

for

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QoS

IMS

Network VPNs

no need for IP convergence

Web enabled user generated content

facebook

doppler

youtube

wikipedia

technology

surplus enables divergence

for
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~~QoS~~ ~~IMS~~ ~~Network VPNs~~

no need for IP convergence

Web enabled user generated content

facebook
doppler
youtube
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heterogeniety

convergence complemented with divergence

interoperability

when there is a use for it

fuelling the usage growth fire

fuelling the usage growth fire

usage = scaling

$\frac{d}{dt}$ usage

fuelling the usage growth fire

Please send heaps more....

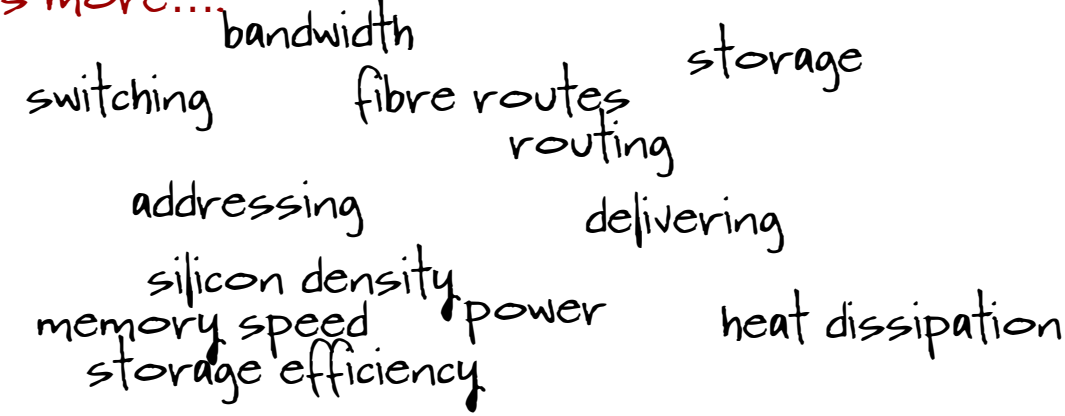
bandwidth
storage
switching
fibre routes
routing
addressing
delivering
silicon density
memory speed
power
heat dissipation
storage efficiency

usage = scaling

$\frac{d\,usage}{dt}$

fuelling the usage growth fire

Please send heaps more....



usage = scaling

But is **bigger** always **cheaper?**

$\frac{d}{dt}$ usage

fuelling the usage growth fire

Please send heaps more....

bandwidth
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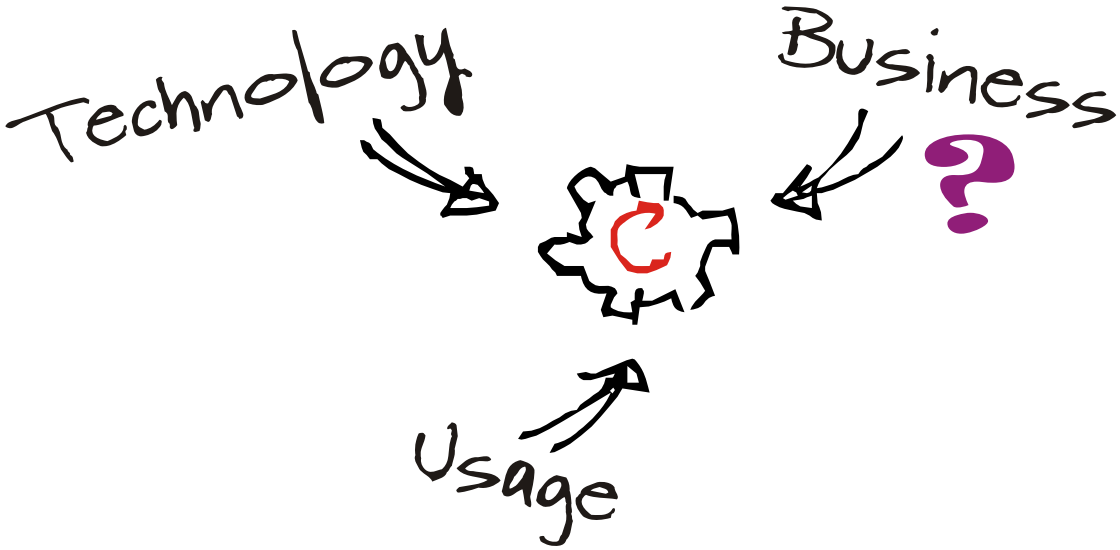
usage = scaling

But is **bigger** always **cheaper**?

and what happens when its not?

Business modelling



..today operators
tend to be very
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convergence

seemlessnet

NGN - . . .

triple play

..today operators tend to be very hype driven ..

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- Everone is talking about it

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triple play

- Everone is talking about it
- Few have actual experience

..today operators tend to be very hype driven ..

convergence

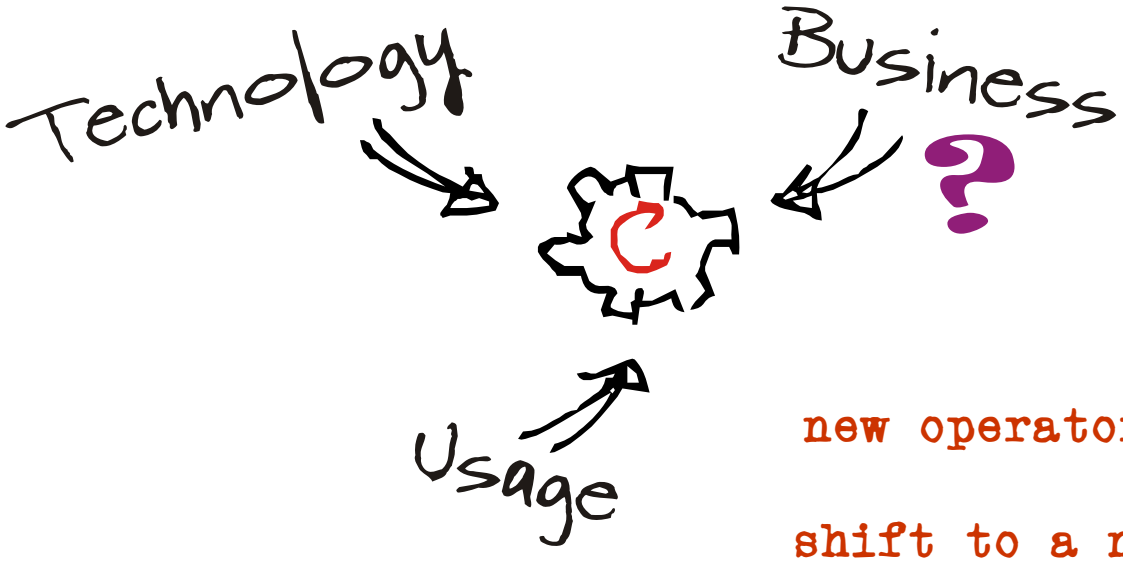
seemlessnet

NGN - . . .

triple play

- Everone is talking about it
- Few have actual experience
- .. and the actual experiences are mostly failures

Business modelling



new operator roles being defined

shift to a new business structure

.. involving users
and other stake-holders

Business modelling

- Packet pushing is a commodity utility activity

Low margins

Low barriers to entry

No product differentiation

Deregulation and competition

Valued services are overlays to the network

Business modelling

- Packet pushing is a commodity utility activity

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Low barriers to entry

No product differentiation

Deregulation and competition

Valued services are overlays to the network

- Traditional revenue streams are vaporizing

Wired telephony

Business data products

Local Access monopolies

Mobile telephony

Business modelling

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Deregulation and competition

Valued services are overlays to the network

- **Traditional revenue streams are vaporizing**

Wired telephony

Business data products

Local Access monopolies

Mobile telephony

- **Investors remain nervous about telcos**

Cost of capital is high

Consumers are fleeing legacy telcos in the face of price gouging

Shareholder returns need to stay high

No residual expertise left in—house

So where are we heading?

My personal view sees the following..

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network

commodity utility
network operation

high capacity
packet pushing

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My personal view sees the following..

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commodity utility
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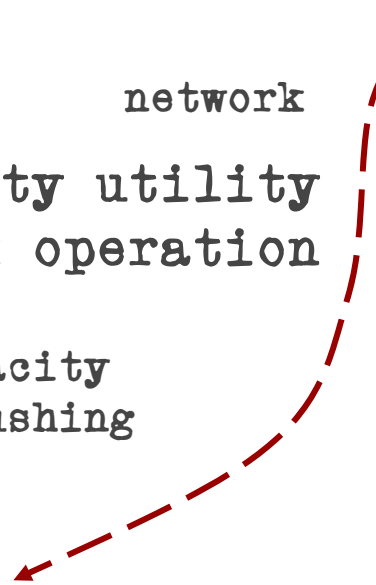
packet pushing

user - drive, production
p2p, content, ..

User-centric applications,
not network-centric services

Value shift up
the protocol stack



So where are we heading?

My personal view sees the following..

network

commodity utility
network operation

high capacity
packet pushing

user - drive, production
p2p, content, ..

User-centric applications,
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Value shift up
the protocol stack

Reinvention:

involving users

new partners

and different business models

Drilling down...

So far this is all rather abstract

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Lets take a more detailed look at some specific technologies

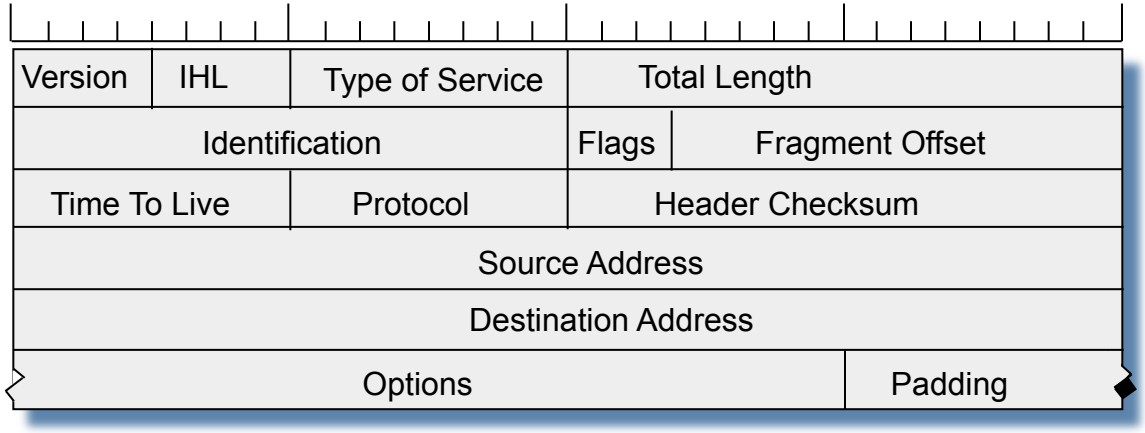
Drilling down...

This is all rather abstract

Lets take a more detailed look at some specific technologies

And bear in mind that the shape of the future can often be found in the mistakes of the past!

IP was just so simple…



Hop-by-Hop stateless forwarding

Datagram transmission

End-To-End data integrity

Decoupled resource management, topology management

What could possibly go wrong?

What's not working…

What's not working…

Multicast

What's not working...

Multicast

MPLS

What's not working...

Multicast

MPLS

Congestion Control

What's not working...

Multicast

Buffering and Queues

MPLS

Congestion Control

What's not working...

Multicast

Buffering and Queues

MPLS

Congestion Control

QoS

What's not working...

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Consistent Speed

What's not working...

Multicast

Buffering and Queues

High Speed

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Consistent Speed

Congestion Control

QoS

What's not working...

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Buffering and Queues

Ultra High Speed

High Speed

MPLS

Congestion Control

Consistent Speed

QoS

What's not working...

Multicast

Delay

Buffering and Queues

Ultra High Speed

High Speed

Consistent Speed

MPLS

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QoS

What's not working...

Multicast

Delay

Buffering and Queues

Ultra High Speed

High Speed

Consistent Speed

MPLS

Congestion Control

QoS

Load Management

What's not working...

Multicast

Delay

Buffering and Queues

Ultra High Speed

High Speed

Consistent Speed

MPLS

Congestion Control

QoS

Routing

Load Management

What's not working...

Multicast

Identity and location overloading

Delay

Buffering and Queues

Ultra High Speed

High Speed

Consistent Speed

MPLS

Routing

Congestion Control

QoS

Load Management

What's not working...

Multicast

Identity and location overloading

Packet quantization and fragmentation

Delay

Buffering and Queues

Ultra High Speed

High Speed

Consistent Speed

MPLS

Routing

Congestion Control

QoS

Load Management

What's not working...

Multicast

Identity and location overloading

Packet quantization and fragmentation

Delay

IPv6

Buffering and Queues

Ultra High Speed

High Speed

Consistent Speed

MPLS

Routing

Congestion Control

QoS

Load Management

What's not working...

Multicast

Identity and location overloading

Packet quantization and fragmentation

Delay

IPv6

Buffering and Queues

Tunnels

Ultra High Speed

MPLS

Routing

High Speed

Congestion Control

Consistent Speed

QoS

Load Management

What's not working...

Multicast

Identity and location overloading

Packet quantization and fragmentation

Delay

IPv6

IPv6 Transition

Tunnels

Buffering and Queues

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Consistent Speed

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Load Management

What's not working...

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Identity and location overloading

Packet quantization and fragmentation

Jitter

Delay

IPv6

IPv6 Transition

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Ultra High Speed

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Load Management

What really needs to work...

Where to from here?

Where to from here?

What 'worked' for the Internet was the shift of control from network to edge

Where to from here?

What's giving us some grief is the overloading of location and identity

What 'worked' for the Internet was the shift of control from network to edge

And if we want to scale further we need to understand flow dynamics and feedback control systems to pack the elephants and mice into the same wavelengths or into the same spectrum frequency

Where to from here?

What's giving us some grief is the overloading of location and identity

What 'worked' for the Internet was the shift of control from network to edge

In thinking about a future Internet

There's no need to clean the slate

There's no need to clean the slate

Nor to forget everything we've learned about packet networks so far

There's no need to clean the slate

Nor to forget everything we've learned about packet networks so far

But we need to think about a future that is way beyond today's Internet

And as we look at the evolution of the technology there are probably two important design principles to bear in mind ...

Focus

Simplicity

a closing thought

I'm probably going to be proved wrong as much as I may be right with these thoughts. There is no certain track of progress here.

Each shift of the Internet's use paradigm through innovation is as much a surprise to the innovator as it is to everyone else

Which is probably a very good thing!