



Scaling the Internet

Harald Tveit Alvestrand

Cisco Fellow, IETF chair

CISCO SYSTEMS



Agenda

- **What is the Internet?**
- **Where are the scaling pains?**
- **Who needs to do something?**
- **What can we do?**

What is the Internet?

Millions of machines, millions of users

Success breeds interest

Interest breeds new applications

New applications breeds growth

The problem

“

Scaling is the ultimate problem.

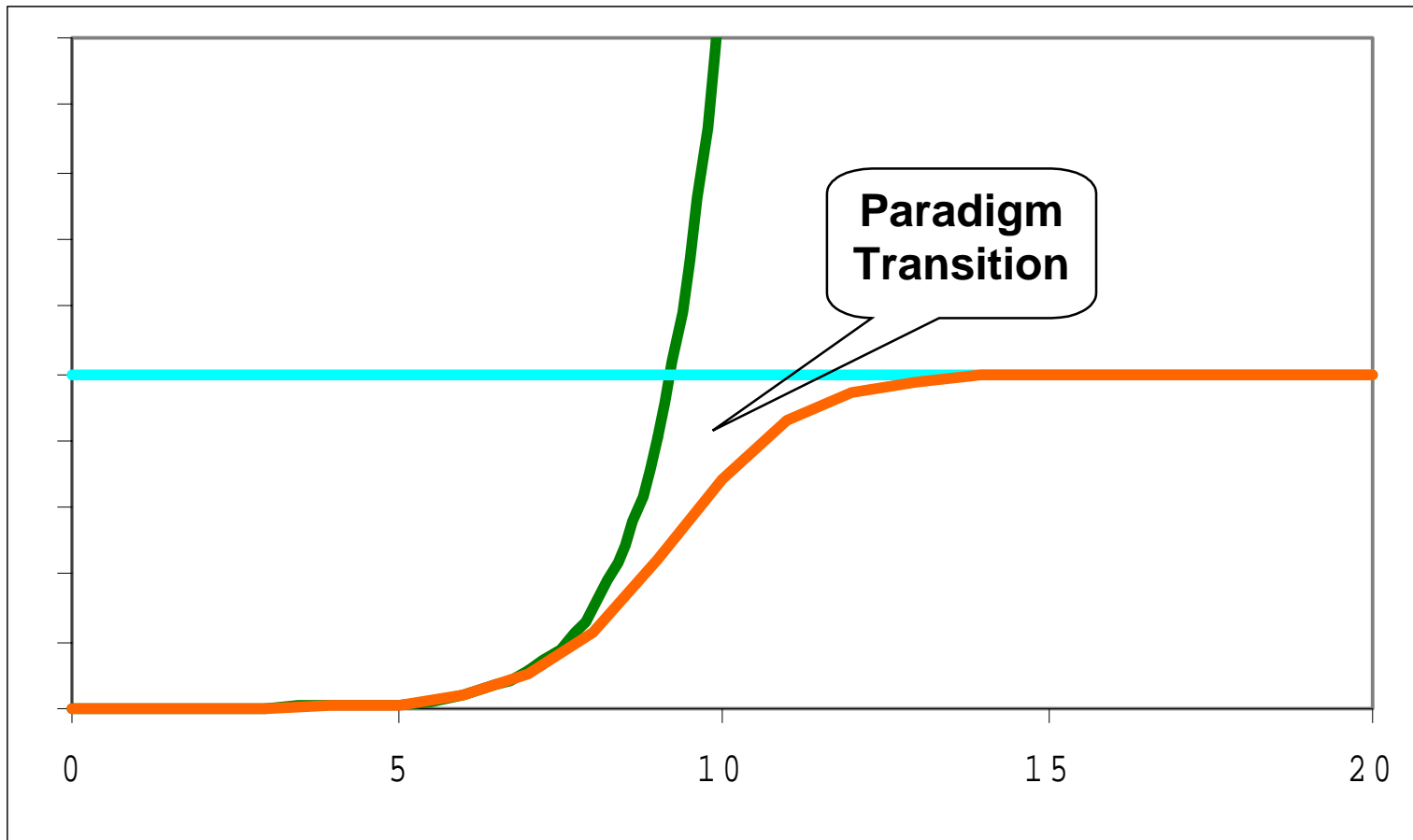
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Mike O'Dell
Chief Scientist, UUNet

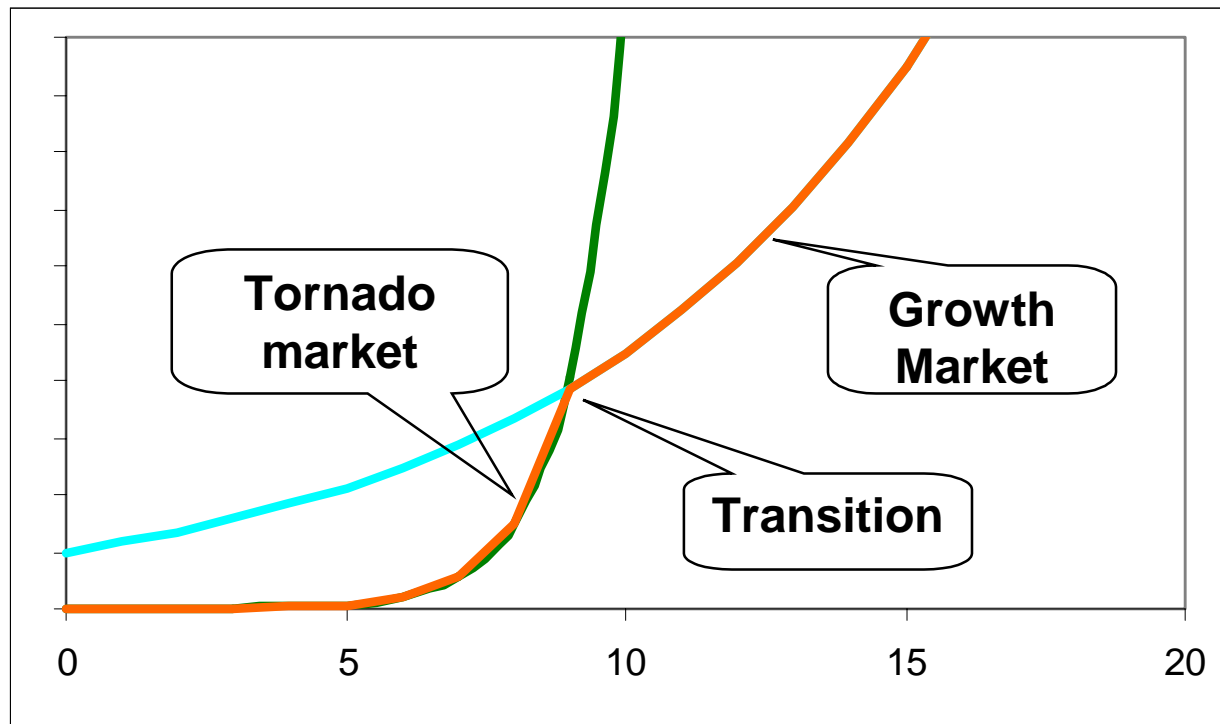
What is a scaling problem?

- **What works for 1 does not always work for 1000**
- **What works for 1000 does not always work for a million**
- **What works for a million does not always work for a billion**

The Canonical Scaling Problem



The Exponent Scaling Problem



Non-numerical scaling issues

Old equipment stays around forever

Not possible to say "replace all"

Unless you can wait for 10 years

Not even if your name is Bill

Complexity generates interesting bugs

Simplicity is a help in scaling

Many relationships means lots of talking

Scaling the smart guys is REAL hard

What can we do?

Remain calm

Identify the limits

Change the problem

Where are the scaling pains?

Addressing

32 bits gives us 0.4 to 4 billion addresses

Redefine the problem (1): IPv6

make address space larger

Redefine the problem (2): NAT

remove global address as a requirement

Routing Table Growth

”Routers can’t keep up with Internet growth”

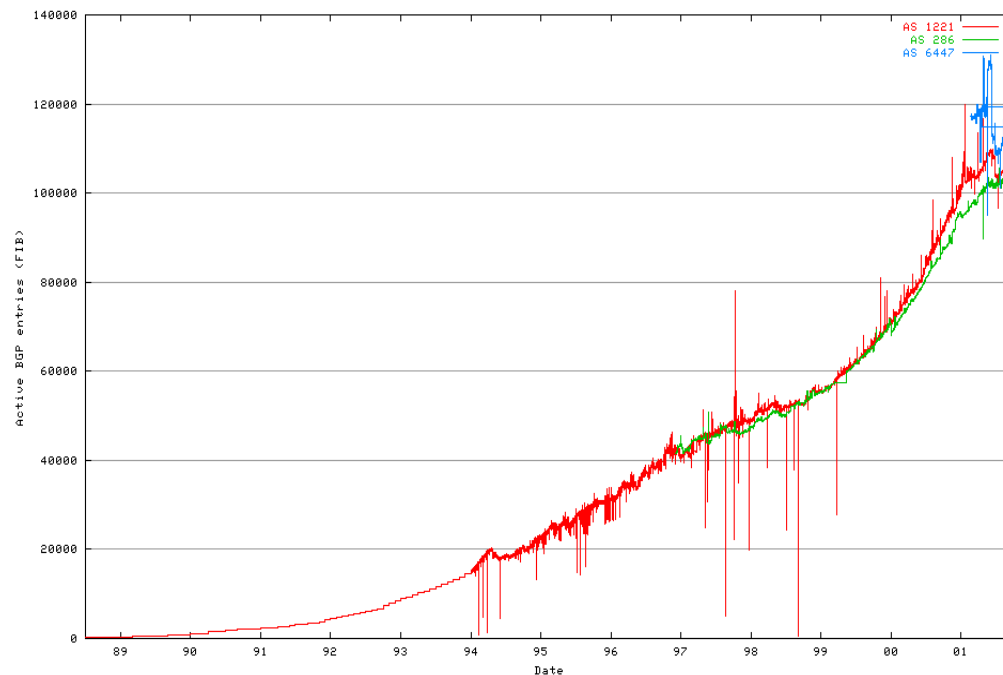
Yes, they can!

Identified:

Combination of real need (multihome et al) and crap configs

Change (now): Filters and reconfiguration

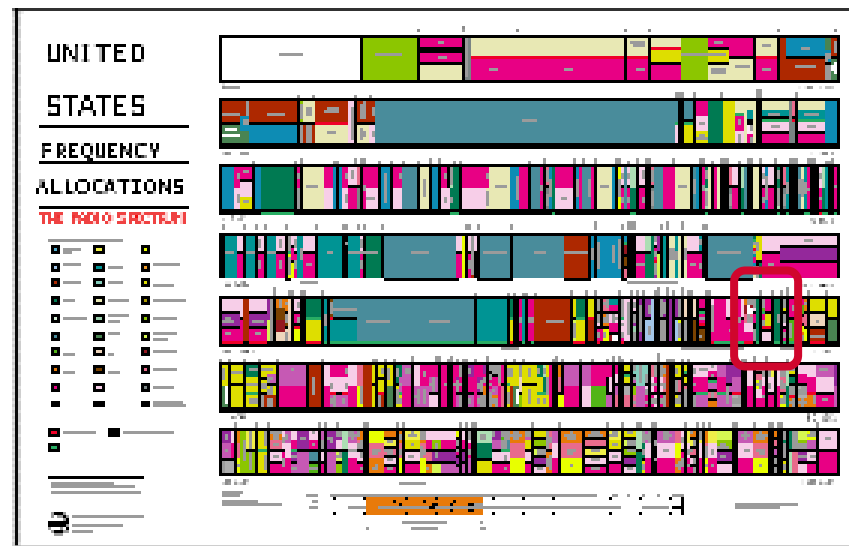
**Redefine (future):
New routing paradigms**



Source: www.telstra.net/ops/bgp/

Radio spectrum

- A fundamentally limited resource
- Government regulation
- 27 MHz and 2.4 GHz: "Open"
- Freedom to share

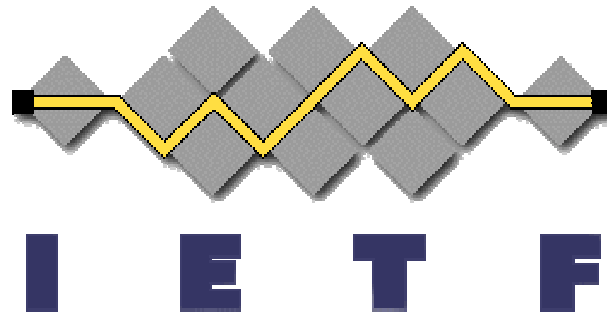


Source: <http://www.ntia.doc.gov/osmhome/allochrt.pdf>

IETF: Process scaling

- **IETF of 1990: 200 people are a crowd**
- **IETF of 2000: 2000 people are not**
- **IETF of 1990: Approx 30 RFCs**
- **IETF of 2000: Approx 280 RFCs**

IETF: New challenges



Scaling Human Processes

- **Monopolies scale well, but have certain disadvantages**
- **Shared secrets (consortia) do not scale well at all**
- **Open processes can scale – but are costly to manage**
- **There is no perfect solution**

Acting To Scale

- **Companies can make boxes faster**
- **Changing paradigms takes cooperation**
- **The IETF is about cooperation**

Conclusions

- **Scale is challenge**
- **Challenge is painful**
- **Challenge is opportunity**

DON'T PANIC