Rocky Mountain 2011 IPv6 Summit

IPv6 Critical Success Factors

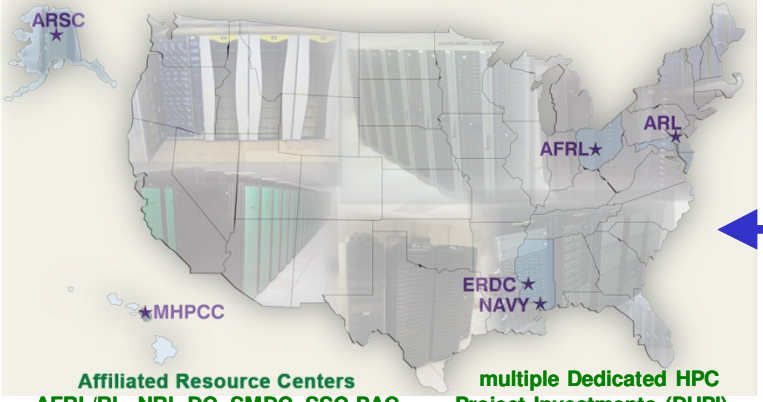
Defense Research and Engineering Network (DREN)

Mr. John M Baird

27 April 2011

This is DREN

DoD Supercomputing Resource Centers

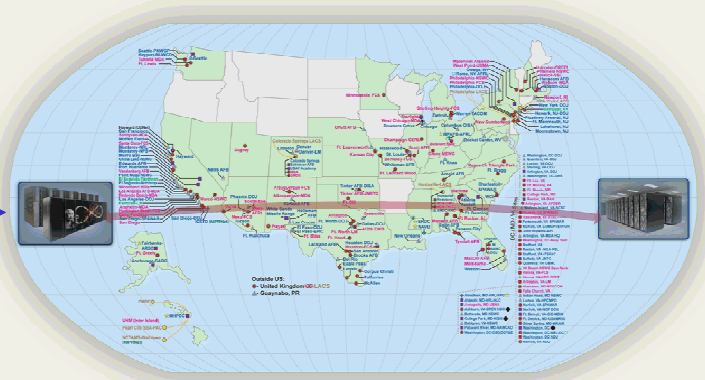


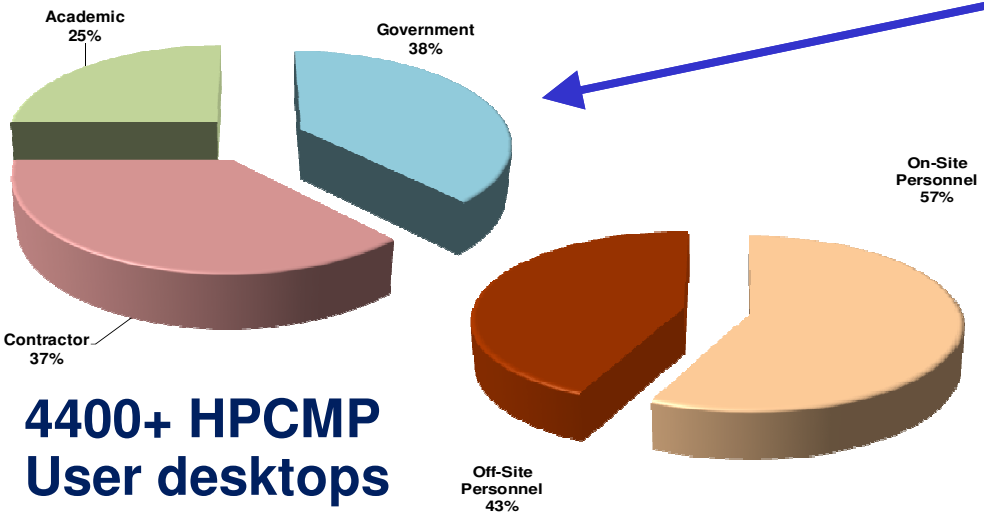
Affiliated Resource Centers
AFRL/RI NRL-DC SMDC SSC-PAC

multiple Dedicated HPC Project Investments (DHPI)

Networking

Defense Research & Engineering Network

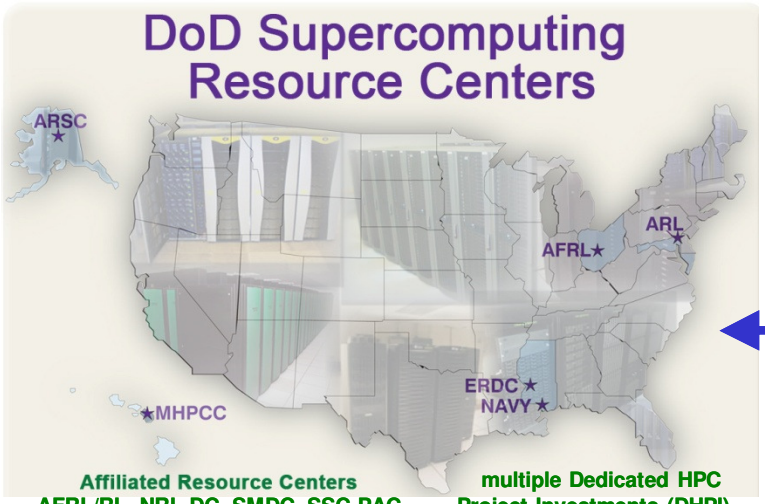




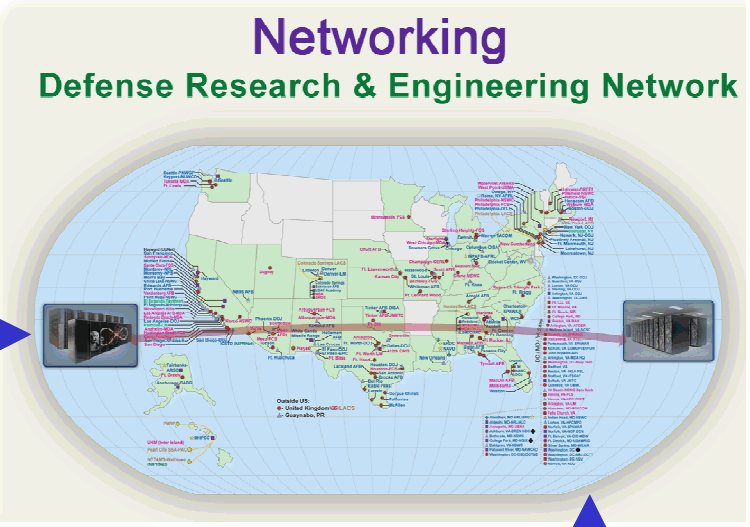
4400+ HPCMP User desktops

Solving the hard problems…

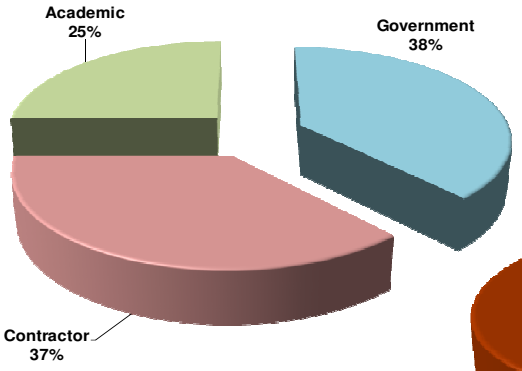
This is DREN: What we did
2003-2005



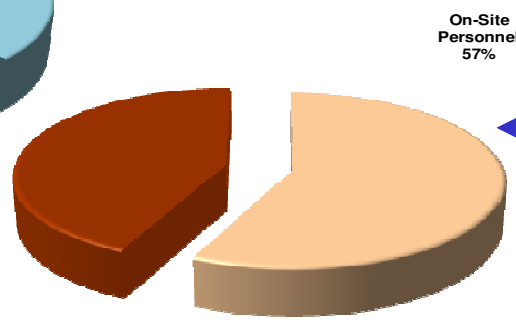
6 DoD SRCs & 9 DREN user sites



Wide-area backbone



4400+ HPCMP User desktops



1 core mission application

This is DREN: What we did Since then

- **We kept expanding deployment and growing use**

	Web	Mail	DNS	NNTP	XMPP (Jabber)
Defense Research and Engineering Network (dren.net)	SUCCESS	SUCCESS	0/0 3/3	Stratum 1	SUCCESS

- **Largest DREN User Site today**
  - **This isn't on just a few systems, its over 99% of the site**
    - **Hundreds of subnets across hundreds of buildings**
    - **Thousands of users and thousands of computing devices**
  - **This is a heterogeneous site, not just Windows**
    - **Win7, Vista, Win2K8/2K3, Win XP, Mac OS X, Linux, Solaris, HP/UX, BSD, ESX, SCO, *et cetera***
  - **The systems and users are not part of one centrally managed environment (e.g. one active directory)**
  - **IPv6 is 10% of the traffic (helped by Google-over-IPv6)**
  - **This is not a small pilot or a limited turn-on/turn-off test**

This is DREN: What we found

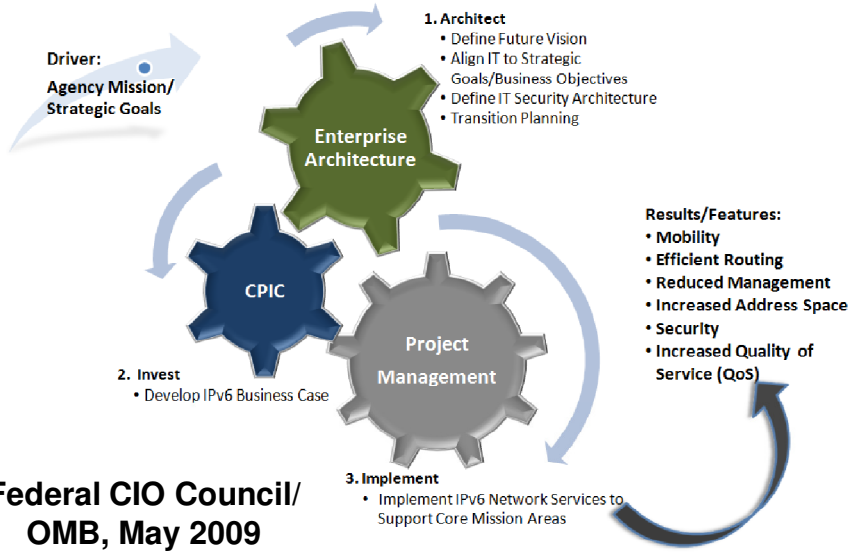
- **Wide-Area**
  - Getting an address plan right is not hard but is different
    - Don't let past IPv4 thinking hobble your IPv6 future
  - A dual-stack security infrastructure takes time
- **Resource Centers and DREN user site metrics**
  - People: no new personnel, all part time assignments
  - Resources: 100-600 hours, 6-9 months, 2-7 people
  - Purchases: 2 small routers, one each at 2 Centers
  - Enabling IPv6 in modern O/S and IOS – easy
    - Windows XP is *not* modern. Expect hiccups since you will use it
- **Applications**
  - More time in Kerberos to install security fixes than IPv6
  - Web servers should be easy, but were not always so
- **User Desktops**
  - Users won't know/shouldn't care when IPv6 is deployed

This is DREN: What we found

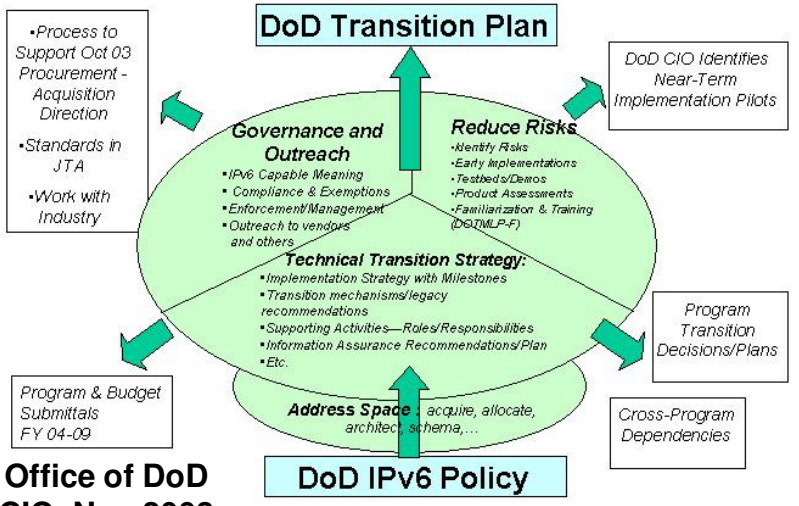
- **IPv6 brought many changes. Some were:**
  - ICMPv6 instead of ICMP
  - Multicast is now actually useful
  - Security device filters. Rapidly by ~2x
  - Network device RAM memory. Slowly grow to ~2x
  - Network device CAM/FEB memory. Will grow to ~2x
  - DNS GROWTH!! Fortunately, it was designed to grow
  - Databases. Varies, but needs to be considered early on
  - Applications. Update for new routines/addresses, done
  - Desktop O/S. The changes have already happened
  - IT employee skills. A few must learn IPv6 early, but *all* will need to learn it
    - Don't overlook help desk, operations, tech writers

This is DREN: How we did it

- **Think Globally**
  - Vision/Goals/Objectives
  - Procurement Policy (IPv4)
  - Communicate, COMMUNICATE!
  - ~~Grand Deployment plans~~
- **Act Locally**
  - Use a proven deployment process (local or imported)
    - Start small with one subnet
    - Add external connectivity
    - Analyze lessons learned
    - Iterate, building on success
  - Volunteers, not draftees
  - Train early and often
  - Test labs at each location

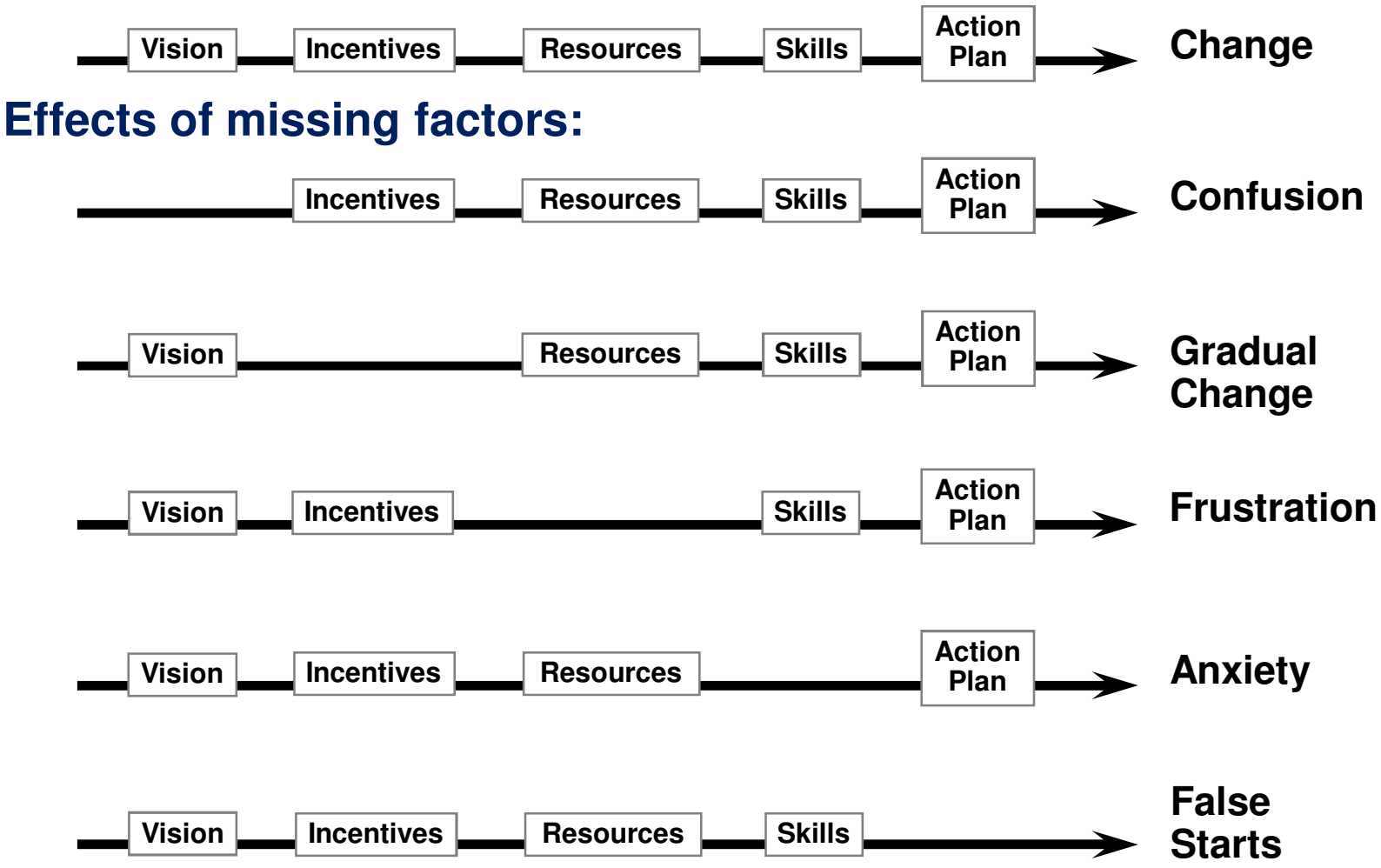


Federal CIO Council/ OMB, May 2009



Office of DoD CIO, Nov 2003

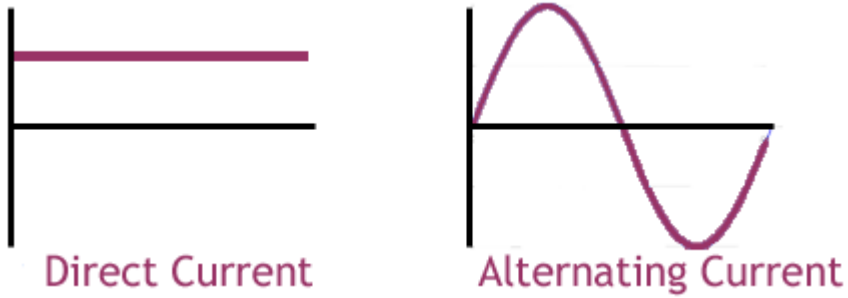
Critical success factors



Source: Delorese Ambrose, in 1987 communication to CMU-SEI TransPlant personnel. Originally from the Enterprise Corporation, a consulting firm no longer in existence.

Vision: Infrastructure change takes time

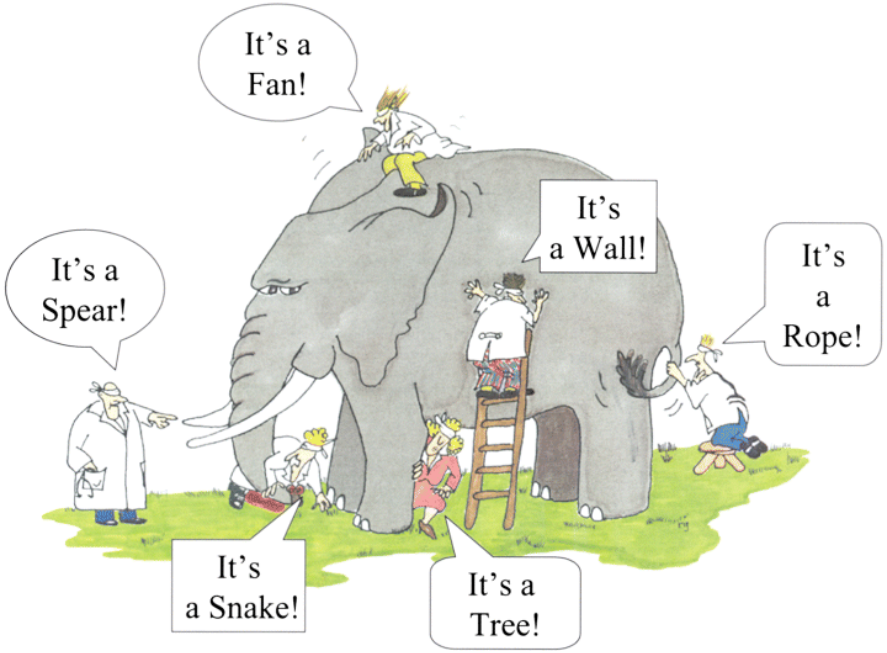
War of the Currents – 1880s to 1960s



- D/C system – Thomas Edison
  - Demonstrated practical advantages
- A/C system – Nikola Tesla and George Westinghouse
  - Unproven theoretical advantages
- Other examples
  - DVD + Blu-Ray, English + Metric, railroad track gauge

Vision: Where you work matters

- There were six men "to learning much inclined, who went to see an elephant (though all of them were blind)…"



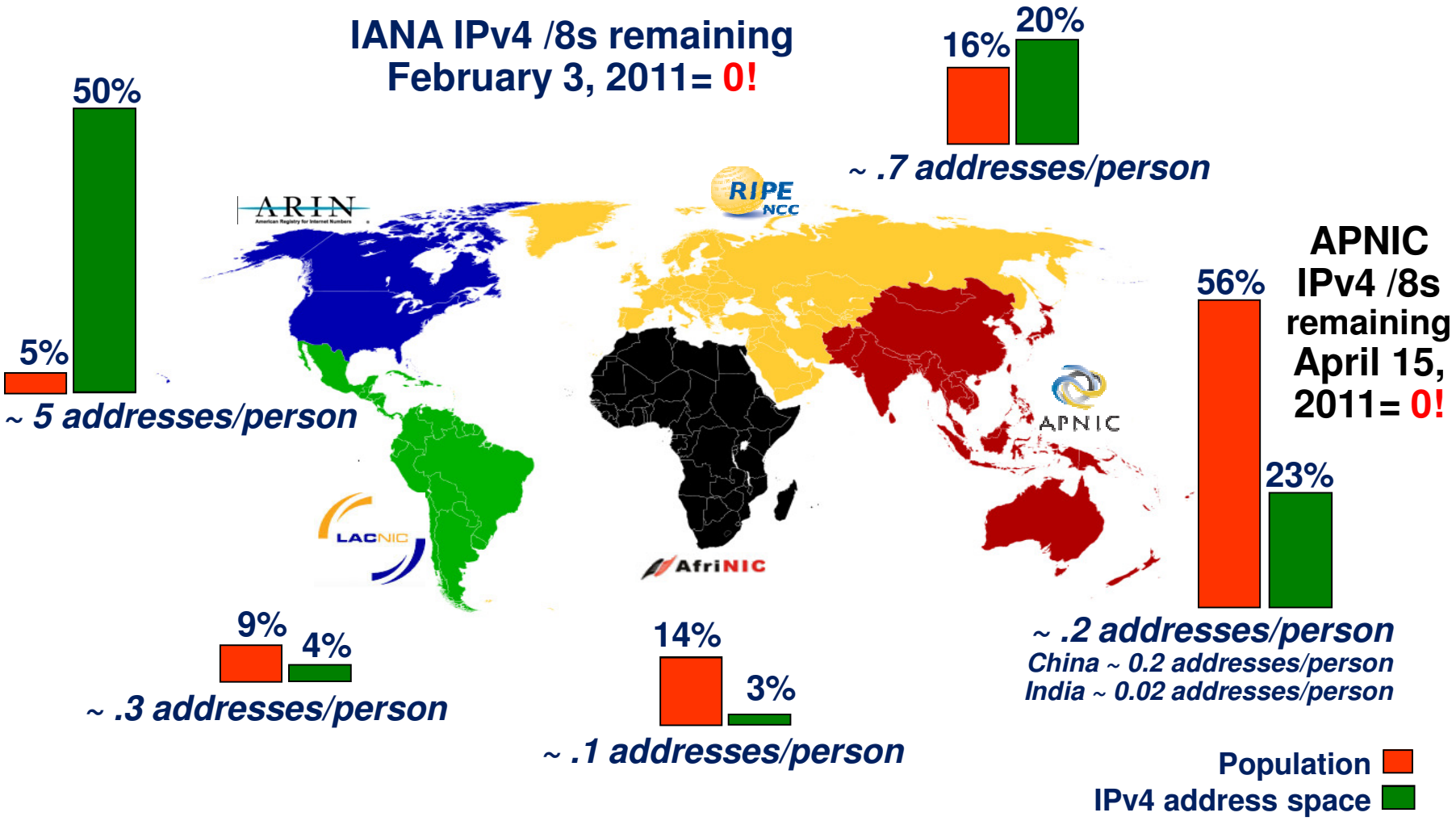
- Afterward, they "…disputed loud and long, each in his own opinion exceeding stiff and strong, though each was partly in the right and all were in the wrong!"

– The Blind Men and the Elephant

Vision: Where you work matters

- When looking at the IPv6 "elephant," are you:
  - ✓ A backbone operator?
  - ✓ An Internet Service Provider?
  - ✓ A content resource provider?
  - ✓ An equipment vendor?
  - ✓ A software developer?
  - ✓ An enterprise or Federal policy official?
  - ✓ A security officer?
  - ✓ An Information Technology employee?
  - ✓ A small business owner?
- Recognize that there are many different views of IPv6
  - ✓ Different ≠ wrong

Vision: Where you live matters



Regional IPv4 depletion will occur unevenly

(see www.ipv4depletion.com for details)

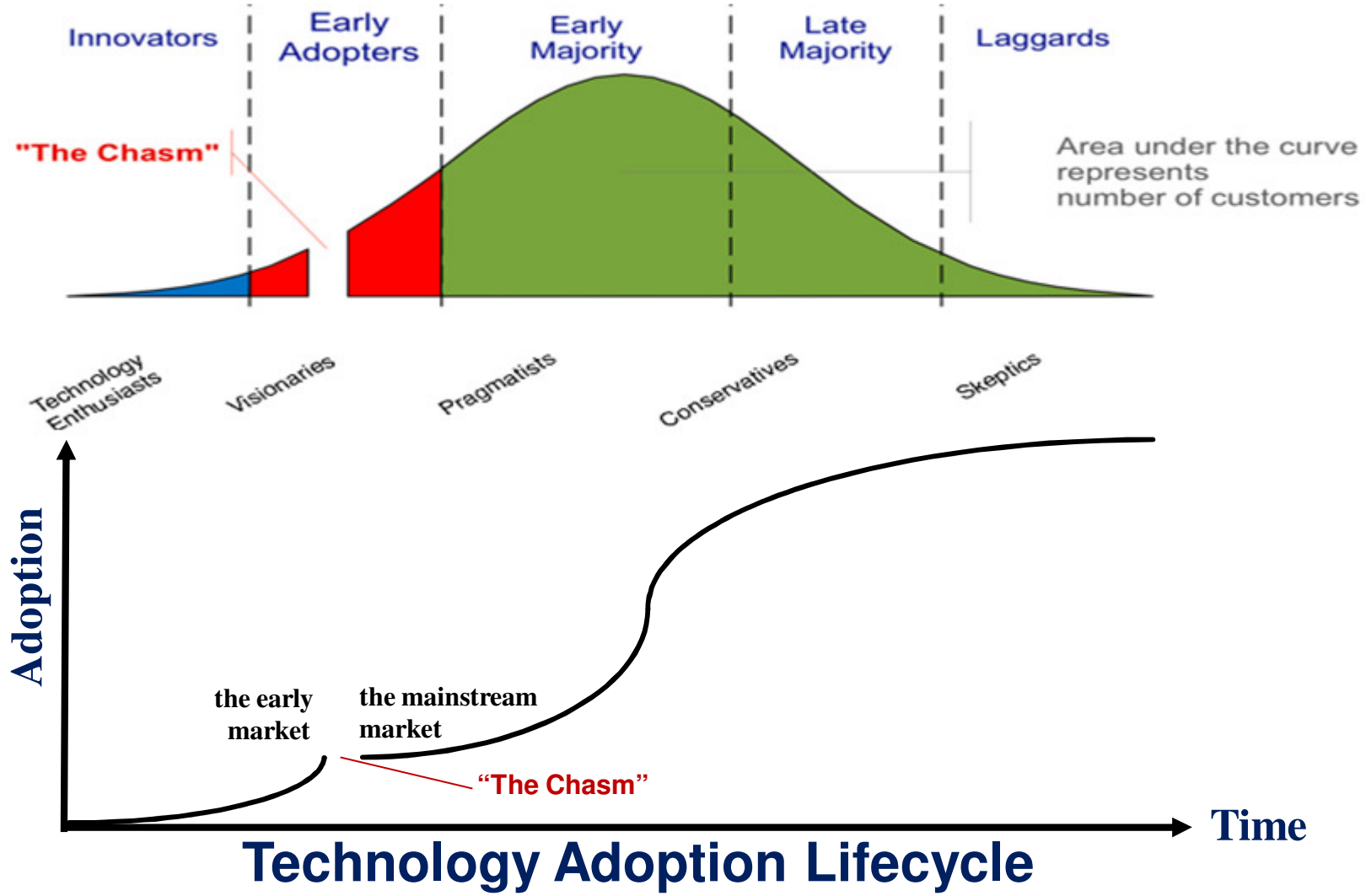
Incentives: Churn happens

- **Why does your network infrastructure exist:**
  - For internal use? – To enable external use?
- **What happens internally**
  - "We have lots of addresses for our own use." So?
- **What happens externally**
  - Growth: new citizens/customers/clients/partners arrive
  - Churn: old citizens/customers/clients/partners leave
  - When more leave than arrive over time, you shrink

- **No infrastructure change → churn without growth**
  →→ you will shrink

"It's the addresses, 'stupid'!!" – apologies to Pres. Clinton

Incentives: Everything is in the timing
IPv6 has emerged from "The Chasm"



Technology Adoption Lifecycle

Bohlen, Beal & Rogers, "Diffusion Process", 1957, Moore, "The Chasm", 1991

Incentives: Security

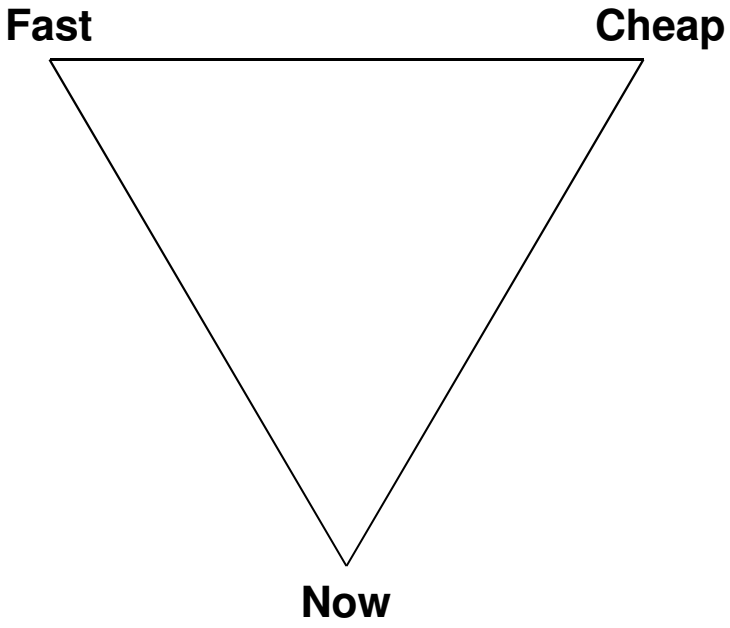
Security – no longer a reason to delay IPv6

"The only truly secure computer is one buried in concrete, with the power turned off and the network cable cut!" – *Anonymous*

- Good news/Bad news
- 30 years ago, if we had waited for IPv4 to be secure
  - We would still be waiting!?!
- "If it ain't broke, don't fix it"
  - But it *is* broken
- Designing one dual-stack infrastructure is extra work
  - v4 + v6 > 2 * v4
  - Protocol interactions exist
- One infrastructure will have
  - Lower maintenance cost
  - Better protection
  - Lower risk

Resources: Time really *is* Money

In hardware design –
"Fast + cheap + now:
pick any two!"



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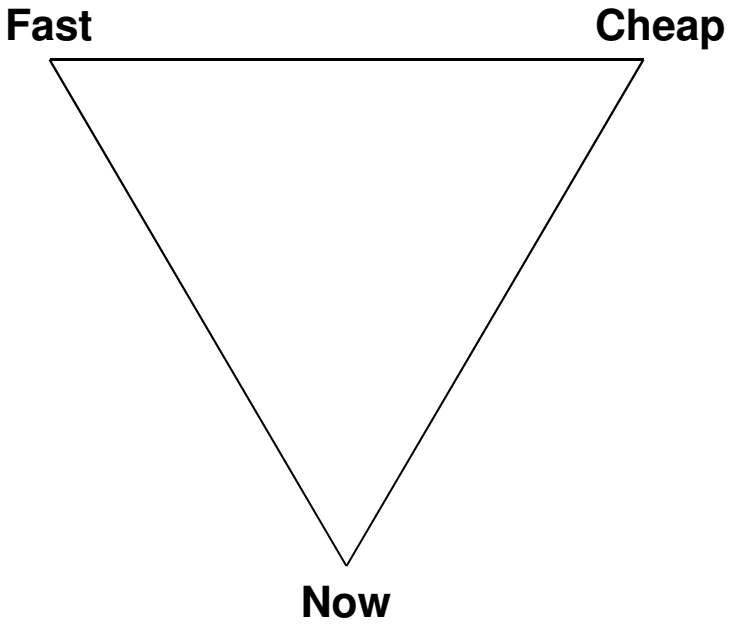

A general maxim –
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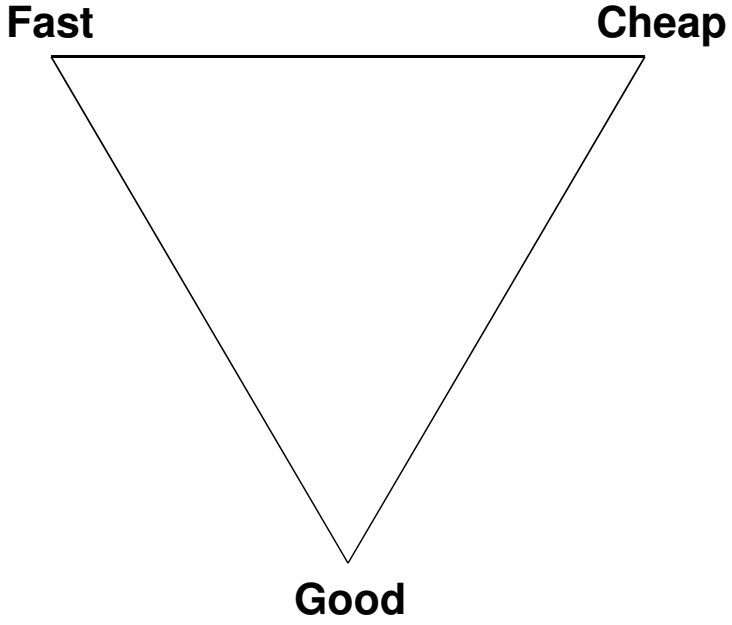

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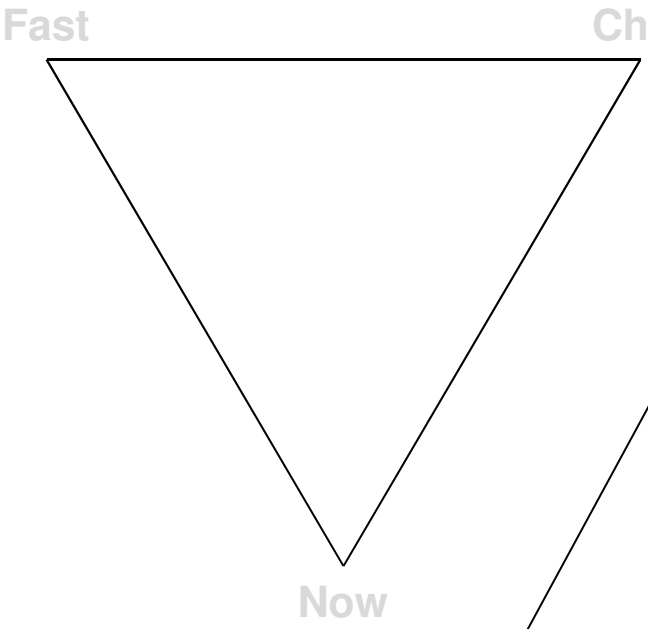

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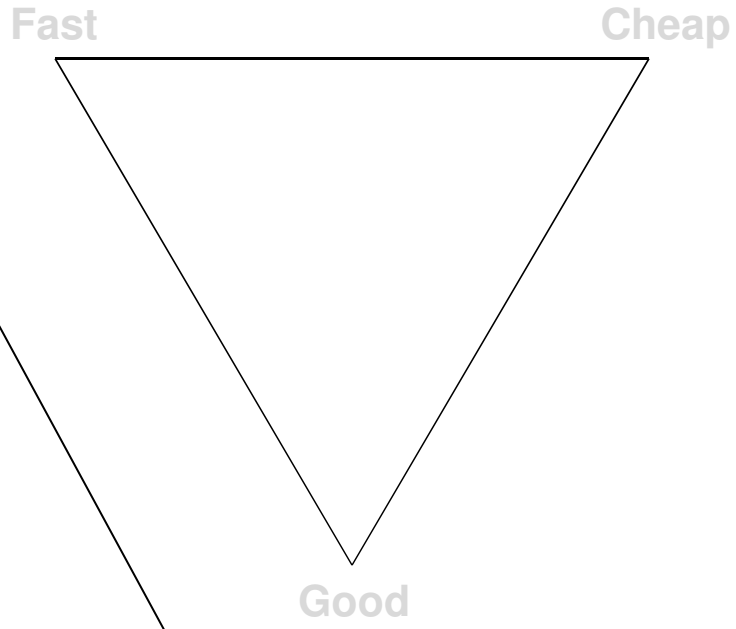
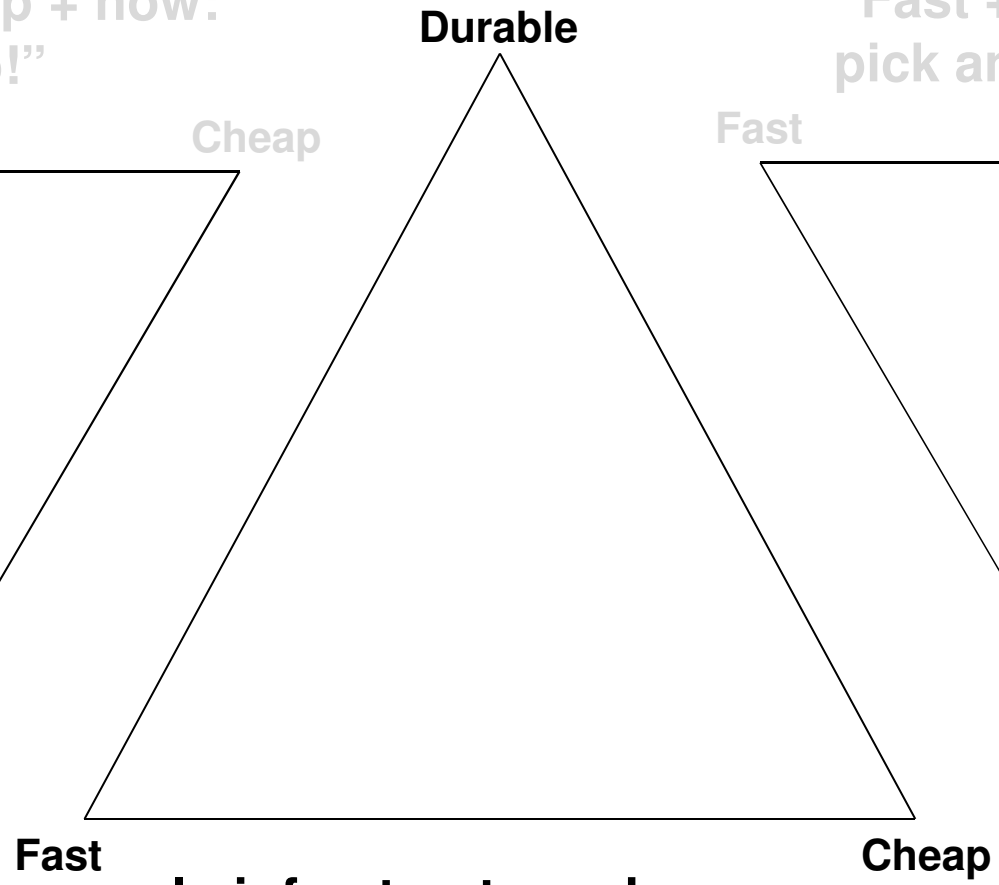




In infrastructure change –
"Fast + cheap + durable: pick any two!"

Resources: Free is Good

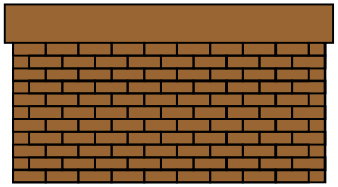
- **IPv6 test programs**
  - IPv6 Ready Logo — www.ipv6ready.org
  - NIST USGv6 — www.antd.nist.gov/usgv6
    - Suppliers Declaration of Conformity (SDOC)
  - DoD UCR APL — https://aplits.disa.mil
- **Procurement Policy (IPv4)**
  - Dec 2009 FAR final rule E9-28931 IPv6 Case 2005-041
  - May 2007 GSA Networx contract limited IPv6 support
- **Lessons Learned**
  - DREN IPv6 knowledge base
    www.hpcmo.hpc.mil/cms2/index.php/ipv6-knowledge-base
  - ARIN IPv6 wiki — www.getipv6.info
  - Linux IPv6 HOWTO — www.bieringer.de/linux/IPv6/

Resources: People

- **Train early and often**
  - Hiring Practices
  - Promotion Factors
  - Performance Reviews
- *Communicate*, COMMUNICATE!
  - Perceptions Motivate
    - The story: A stranger saw three stonemasons working and asked each one the same question
    - Three people doing the same job, with different perceptions/motivations

1. The first worker was toting rocks to a pile, near a wall. "What are you doing?" asked the stranger. "Can't you see that I'm carrying rocks?" was the reply

2. The stranger asked the second worker, "What are you doing?" "I'm building a wall," he snarled



3. A few steps away, the stranger came upon a third worker and asked "What are you doing?" The worker smiled. "I'm building a cathedral to the glory of God!" was the answer

"Technology makes change possible, or even necessary, but people make change happen." – *David S. McIntosh*

Skills: Training

- **Training**
  - Free is best (web sites and webinars)
  - Low cost is good (books, Internet2, conferences)
  - Commercial training is available from multiple sources
- **Who needs training and how much**
  - Skilled in IPv4: 1 week seminar / 1 day + self-training
  - Not skilled in IPv4: 7 weeks formal training in both IPv4 + IPv6 – instead of 5 weeks training in IPv4 only
  - IPv6 awareness: ranges from ¼ hour → 2 hours
  - Those involved in actual deployments
    - The next 3 slides with their links are typically enough

"Just because you're trained for something doesn't mean you're prepared to do it." – *Anonymous*

Skills: Experience

- **Experience is the best teacher**
  - The May 2009 Federal Planning Guide/Roadmap Toward IPv6 Adoption recommended setting up an IPv6 test lab
    - 2 computers, a router, and some cabling is enough to begin
    - Microsoft describes a virtual lab using only one real computer
  - Need to test your external IPv6-only connectivity?
    - www.v6.dren.net lists many IPv6-only links
  - Need to test your IPv6 infrastructure?
    - www. ipv6-test.com, www. test-ipv6.com verify connectivity
    - www.ipv6tools.org allows you to ping, trace, and query DNS
    - ipv6-speedtest.net allows you to test performance ('-' *not* '.')
  - Want IPv6 connectivity today? (try this at home)
    - Use the gogoCLIENT from gogoware.gogo6.com and the authenticated.freenet6.net Freenet6 tunnel broker
    - Others are available: tunnelbroker.net and www.sixxs.net

"Build a Little, Test a Little, Learn a Lot!" – RADM *Wayne Meyer*

Action Plan: Think globally, act locally

Top Level Action Plan for the enterprise:

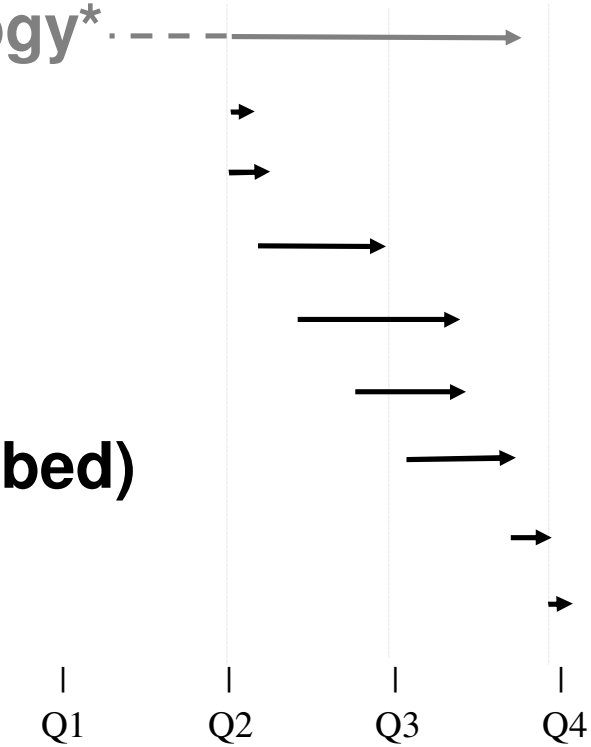
1. Define problem, solution, and scope for planning
2. Decide on a transition strategy
3. Characterize adopters
4. Identify effective transition mechanisms
5. Select and synthesize
   - refine scope and strategy
   - design interactions among adopters
   - refine whole product
   - set priorities for action
6. Prepare to manage risk
7. Document the plan

See Carnegie-Mellon University (CMU) Software Engineering Institute (SEI) http://www.sei.cmu.edu/news-at-sei/features/2001/4q01/feature-4-4q01.htm for details of TransPlant technology transition process. See DREN IPv6 knowledge base for our adaptation

Action Plan: Think globally, act locally

Lower Level Action Plans for local enclaves:

1. Learn the terminology and technology*
2. Establish the Change Team
3. Describe Desired State
4. Baseline Current State
5. Analyze the Gap
6. Develop the Solution(s)
7. Trial the Solution(s) (on a local test bed)
8. Roll Out the Solution(s)
9. Analyze Lessons Learned
10. Iterate until transition complete*



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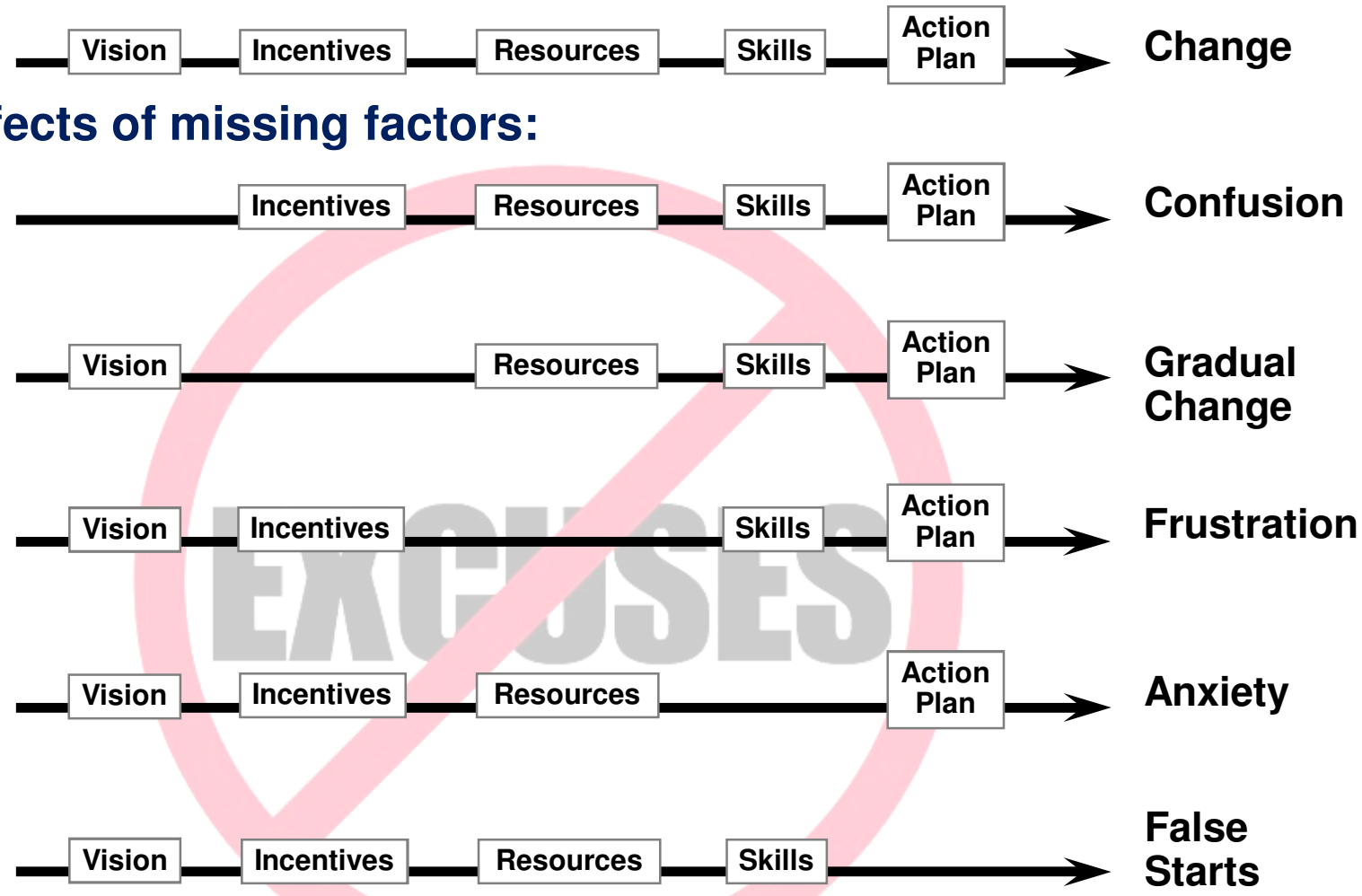
*Shown in grey since not in the SEI steps

Critical success factors



BACKUP SLIDES

This is DREN: What we found

- **Wide-Area metrics**
  - People: no new personnel, all part time assignments
  - Resources: 420 hours, 4 months, from 2-7 people
  - Purchases: none
  - Enabling IPv6 in modern IOS – easy
    - Numerous software upgrades were made