



**Department of Defense**  
**High Performance Computing Modernization Program**  
**Defense Research and Engineering Network**



**Next Generation Internet: How  
IPv6 Enables Agency Operations**

# Deployment Explained: DREN IPv6 Pilot

***Presented by***

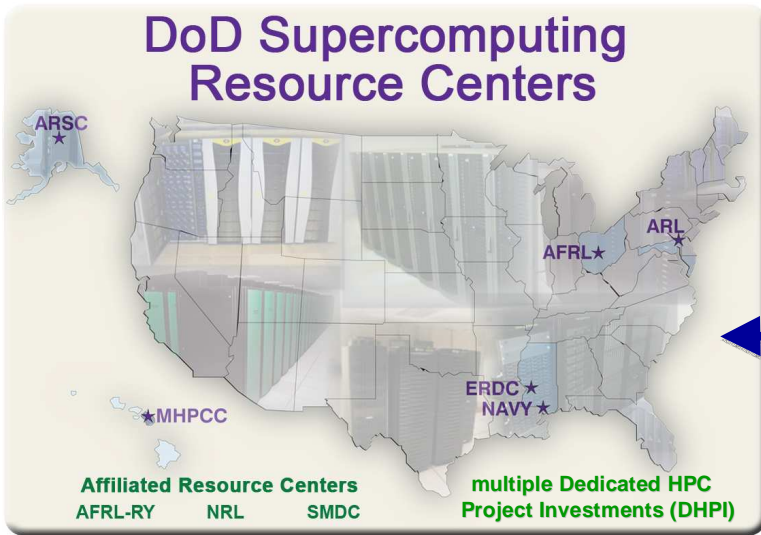
**John M Baird**

***Date: Sept 17, 2009***





# HPCMP and DREN



**6 DSRCs plus ...**



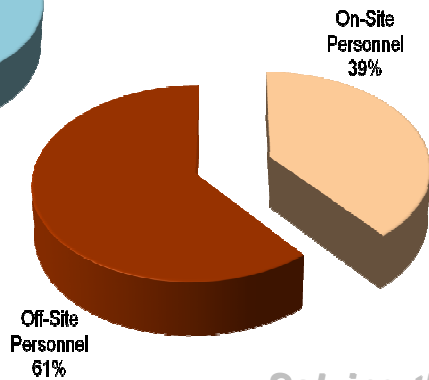
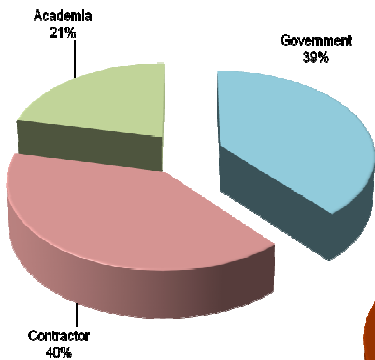
**200+ DREN sites**

**PKI-Enabled**

**KERBEROS**



DC  
OA  
DC



**4000+ Users**





# HPCMP and DREN IPv6 Pilot



**100+ DREN sites**

## DREN IPv6 pilot goals in July 2003:

- 1. End-to-end IPv6-enable the DREN Wide-Area Network (WAN)**
- 2. Maintain the performance and security levels that existed prior to the IPv6 pilot**

The 5 goals of the DREN IPv6 pilot are summarized on page 32 of the CIO Council's May 2009 "Planning Guide/Roadmap Toward IPv6 Adoption within the U.S. Government"



# HPCMP and DREN IPv6 Pilot



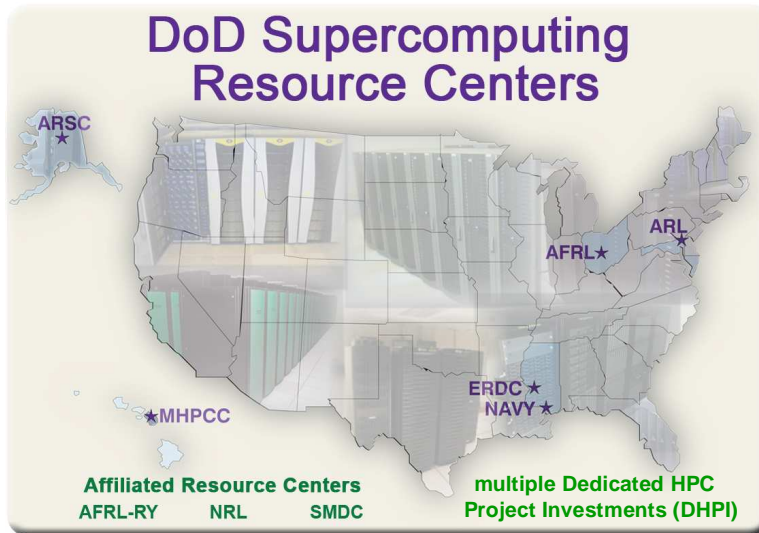
## As of 2009:

**200+ DREN sites**

- ✓ The entire WAN supports end-to-end IPv6 traffic
  - ✓ IPv6-enabled the WAN and initial pilot sites in 2003
  - + Extensive peering with other IPv6-enabled networks
- ✓ Maintained the performance and improved the security levels that existed prior to the IPv6 pilot
- ✓ Metrics: no new personnel, no new equipment, 400 hours over 4 months in 2003



# HPCMP and DREN IPv6 Pilot



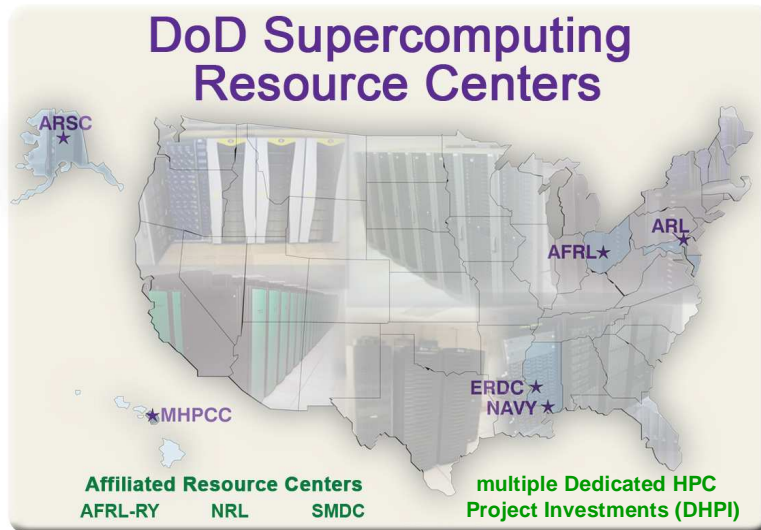
**6 DSRCs plus 4 user sites**

## DREN IPv6 pilot goals in July 2003:

- 3. Develop a process that would facilitate deploying IPv6**
  - IPv6-enable the infrastructure at selected sites
  - Capture metrics from deployment



# HPCMP and DREN IPv6 Pilot



**6 DSRCs plus 4 user sites**

**As of 2009:**

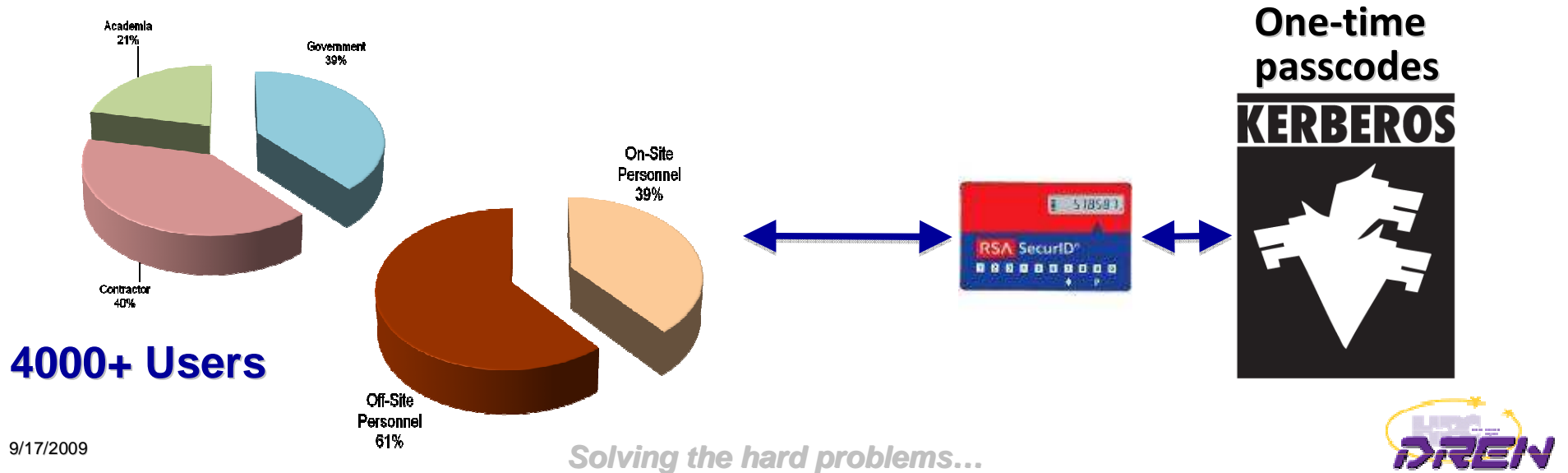
- ✓ **Developed a process that facilitated deploying IPv6**
- ✓ **IPv6-enabled 6 HPC Centers + 4 user sites plus ...**
- + **Captured metrics from deployment**
- ✓ **Metrics: no new personnel, replaced 2 small routers, 100-600 hours, 6-9 months, 2-7 people per site**



# HPCMP and DREN IPv6 Pilot

## DREN IPv6 pilot goals in July 2003:

- 4. IPv6-enable a core mission application

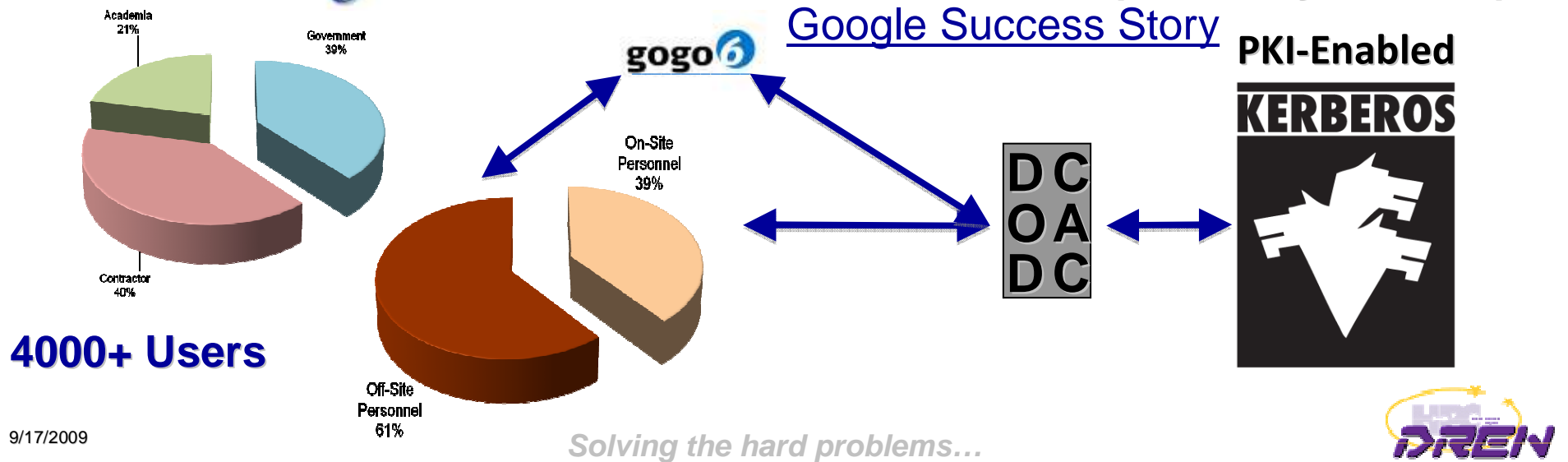




# HPCMP and DREN IPv6 Pilot

## As of 2009:

- ✓ Kerberos/SSh servers on HPC systems IPv6-enabled
- ✓ All users are using IPv6-enabled clients, few are aware of their IPv6 capabilities
- ✓ Metrics: not captured, MIT did most of the work
- + Tunnel brokers allow IPv6 access from anywhere
- + IPv6-enabled web, email, other services (**ongoing**)
- + **Google-over-IPv6** to all DREN sites (**recently added**)







# HPCMP and DREN IPv6 Pilot

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## DREN IPv6 pilot goals in July 2003:

### 5. Document lessons learned

- Facilitate other organizations' future efforts at the enterprise, WAN, site, and applications level
- Share lessons learned with others

## As of 2009:

- ✓ Documented lessons learned (**ongoing**)
- ✓ Accessible via the DREN IPv6 knowledge base  
<https://kb.v6.dren.net>
- ✓ Government, industry, and trade organizations
  - ✓ Conferences
  - ✓ Working groups



## DREN IPv6 pilot success factors

- **People**
  - Interest Level
  - Training
- **Personality**
  - Openness to change
  - Vision trickle-down
- **Process** (on later slides)
- **Procurement**
  - Policy (DoD + HPCMP guidance)
  - Preparation (existing contract option)
  - Practice (relatively new equipment)

**“Technology makes change possible, or even necessary, but people make change happen” – David S. McIntosh, CBI Network**



## DREN IPv6 pilot success factors

- **Basic network transport protocol**
  - Multiprotocol Label Switching (MPLS)
- **Target IPv6 protocol suite** – the DREN pilot IPv6 Transition Concept of Operations.  
(See figure 2 in CIO Council’s Planning Guide.)
  - **2003: architect + invest for functional parity with IPv4 network services**
  - **Later: implement advanced IPv6-enabled network services and applications**

For more information, click on the link to “Success Story: DREN Helps Make the Transition to Internet Protocol version 6 (IPv6)” under the **Resources** section of the [DGI IPv6 Knowledge Center](#)



# Process to facilitate deploying IPv6

## TransPlant technology deployment steps include:

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

\*Shown in grey since not in the SEI steps

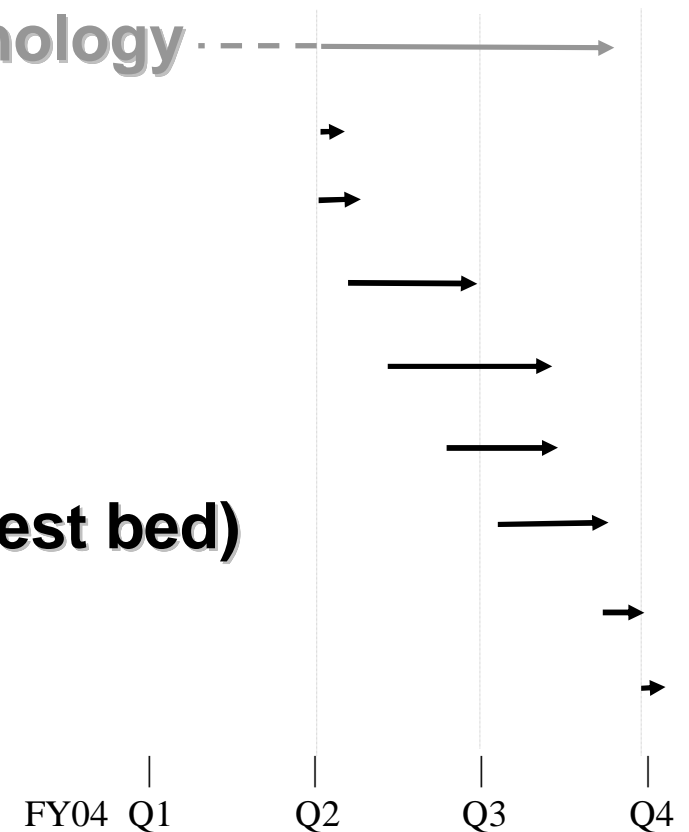
Source the Carnegie-Mellon University (CMU) Software Engineering Institute (SEI). See <http://www.sei.cmu.edu/pub/documents/98.reports/pdf/98tr004.pdf>



# Process to facilitate deploying IPv6

## Notional 9-month schedule to deploy IPv6:

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





# Success factors for *any* change



## Effects of missing factors:



Source: Delores Ambrose, in 1987 personal communication to TransPlant personnel. Originally from the Enterprise Corporation, a consulting firm no longer in existence.



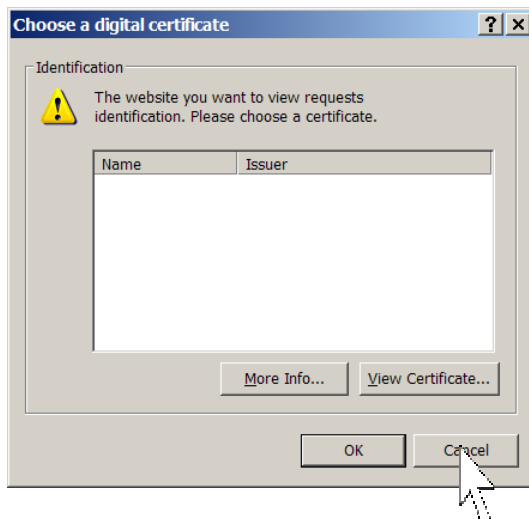
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# Backup Slides



# DREN IPv6 knowledge base access

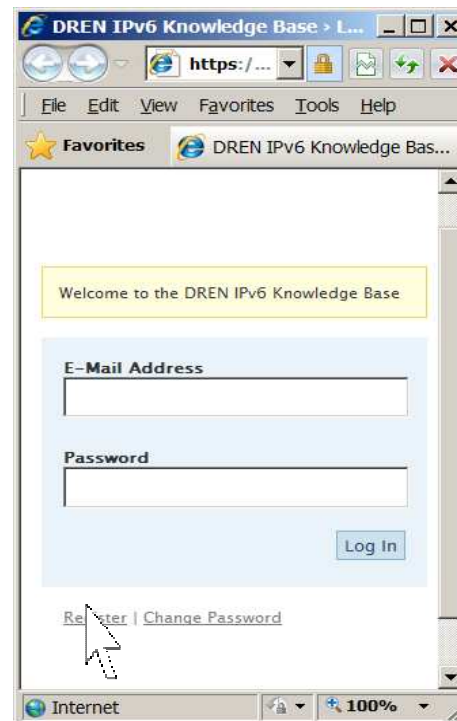
**Step 1:** In a web browser, go to <https://kb.v6.dren.net>. This window will pop up. Click on Cancel.



Note 1: If you have a DoD-issued Common Access Card (CAC), click on one of the certificates listed. Then click on OK to access the web site. You do not need to complete the registration process.

Note 2: If you use Safari on a Mac and have a DoD-issued CAC, open the "Keychain Access" application, select the CAC keychain, right click on the ID certificate, and then select "New Identify Preference". Enter **both** <https://kb.v6.dren.net> and <https://kb.v6.dren.net/> **before** performing step 1. You do not need to complete the registration process.

**Step 2:** Another window will open. Do not enter any information. Just click on Register.



**Step 3:** Another window will open. Enter information shown and click on Submit. Then wait ... a Password will arrive via email.

**Access:** Repeat step 1. In step 2, enter your E-Mail Address and your Password. Then click on **Log In**. The temporary Password is changed during initial access.