Kerberos at Penn

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Kerberos Deployment

- Two main realms:
  - UPENN.EDU : the main one
  - A central Windows based realm (1-way trust with UPENN.EDU)
- Various other departmental Windows server based realms that mostly also have 1-way cross realm relationship with the central Kerberos servers

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Software & Hardware

- Central servers run MIT Kerberos 5 version 1.5.x
- Central servers run on Intel hardware and Red Hat Enterprise Linux 4.x (current generation > 4 years old)
- Three servers, distributed on 3 distinct IP subnets, located in 3 distinct machine rooms around the campus
- One active master (kadmin server); manual procedure in place to reconfigure alternate as master
- Servers physically secured in machine rooms; run no extraneous network services, and provide limited access to the OS via an OOB console network protected by hardware token authentication

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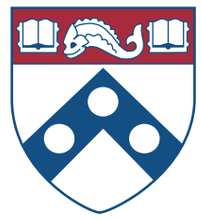

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Some statistics

About 1.5 to 1.7 million tickets issued per day (AS and TGS combined) and about 40,000 distinct users authenticated per day.

Principal type	Count	% of total
User	**196,928**	**98.94%**
Service	**1,887**	**0.95%**
Kadmin (localism)	**197**	**0.10%**
Other	**19**	**0.01%**
Total	**199,031**	

~ 200,000 principals, mostly user principals. Accumulated over time, no automatic principal deletion after students/employees depart.

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Native Kerberos vs. Password Verification

- We've spent a significant amount of time and energy trying to influence large scale use of native Kerberos authentication.
- Some successes but numerous failures. It's difficult to do this in an environment of heterogenous, unmanaged computers.
- A number of application protocols (and their popular implementations) still don't have good support for Kerberos.
- By contrast, easier in a *managed* Windows environment, where the details of Kerberos can be hidden from the user by integrating it into the workstation login process.

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Applications that support native Kerberos

- Windows domain login via cross-realm authentication
- Small amount of Web (HTTP/SPNEGO Negotiate)
- Jabber/XMPP
- E-mail: SMTP, POP, and IMAP
- Authenticated LDAP (Online directory etc)
- Local DNS content management system (custom protocol)
- Remote login (telnet/ssh) for sysadmin staff
- NFS v4 (Engineering School)

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Intermediate Systems

- Web Single Sign-On: CoSign (see weblogin.org)
- RADIUS
  - Primarily to support EAP-TTLS-PAP for wireless authentication
- Federation: Shibboleth (via CoSign)
- LDAP - authenticated access to online directory
  - we strongly discourage using LDAP as an application authN system

These are mostly using Kerberos as a password verification database.

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Kerberos for the Web

- Made several attempts in this area over the years, but solutions trialled have not yet gained much traction
- SPNEGO/HTTP Negotiate (+SSL for channel protection)
- KX.509 - Kerberos to obtain short term X.509 credentials
- Need: widespread support and adoption, and standardization (IETF)

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Authorization Systems

- Kerberos: authentication only
- Applications need to consult separate authorization system (ours is based on Grouper)
  - http://www.internet2.edu/grouper/
- Many windows systems also use their usual methods (AuthZ data/PAC etc) for additional local policies
- We're interesting in looking at the PAC/PAD work in progress in the IETF

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Multi-factor Authentication

- Investigated and piloted (but no production use yet):
  - CRYPTOCard (using SAM-2 Kerberos pre-authentication)
  - RSA SecurID (using 2nd input to CoSign web SSO)

- (We do use SecurID to authenticate access to out-of-band console sharing networks, but this doesn't involve Kerberos)

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Near term plans

- Upgrade to current version of MIT code (1.9.x?)
- Adapt local changes to plug-in framework
- Test FAST (protect AS exchange from offline dict attack)
- Investigate LDAP backend & multi-master KDC
- Migration to stronger encryption types
- IPv6 Support for KDC and Kadmind

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Wants, desires ..

- Standardized Kerberos support (and implementations) for as many protocols as possible
  - HTTP
  - EAP (Wireless/802.1x authentication)
  - IPsec (does anyone use KINK, GSS-IKE etc?)
  - SIP (Session Initiation Protocol) - for VoIP and other realtime apps
- Kerberos on mobile devices?

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Questions?

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