Remote Name Mapping for Linux NFSv4

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NFSv4 Administrative Domain

- NFSv4: names not numbers on the wire
- NFSv4 domain = unique UID/GID space
- Multiple Security Realms
  - Kerberos, PKI Certificate Authorities (SPKM3)
- Multiple DNS - NIS domains
- Pick one DNS domain to be the NFSv4 Domain Name
  <user@nfsv4domain>
  - nfsv4domain is used for ACL 'who' and GETATTR
    owner and owner_group
NFSv4 Domain

Kerberos V5

DNS Domain

X509/SPKM

Kerberos V5

DNS Domain
Local NFSv4 Domain: Name to ID

- One to one correspondence between UID and NFSv4 domain name
  - joe@arbitrary.domain.org
- GSS Principal name will differ from NFSv4 domain name
  - Kerberos V: joe@ARBITRARY.DOMAIN.ORG
  - PKI: OU=US, OU=State, OU= Arbitrary Inc, CN = Joe User Email= joe@arbitrary.domain.org
New LDAP Attributes

- We created a new LDAP object to hold two new LDAP attributes for NFSv4 id mapping
  - GSSAuthName
  - NFSv4Name
- We associate one NFSv4Name attribute with a RFC 2307 NSS-LDAP posixAccount to hold the users v4 domain name
- We associate multiple GSSAuthNames with a PosixAccount to hold the users multiple GSS principal names
- Attributes are configurable via /etc/idmap.conf
Local Mount: Kerberos V

v4 Domain: arbitrary.domain.org
K5 Realm: TANGENT.REALM
DNS Domain: citi.umich.edu

/etc/krb5.keytab

NFSv4 Client

nfs/host.citi.umich.edu@TANGENT.REALM

LDAP

Secure LDAP Call FAILS

nfs/host.citi.umich.edu@TANGENT.REALM

GSSD

If machine name, map to nobody

NFSv4 Server

gss context call succeeds

nfs/host.citi.umich.edu@TANGENT.REALM

gss context creation

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Local Mount: Kerberos V Issues

- Distribution of client keytabs? Linux: yes
  - With no keytab:
    - Allow AUTH_SYS for SETCLIENTIDID and mount of Kerberos export
    - User Kerberos credentials
  - Server: maps machine credentials to nobody (mount)
- Client root user: UID 0?
  - Map to machine principal (no password)
  - Map to per server root principal (with password)
Local Principal: Kerberos V

- New Linux kernel keyring service enables kernel Kerberos credential storage, and PAG-like behaviour
- NSSwitch ID mapping (LDAP PosixAccount)
  - `getpwid` on principal portion assumes UNIX name
    `(posixAccount uid) == K5 principal`
- UMICH LDAP ID mapping
  - `GSSAuthName` attribute added to LDAP posixAccount to associate with uidNumber
- Server GSSD principal mapping failure = context creation failure
Local Principal: Kerberos V

v4 Domain: arbitrary.domain.org
K5 Realm: TANGENT.REALM
DNS Domain: citi.umich.edu

% kinit joe@TANGENT.REALM

GSSD /tmp/krb5cc_UID

NFSv4 Client

joe@TANGENT.REALM

LDAP GSSAuthName:joe@TANGENT.REALM
uidNumber: 10098
gidNumber: 10

GSSD secure LDAP call

NFSv4 Server

gss context creation succeeds

gss context creation succeeds
Local User: Set ACL issues

- Client setfacl POSIX interface uses UID/GID across kernel boundary (NS Switch)
  - Two name mapping calls
  - NSS posixAccount name (no @nfsv4domain)
  - NFSv4Name attribute added to LDAP posixAccount to associate full nfsv4 name with uidNumber
- New linux nfs4_setfacl interface passes string names across kernel boundary
  - No local name to ID mapping needed
Local User: Set ACL

v4 Domain: arbitrary.domain.org
K5 Realm: TANGENT.REALM
DNS Domain: citi.umich.edu

10098
joe

% setfacl -m u:joe:rw /tmp/x.c

NFSv4 Name: joe@arbitrary.domain.org
uidNumber: 10098  uid: joe

IDMAPD

LDAP

NFSv4 Server

10098
joe@arbitrary.domain.org

IDMAPD

NFSv4 Client  joe@arbitrary.domain.org

SETATTR

/tmp/x.c
10098:rw
Local User: Get ACL issues

- Client getfacl POSIX interface uses UID/GID across kernel boundary (NS Switch)
  - NS Switch posixAccount: uid is displayed
  - Two name mapping calls
- New Linux nfs4_getfacl interface passes string names across kernel boundary
Local User: Get ACL

v4 Domain: arbitrary.domain.org
K5 Realm: TANGENT.REALM
DNS Domain: citi.umich.edu

% getfacl /tmp/x.c

NFSv4 Client
joe@arbitrary.domain.org

NFSv4 Server
joe@arbitrary.domain.org

IDMAPD
10098:rw

LDAP
NFSv4Name: joe@arbitrary.domain.org
uidNumber: 10098
uid: joe

10098

GETATTR

/jtmp/x.c
10098:rw
Kerberos V X-Realm and Linux NFSv4

- X-realms GSS context initialization just works
- GSSAuthName and NFSv4Name can hold remote user names.
- Need to add posix account with GSSAuthName for UID/GID mapping of remote user
- Set posixAccount shell to /dev/null for NFSv4 remote access without local machine access
- Secure LDAP communication required
Remote Kerberos V Principal

v4 Domain: citi.umich.edu
K5 Realm: CITI.UMICH.EDU
DNS Domain: citi.umich.edu

% kinit andros@CITI.UMICH.EDU

GSSD
/tmp/krb5cc_UID

NFSv4 Client

GSSD
secure LDAP call

NFSv4 Server

GSSAuthName: andros@CITI.UMICH.EDU
uidNumber: 10075
gidNumber: 10

andros@CITI.UMICH.EDU

gss context creation succeeds

gss context creation succeeds
Remote User: Set ACL

v4 Domain: citi.umich.edu
K5 Realm: CITI.UMICH.EDU
DNS Domain: citi.umich.edu

NFSv4 Client

% setfacl -m u:andros:rw /tmp/x.c

NFSv4 Server

IDMAPD

LDAP
NFSv4Name: andros@citi.umich.edu
uidNumber: 23975  uid: andros

NFSv4 Name: andros@citi.umich.edu
uidNumber: 10075
uid: andros

IDMAPD

v4 Domain: arbitrary.domain.org
K5 Realm: TANGENT.REALM
DNS Domain: citi.umich.edu

LDAP
NFSv4Name: andros@citi.umich.edu
uidNumber: 23975

10075

andros@citi.umich.edu

10075:rw
Remote User: Set ACL

- Remote realm: associate NFSv4Name with uidNumber, gidNumber, and GSSAuthName
  - NFSv4RemoteUser schema available
  - NFSv4domain name always used
- Secure LDAP communication required
Remote User: Get ACL

v4 Domain: citi.umich.edu
K5 Realm: CITI.UMICH.EDU
DNS Domain: citi.umich.edu

NFSv4 Name: andros@citi.umich.edu
uidNumber: 23975  uid: joe

% getfacl /tmp/x.c
andros@citi.umich.edu

IDMAPD

NFSv4 Server
NFSv4 Client
andros@citi.umich.edu
10075:rw

v4 Domain: arbitrary.domain.org
K5 Realm: TANGENT.REALM
DNS Domain: citi.umich.edu

NFSv4 Name: andros@citi.umich.edu
uidNumber: 10075

andros@citi.umich.edu

IDMAPD

GETATTR
Remote User: Get ACL

- LDAP mappings required only for POSIX getfacl
  - NFSv4Name and uidNumber for remote user
  - uid (local user name) for remote user
- nfsv4_getfacl simply displays the on-the-wire ACL name
- Secure LDAP not required
Foreign Groups

- Need design requirements
- Foreign group names could be assigned a local gid
- How does the server resolve foreign membership
  - Callback to foreign NFSv4 domain
  - Only resolve with local uid's (no callback)
  - Pass group list (names) in GSS initialization (a la EPAC)
  - Other?
Cross Platform ID Mapping

- NS Switch which uses posixAccount is the common denominator
- Our cross realm mapping extends NS Switch
  - Not supported by other implementations
- IBM also has a cross realm solution
Any Questions?

http://www.citi.umich.edu/projects