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Interoperability with Windows using CIFS File Sharing with Kerberos Authentication

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Who is this person?

- Around a decade of work as Unix sysadmin
- Member of file system engineering team at Red Hat since 2006
- Joined worldwide Samba team in 2008
- Primarily work on NFS and CIFS, but also dabble in generic VFS layer (and other places)
- Maintain the cifs-utils package upstream, and in Fedora and RHEL



Overview

- Basic Kerberos Concepts
- CIFS and Kerberos 5
- Problems with current implementation
- Deployment scenarios and recommendations
- Future directions



Introduction to Kerberos

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What is Kerberos?

- Secure authentication over insecure networks:
 - Verify identity without exposing passwords to network
 - Relies on a trusted 3rd party – the Key Distribution Center (KDC)
 - All entities (users and services) are considered “principals” to the KDC
 - Authentication is mutual

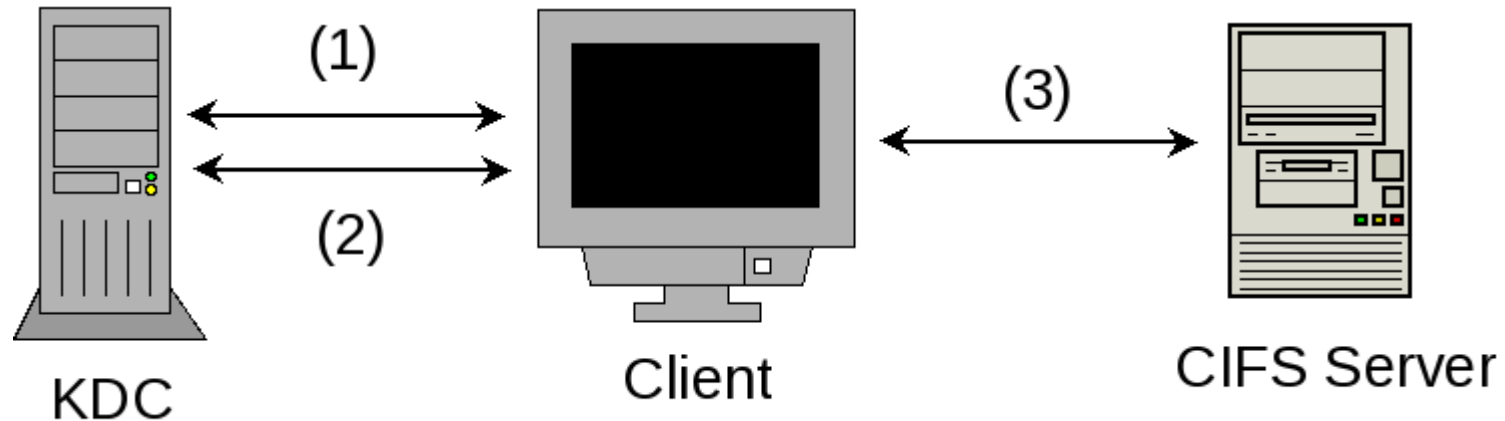


A Brief History of Kerberos

- Invented at MIT, first publication of v4 in the 1980's
- v5 published in 1993
- Most Unix-like OS's have had it for many years
- Microsoft adopted it as the basis of its authentication model with Windows 2000



Overview of Kerberos Authentication



- 1) Get Ticket Granting Ticket (TGT)
- 2) Use TGT to get service ticket
- 3) Use service ticket to establish server session



Krb5 Principal Format

primary/instance@REALM

- **primary:** user or service name (e.g. “nfs”, “cifs”, or “host”)
- **instance:** optional qualifier. Usually FQDN for service principals. Sometimes “/admin” for user principals.
- **realm:** all principals are unique within a realm. Convention is to use DNS domain name in uppercase.

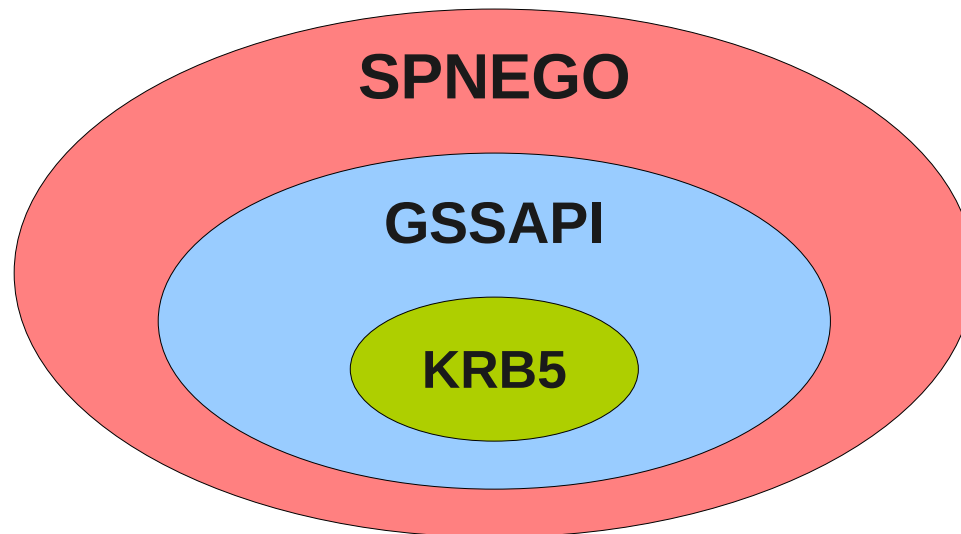


Examples of Principals

- User Principals:
 - `jlayton@EXAMPLE.COM`
 - `jlayton/admin@EXAMPLE.COM`
- Service Principals:
 - `host/server.example.com@EXAMPLE.COM`
 - `cifs/server.example.com@EXAMPLE.COM`



Authentication Layers



- **GSSAPI:** Generic Security Services Application Programming Interface. A standard plugin interface for authentication schemes.
- **SPNEGO:** Simple Protected GSSAPI Negotiation Mechanism. A way for client and server to agree on an authentication method to use.



CIFS and Kerberos 5

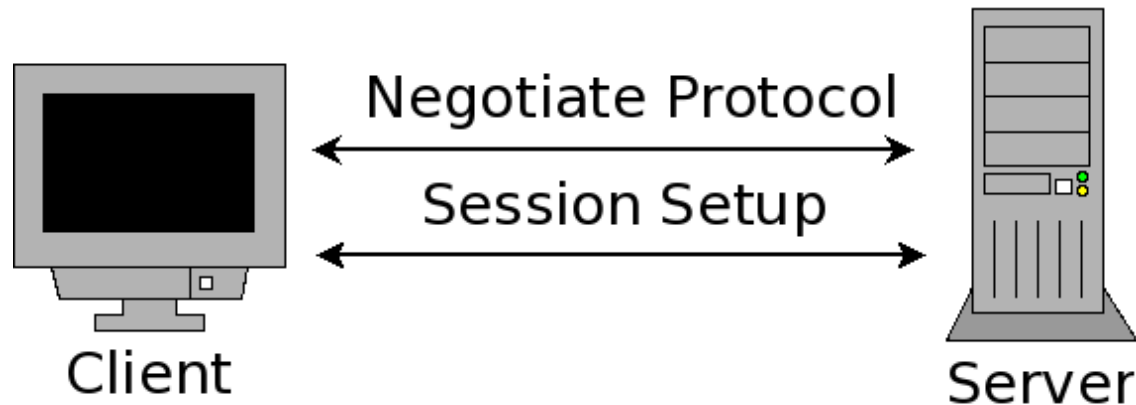
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CIFS Authentication with KRB5

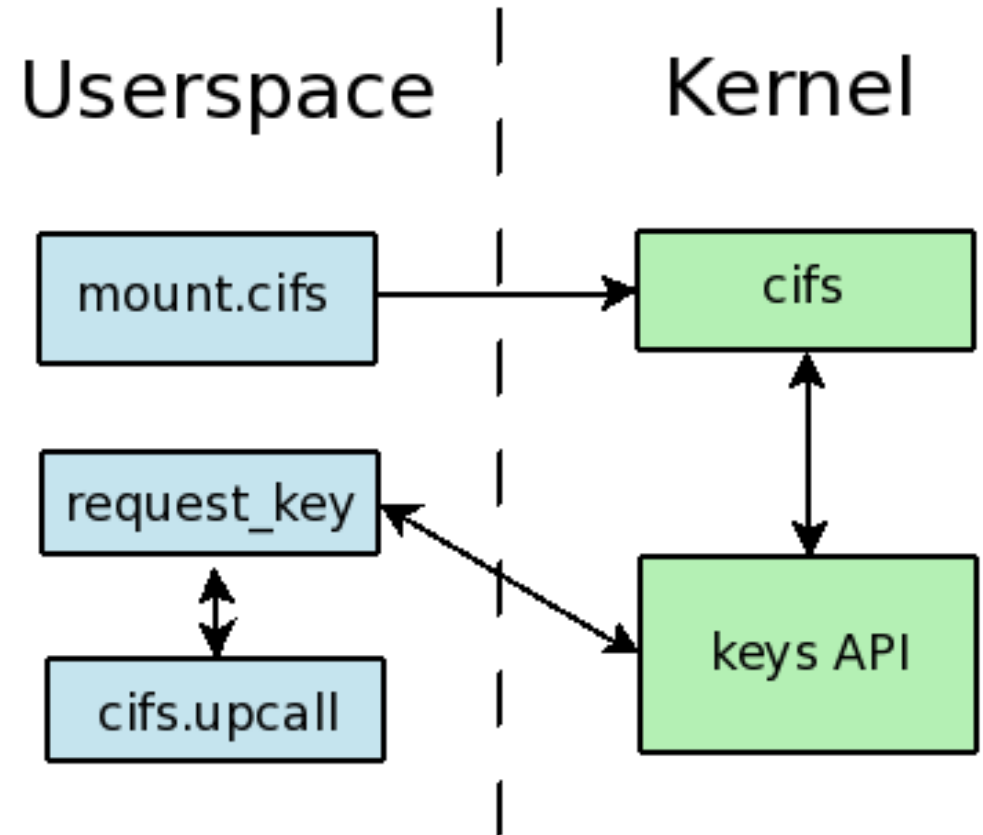


- Client sends NegProt req with extended security bit set
- Server replies with list of auth methods that it supports (via SPNEGO)
- Client sends Session Setup request with SPNEGO blob that contains KRB5 ticket wrapped in GSSAPI



CIFS+KRB5 Upcall Process

- mount.cifs requests krb5 auth
- cifs calls into keys API for SPNEGO blob
- keys api calls out to /sbin/request_key
- request_key calls cifs.upcall which builds SPNEGO blob



Requirements for CIFS + krb5

- Linux kernel that supports SPNEGO upcalls
 - Support first went into mainline in 2.6.24
 - Also backported to RHEL5.3
- Client Configured for krb5 (**`/etc/krb5.conf`**)
- **`/sbin/request-key`**
 - part of the “keyutils” package
- **`/usr/sbin/cifs.upcall`**
 - RHEL5 & Fedora (pre F13): samba-client package
 - RHEL6 & F13+: cifs-utils package



Basic krb5.conf configuration

- Easiest to use **system-config-authentication**
- Basic config follows:

```
[realms]
EXAMPLE.COM = {
    kdc = ad.example.com:88
    admin_server = ad.example.com:749
}
```

```
[domain_realm]
.example.com = EXAMPLE.COM
example.com = EXAMPLE.COM
```



Configuring /etc/request-key.conf

Tells request-key program what program it should run and how. Note that cifs also uses this to handle DNS resolution for DFS (see cifs.upcall(8)):

/etc/request-key.conf:

```
#OPERATION  TYPE          D C PROGRAM ARG1 ARG2...
#=====
create      cifs.spnego   * * /usr/sbin/cifs.upcall %k
create      dns_resolver * * /usr/sbin/cifs.upcall %k
```



Simple Mount with krb5

- Get a krb5 ticket for the user as whom you'll be authenticating.
- Then mount the share with the sec=krb5 option
 - **Hostname in UNC much match service principal!**

```
# kinit testuser@EXAMPLE.COM
```

```
Password for testuser@EXAMPLE.COM:
```

```
# mount -t cifs -o sec=krb5 \  
//server.example.com/export /mnt/cifs
```



Problems with Current Implementation

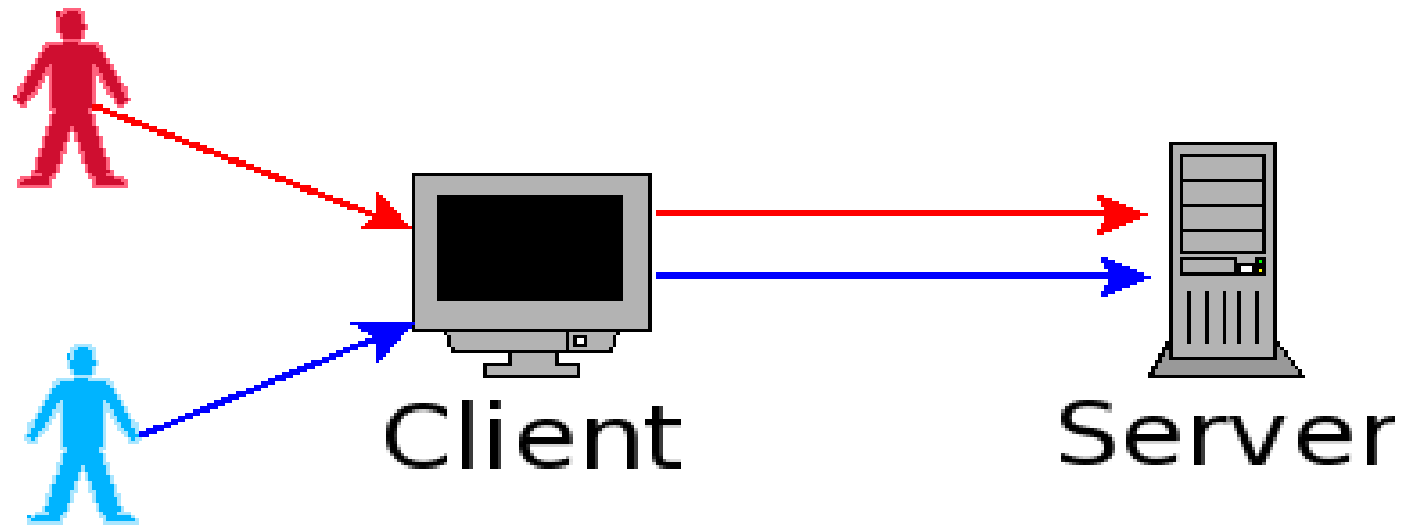
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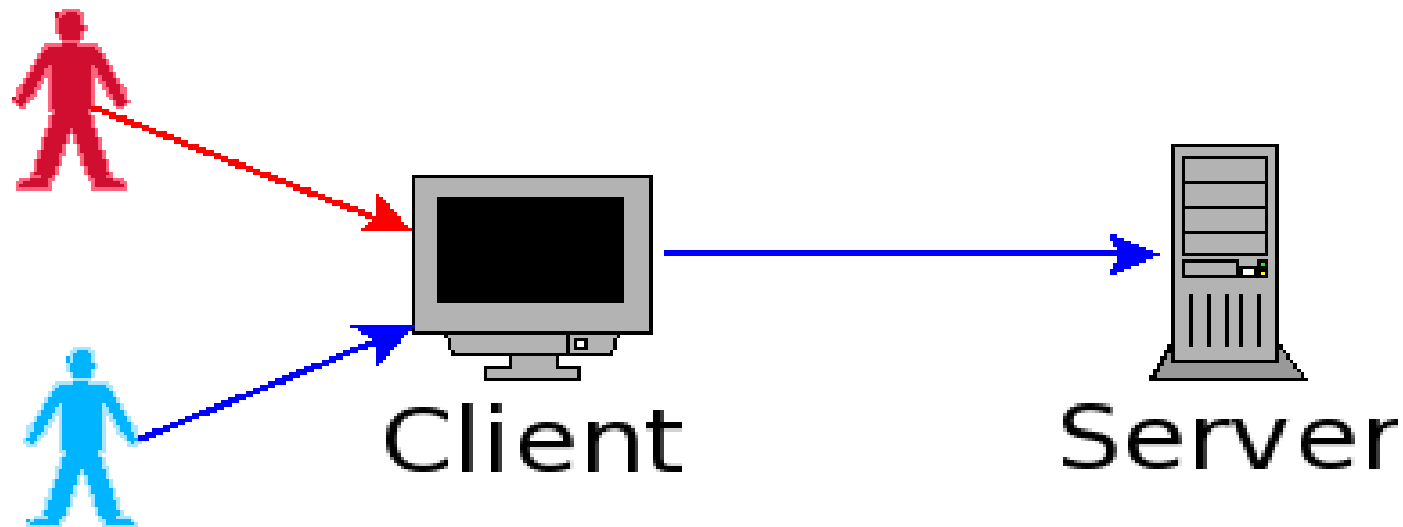
The NFS Mount Model



- “Traditional” network filesystem for unix is NFS
- User creds are sent to the server in each call
- No one “owns” the connection to the server



The CIFS Mount Model Today



- Only one CIFS session per mount
- One set of credentials per CIFS session
- Other users who use the mount are using the same credentials as the user who “owns” the mount



POSIX Extensions

- CIFS enables POSIX extensions by default
- Problems with modes and ownership:
 - uid/gid may not match on client and server
 - uid=/gid= mount options override ownership but not mode. The result is permissions that have no basis in reality.
 - all ops on the server are done using mount creds, but VFS enforces these permissions locally. The client's VFS may limit a user from doing ops that the server would allow



File Creation and Permissions

- First test:
 - Mount cifs share with one user's credentials and with unix extensions enabled
 - Share is world-writable
 - “touch” file in share as another user

```
$ touch testfile
touch: cannot touch `testfile': Permission denied
$ ls testfile
testfile
```



What happened?



- File was created on server using mount credentials
- CIFS attempts to enforce permissions on client
- That can't fix ownership
- File is created but later operations fail!



Permissions Enforcement

- Second test:
 - Mount share with one user's credentials and without unix permissions
 - As another user, access a file that should be accessible by only that user.
- You can't enforce permissions correctly if you don't know what they should be
- Even if you do, checking on the client is racy – permissions can change after you check them but before they are enforced



So there are problems...

- Summary:
 - POSIX extensions aren't terribly useful as implemented by CIFS VFS
 - “shared” mounts don't work as expected
- Recommendations:
 - Limit permissions to the user who owns the creds
 - Maybe disable unix extensions altogether?



Deploying CIFS with Kerberos 5

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User mounts in /etc/fstab

- mount(8) allows unprivileged users to mount filesystems if:
 - /bin/mount and mount helper are setuid root (not recommended with the version that ships in RHEL4/5)
 - the user owns the mountpoint
 - mount is in /etc/fstab with “user” option (distinct from user= option that CIFS uses)



User mounts in /etc/fstab

/etc/fstab:

```
//server/share /home/testuser/cifs \
sec=krb5,user,nounix,file_mode=0700, \
dir_mode=0700,noauto 0 0
```

Then, as unprivileged user:

```
testuser@client$ kinit
```

Password for testuser@EXAMPLE.COM:

```
testuser@client$ mount /home/testuser/cifs
```



Using autofs

- Another possibility is to use autofs:

```
jlayton \  
-fstype=cifs,sec=krb5,uid=$UID,gid=$GID \  
\\server.example.com\jlayton
```

- How do we ensure that the “right” user gets the mount?



Using pam_mount

- Linux PAM module that can mount filesystems on login
 - PAM == Pluggable Authentication Modules
- Users can configure their own set of mounts (within limits set by admin)
- Most useful when combined with pam_krb5
- see pam_mount(8) and pam_mount.conf(5)



What about MultiuserMount?

- Can be enabled via:

`/proc/fs/cifs/MultiuserMount`

- When there are multiple sessions to the same server, use one that's owned by my UID
- Problems with this approach:
 - Requires a separate mount for each user
 - Users w/o a mount use “default” creds
 - Permissions and file ownership, writeback...



Future Development

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MultiuserMount Redux

- Patchset in progress to do multiuser mounts the “right way” (renamed “multisession mounts” to avoid confusion)
- Have multiple sessions per mount
- Sessions are established on an as-needed basis using krb5 creds
 - and possibly NTLM auth later
- Server handles permissions
- **Goal:** as easy as Kerberized NFS (or easier)



Questions?

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