Clustered CIFS For Everybody
Clustering Samba With CTDB

LinuxTag 2009

Michael Adam

obnox@samba.org

Samba Team / SerNet

2009-06-24

Outline

About /me

- Developer / member of the Samba Team
  `http://www.samba.org/samba/team`
- Cluster support in Samba / CTDB, registry configuration, ...
  `http://www.samba.org/~obnox/`
- Software engineer and consultant at SerNet GmbH (Germany)
  `http://www.sernet.de/`

Outline

Basic Ideas

- storage tends to become too small
- ⇒ use a SAN and volume based file systems
- services using the storage tend to become too slow
- ⇒ cluster these services (all-active)
- this clustering makes use of a *clustered file system*
- quite common for web and database servers
- how about offering the file system itself via CIFS or NFS in a clustered fashion?
- i.e. turn your SAN in a clustered NAS...
- Windows servers don't offer this form of clustering
- Samba now does! With the help of CTDB.

Basic Ideas

- storage tends to become too small
- ⇒ use a SAN and volume based file systems
- services using the storage tend to become too slow
- ⇒ cluster these services (all-active)
- this clustering makes use of a *clustered file system*
- quite common for web and database servers
- how about offering the file system itself via CIFS or NFS in a clustered fashion?
- i.e. turn your SAN in a clustered NAS...
- Windows servers don't offer this form of clustering
- Samba now does! With the help of CTDB.

Basic Ideas

- storage tends to become too small
- ⇒ use a SAN and volume based file systems
- services using the storage tend to become too slow
- ⇒ cluster these services (all-active)
- this clustering makes use of a *clustered file system*
- quite common for web and database servers
- how about offering the file system itself via CIFS or NFS in a clustered fashion?
- i.e. turn your SAN in a clustered NAS...
- Windows servers don't offer this form of clustering
- Samba now does! With the help of CTDB.

Basic Ideas

- storage tends to become too small
- ⇒ use a SAN and volume based file systems
- services using the storage tend to become too slow
- ⇒ cluster these services (all-active)
- this clustering makes use of a *clustered file system*
- quite common for web and database servers
- how about offering the file system itself via CIFS or NFS in a clustered fashion?
- i.e. turn your SAN in a clustered NAS...
- Windows servers don't offer this form of clustering
- Samba now does! With the help of CTDB.

Basic Ideas

- storage tends to become too small
- ⇒ use a SAN and volume based file systems
- services using the storage tend to become too slow
- ⇒ cluster these services (all-active)
- this clustering makes use of a *clustered file system*
- quite common for web and database servers
- how about offering the file system itself via CIFS or NFS in a clustered fashion?
- i.e. turn your SAN in a clustered NAS...
- Windows servers don't offer this form of clustering
- Samba now does! With the help of CTDB.

Basic Ideas

- storage tends to become too small
- ⇒ use a SAN and volume based file systems
- services using the storage tend to become too slow
- ⇒ cluster these services (all-active)
- this clustering makes use of a *clustered file system*
- quite common for web and database servers
- how about offering the file system itself via CIFS or NFS in a clustered fashion?
- i.e. turn your SAN in a clustered NAS...
- Windows servers don't offer this form of clustering
- Samba now does! With the help of CTDB.

Basic Ideas

- storage tends to become too small
- ⇒ use a SAN and volume based file systems
- services using the storage tend to become too slow
- ⇒ cluster these services (all-active)
- this clustering makes use of a *clustered file system*
- quite common for web and database servers
- how about offering the file system itself via CIFS or NFS in a clustered fashion?
- i.e. turn your SAN in a clustered NAS...
- Windows servers don't offer this form of clustering
- Samba now does! With the help of CTDB.

Basic Ideas

- storage tends to become too small
- ⇒ use a SAN and volume based file systems
- services using the storage tend to become too slow
- ⇒ cluster these services (all-active)
- this clustering makes use of a *clustered file system*
- quite common for web and database servers
- how about offering the file system itself via CIFS or NFS in a clustered fashion?
- i.e. turn your SAN in a clustered NAS...
- Windows servers don't offer this form of clustering
- Samba now does! With the help of CTDB.

Basic Ideas

- storage tends to become too small
- ⇒ use a SAN and volume based file systems
- services using the storage tend to become too slow
- ⇒ cluster these services (all-active)
- this clustering makes use of a *clustered file system*
- quite common for web and database servers
- how about offering the file system itself via CIFS or NFS in a clustered fashion?
- i.e. turn your SAN in a clustered NAS...
- Windows servers don't offer this form of clustering
- Samba now does! With the help of CTDB.

Basic Ideas

- storage tends to become too small
- ⇒ use a SAN and volume based file systems
- services using the storage tend to become too slow
- ⇒ cluster these services (all-active)
- this clustering makes use of a *clustered file system*
- quite common for web and database servers
- how about offering the file system itself via CIFS or NFS in a clustered fashion?
- i.e. turn your SAN in a clustered NAS...
- Windows servers don't offer this form of clustering
- Samba now does! With the help of CTDB.

About Samba

- open source software (GPL) started in 1992
- file and print services for windows clients on unix systems
- makes unix host appear in the windows network neighborhood
- member file server in windows NT and Active Directory domains
- can act as NT-style domain controller (logon server)
- deployed widely in production environments
- Samba4 (alpha): Active Directory domain controller
- "Franky": glue the good parts together

Challenges For Samba

- samba daemons on cluster nodes need to act as *one* CIFS server:
  - view of file ownership
  - windows file lock coherence
- samba instances need to share certain persistent data:
  - user database (`passdb.tdb`)
  - join information (`secrets.tdb`)
  - id mapping tables (`winbindd_idmap.tdb`)
- further share volatile session data:
  - SMB sessions (`sessionid.tdb`)
  - share connections (`connections.tdb`)
  - share modes (`locking.tdb`)
  - byte range locks (`brlock.tdb`)
- messaging

Challenges For Samba

- samba daemons on cluster nodes need to act as *one* CIFS server:
  - view of file ownership
  - windows file lock coherence
- samba instances need to share certain persistent data:
  - user database (`passdb.tdb`)
  - join information (`secrets.tdb`)
  - id mapping tables (`winbindd_idmap.tdb`)
- further share volatile session data:
  - SMB sessions (`sessionid.tdb`)
  - share connections (`connections.tdb`)
  - share modes (`locking.tdb`)
  - byte range locks (`brlock.tdb`)
- messaging

Challenges For Samba

- samba daemons on cluster nodes need to act as *one* CIFS server:
  - view of file ownership
  - windows file lock coherence
- samba instances need to share certain persistent data:
  - user database (`passdb.tdb`)
  - join information (`secrets.tdb`)
  - id mapping tables (`winbindd_idmap.tdb`)
- further share volatile session data:
  - SMB sessions (`sessionid.tdb`)
  - share connections (`connections.tdb`)
  - share modes (`locking.tdb`)
  - byte range locks (`brlock.tdb`)
- messaging

Challenges For Samba

- samba daemons on cluster nodes need to act as *one* CIFS server:
  - view of file ownership
  - windows file lock coherence
- samba instances need to share certain persistent data:
  - user database (`passdb.tdb`)
  - join information (`secrets.tdb`)
  - id mapping tables (`winbindd_idmap.tdb`)
- further share volatile session data:
  - SMB sessions (`sessionid.tdb`)
  - share connections (`connections.tdb`)
  - share modes (`locking.tdb`)
  - byte range locks (`brlock.tdb`)
- messaging

Challenges For Samba

- samba daemons on cluster nodes need to act as *one* CIFS server:
  - view of file ownership
  - windows file lock coherence
- samba instances need to share certain persistent data:
  - user database (`passdb.tdb`)
  - join information (`secrets.tdb`)
  - id mapping tables (`winbindd_idmap.tdb`)
- further share volatile session data:
  - SMB sessions (`sessionid.tdb`)
  - share connections (`connections.tdb`)
  - share modes (`locking.tdb`)
  - byte range locks (`brlock.tdb`)
- messaging

Challenges For Samba

- samba daemons on cluster nodes need to act as *one* CIFS server:
  - view of file ownership
  - windows file lock coherence
- samba instances need to share certain persistent data:
  - user database (`passdb.tdb`)
  - join information (`secrets.tdb`)
  - id mapping tables (`winbindd_idmap.tdb`)
- further share volatile session data:
  - SMB sessions (`sessionid.tdb`)
  - share connections (`connections.tdb`)
  - share modes (`locking.tdb`)
  - byte range locks (`brlock.tdb`)
- messaging

Challenges For Samba

- samba daemons on cluster nodes need to act as *one* CIFS server:
  - view of file ownership
  - windows file lock coherence
- samba instances need to share certain persistent data:
  - user database (`passdb.tdb`)
  - join information (`secrets.tdb`)
  - id mapping tables (`winbindd_idmap.tdb`)
- further share volatile session data:
  - SMB sessions (`sessionid.tdb`)
  - share connections (`connections.tdb`)
  - share modes (`locking.tdb`)
  - byte range locks (`brlock.tdb`)
- messaging

Challenges For Samba

- samba daemons on cluster nodes need to act as *one* CIFS server:
  - view of file ownership
  - windows file lock coherence
- samba instances need to share certain persistent data:
  - user database (`passdb.tdb`)
  - join information (`secrets.tdb`)
  - id mapping tables (`winbindd_idmap.tdb`)
- further share volatile session data:
  - SMB sessions (`sessionid.tdb`)
  - share connections (`connections.tdb`)
  - share modes (`locking.tdb`)
  - byte range locks (`brlock.tdb`)
- messaging

Challenges For Samba

- samba daemons on cluster nodes need to act as *one* CIFS server:
  - view of file ownership
  - windows file lock coherence
- samba instances need to share certain persistent data:
  - user database (`passdb.tdb`)
  - join information (`secrets.tdb`)
  - id mapping tables (`winbindd_idmap.tdb`)
- further share volatile session data:
  - SMB sessions (`sessionid.tdb`)
  - share connections (`connections.tdb`)
  - share modes (`locking.tdb`)
  - byte range locks (`brlock.tdb`)
- messaging

Challenges For Samba

- samba daemons on cluster nodes need to act as *one* CIFS server:
  - view of file ownership
  - windows file lock coherence
- samba instances need to share certain persistent data:
  - user database (`passdb.tdb`)
  - join information (`secrets.tdb`)
  - id mapping tables (`winbindd_idmap.tdb`)
- further share volatile session data:
  - SMB sessions (`sessionid.tdb`)
  - share connections (`connections.tdb`)
  - share modes (`locking.tdb`)
  - byte range locks (`brlock.tdb`)
- messaging

Challenges For Samba

- samba daemons on cluster nodes need to act as *one* CIFS server:
  - view of file ownership
  - windows file lock coherence
- samba instances need to share certain persistent data:
  - user database (`passdb.tdb`)
  - join information (`secrets.tdb`)
  - id mapping tables (`winbindd_idmap.tdb`)
- further share volatile session data:
  - SMB sessions (`sessionid.tdb`)
  - share connections (`connections.tdb`)
  - share modes (`locking.tdb`)
  - byte range locks (`brlock.tdb`)
- messaging

Challenges For Samba

- samba daemons on cluster nodes need to act as *one* CIFS server:
  - view of file ownership
  - windows file lock coherence
- samba instances need to share certain persistent data:
  - user database (`passdb.tdb`)
  - join information (`secrets.tdb`)
  - id mapping tables (`winbindd_idmap.tdb`)
- further share volatile session data:
  - SMB sessions (`sessionid.tdb`)
  - share connections (`connections.tdb`)
  - share modes (`locking.tdb`)
  - byte range locks (`brlock.tdb`)
- messaging

Challenges For Samba

- samba daemons on cluster nodes need to act as *one* CIFS server:
  - view of file ownership
  - windows file lock coherence
- samba instances need to share certain persistent data:
  - user database (`passdb.tdb`)
  - join information (`secrets.tdb`)
  - id mapping tables (`winbindd_idmap.tdb`)
- further share volatile session data:
  - SMB sessions (`sessionid.tdb`)
  - share connections (`connections.tdb`)
  - share modes (`locking.tdb`)
  - byte range locks (`brlock.tdb`)
- messaging

TDBs And Clustering

- most problems are about distributing TDBs in the cluster
- TDB: small, fast Berkeley-DB-style database with record locks and memory mapping
- persistent TDBs vs. "normal" (volatile) TDBs
- TDB R/W performance critical for Samba performance
- TDB R/W ops: excessive use of POSIX `fcntl` byte range locks
- `fcntl` locks are *slow* on cluster file systems
- the more nodes, the slower...
- $\Rightarrow$ naive approach of putting TDBs on cluster storage works in principle but scales *very badly*
- $\Rightarrow$ A more clever approach is needed.

TDBs And Clustering

- most problems are about distributing TDBs in the cluster
- TDB: small, fast Berkeley-DB-style database with record locks and memory mapping
- persistent TDBs vs. "normal" (volatile) TDBs
- TDB R/W performance critical for Samba performance
- TDB R/W ops: excessive use of POSIX `fcntl` byte range locks
- `fcntl` locks are *slow* on cluster file systems
- the more nodes, the slower...
- $\Rightarrow$ naive approach of putting TDBs on cluster storage works in principle but scales *very badly*
- $\Rightarrow$ A more clever approach is needed.

TDBs And Clustering

- most problems are about distributing TDBs in the cluster
- TDB: small, fast Berkeley-DB-style database with record locks and memory mapping
- persistent TDBs vs. "normal" (volatile) TDBs
- TDB R/W performance critical for Samba performance
- TDB R/W ops: excessive use of POSIX `fcntl` byte range locks
- `fcntl` locks are *slow* on cluster file systems
- the more nodes, the slower...
- $\Rightarrow$ naive approach of putting TDBs on cluster storage works in principle but scales *very badly*
- $\Rightarrow$ A more clever approach is needed.

TDBs And Clustering

- most problems are about distributing TDBs in the cluster
- TDB: small, fast Berkeley-DB-style database with record locks and memory mapping
- persistent TDBs vs. "normal" (volatile) TDBs
- TDB R/W performance critical for Samba performance
- TDB R/W ops: excessive use of POSIX `fcntl` byte range locks
- `fcntl` locks are *slow* on cluster file systems
- the more nodes, the slower...
- $\Rightarrow$ naive approach of putting TDBs on cluster storage works in principle but scales *very badly*
- $\Rightarrow$ A more clever approach is needed.

TDBs And Clustering

- most problems are about distributing TDBs in the cluster
- TDB: small, fast Berkeley-DB-style database with record locks and memory mapping
- persistent TDBs vs. "normal" (volatile) TDBs
- TDB R/W performance critical for Samba performance
- TDB R/W ops: excessive use of POSIX `fcntl` byte range locks
- `fcntl` locks are *slow* on cluster file systems
- the more nodes, the slower...
- $\Rightarrow$ naive approach of putting TDBs on cluster storage works in principle but scales *very badly*
- $\Rightarrow$ A more clever approach is needed.

TDBs And Clustering

- most problems are about distributing TDBs in the cluster
- TDB: small, fast Berkeley-DB-style database with record locks and memory mapping
- persistent TDBs vs. "normal" (volatile) TDBs
- TDB R/W performance critical for Samba performance
- TDB R/W ops: excessive use of POSIX `fcntl` byte range locks
- `fcntl` locks are *slow* on cluster file systems
- the more nodes, the slower...
- $\Rightarrow$ naive approach of putting TDBs on cluster storage works in principle but scales *very badly*
- $\Rightarrow$ A more clever approach is needed.

TDBs And Clustering

- most problems are about distributing TDBs in the cluster
- TDB: small, fast Berkeley-DB-style database with record locks and memory mapping
- persistent TDBs vs. "normal" (volatile) TDBs
- TDB R/W performance critical for Samba performance
- TDB R/W ops: excessive use of POSIX `fcntl` byte range locks
- `fcntl` locks are *slow* on cluster file systems
- the more nodes, the slower...
- $\Rightarrow$ naive approach of putting TDBs on cluster storage works in principle but scales *very badly*
- $\Rightarrow$ A more clever approach is needed.

TDBs And Clustering

- most problems are about distributing TDBs in the cluster
- TDB: small, fast Berkeley-DB-style database with record locks and memory mapping
- persistent TDBs vs. "normal" (volatile) TDBs
- TDB R/W performance critical for Samba performance
- TDB R/W ops: excessive use of POSIX `fcntl` byte range locks
- `fcntl` locks are *slow* on cluster file systems
- the more nodes, the slower...
- ⇒ naive approach of putting TDBs on cluster storage works in principle but scales *very badly*
- ⇒ A more clever approach is needed.

TDBs And Clustering

- most problems are about distributing TDBs in the cluster
- TDB: small, fast Berkeley-DB-style database with record locks and memory mapping
- persistent TDBs vs. "normal" (volatile) TDBs
- TDB R/W performance critical for Samba performance
- TDB R/W ops: excessive use of POSIX `fcntl` byte range locks
- `fcntl` locks are *slow* on cluster file systems
- the more nodes, the slower...
- $\Rightarrow$ naive approach of putting TDBs on cluster storage works in principle but scales *very badly*
- $\Rightarrow$ A more clever approach is needed.

Goals

- Cluster Samba so that:
  - One node is not slower than an unclustered Samba server.
  - $n + 1$ nodes are faster than n nodes.
- This requires a clustered TDB implementation ...
- ... and a clustered messaging solution.

$\Rightarrow \Rightarrow \rightarrow$

Goals

- Cluster Samba so that:
  - One node is not slower than an unclustered Samba server.
  - $n + 1$ nodes are faster than n nodes.
- This requires a clustered TDB implementation ...
- ... and a clustered messaging solution.

$\Rightarrow \Rightarrow \rightarrow$

Goals

- Cluster Samba so that:
  - One node is not slower than an unclustered Samba server.
  - $n + 1$ nodes are faster than n nodes.
- This requires a clustered TDB implementation ...
- ... and a clustered messaging solution.

$\Rightarrow \Rightarrow \rightarrow$

Goals

- Cluster Samba so that:
  - One node is not slower than an unclustered Samba server.
  - $n + 1$ nodes are faster than n nodes.
- This requires a clustered TDB implementation ...
- ... and a clustered messaging solution.

Goals

- Cluster Samba so that:
  - One node is not slower than an unclustered Samba server.
  - $n + 1$ nodes are faster than n nodes.
- This requires a clustered TDB implementation ...
- ... and a clustered messaging solution.

Goals

- Cluster Samba so that:
  - One node is not slower than an unclustered Samba server.
  - $n + 1$ nodes are faster than n nodes.
- This requires a clustered TDB implementation ...
- ... and a clustered messaging solution.

Goals

- Cluster Samba so that:
  - One node is not slower than an unclustered Samba server.
  - $n + 1$ nodes are faster than n nodes.
- This requires a clustered TDB implementation ...
- ... and a clustered messaging solution.

⇒ ⇒ ⇒ ⇒ ⇒

Goals

- Cluster Samba so that:
  - One node is not slower than an unclustered Samba server.
  - $n + 1$ nodes are faster than n nodes.
- This requires a clustered TDB implementation ...
- ... and a clustered messaging solution.

$\Rightarrow \Rightarrow \Rightarrow \Rightarrow \Rightarrow$ CTDB $\Rightarrow$

Goals

- Cluster Samba so that:
  - One node is not slower than an unclustered Samba server.
  - $n + 1$ nodes are faster than n nodes.
- This requires a clustered TDB implementation ...
- ... and a clustered messaging solution.

$\Rightarrow \Rightarrow \Rightarrow \Rightarrow \Rightarrow$ CTDB :-)

Goals

- Cluster Samba so that:
  - One node is not slower than an unclustered Samba server.
  - $n + 1$ nodes are faster than n nodes.
- This requires a clustered TDB implementation ...
- ... and a clustered messaging solution.

$\Rightarrow \Rightarrow \Rightarrow \Rightarrow \Rightarrow$ CTDB :-)

Goals

- Cluster Samba so that:
  - One node is not slower than an unclustered Samba server.
  - $n + 1$ nodes are faster than n nodes.
- This requires a clustered TDB implementation ...
- ... and a clustered messaging solution.

$\Rightarrow \Rightarrow \Rightarrow \Rightarrow \Rightarrow$ CTDB :-)

Outline

The CTDB Project

- started in 2006
- first prototypes by Volker Lendecke, Andrew Tridgell, ...
- first usable version of CTDB: April 2007
- meanwhile: Ronnie Sahlberg project maintainer
- `git://git.samba.org/sahlberg/ctdb.git`
- `http://ctdb.samba.org/packages/` (RPMs, Sources)
- Currently runs on Linux and AIX

The CTDB Project

- started in 2006
- first prototypes by Volker Lendecke, Andrew Tridgell, ...
- first usable version of CTDB: April 2007
- meanwhile: Ronnie Sahlberg project maintainer
- `git://git.samba.org/sahlberg/ctdb.git`
- `http://ctdb.samba.org/packages/` (RPMs, Sources)
- Currently runs on Linux and AIX

The CTDB Project

- started in 2006
- first prototypes by Volker Lendecke, Andrew Tridgell, ...
- first usable version of CTDB: April 2007
- meanwhile: Ronnie Sahlberg project maintainer
- `git://git.samba.org/sahlberg/ctdb.git`
- `http://ctdb.samba.org/packages/` (RPMs, Sources)
- Currently runs on Linux and AIX

The CTDB Project

- started in 2006
- first prototypes by Volker Lendecke, Andrew Tridgell, ...
- first usable version of CTDB: April 2007
- meanwhile: Ronnie Sahlberg project maintainer
- `git://git.samba.org/sahlberg/ctdb.git`
- `http://ctdb.samba.org/packages/` (RPMs, Sources)
- Currently runs on Linux and AIX

The CTDB Project

- started in 2006
- first prototypes by Volker Lendecke, Andrew Tridgell, ...
- first usable version of CTDB: April 2007
- meanwhile: Ronnie Sahlberg project maintainer
- `git://git.samba.org/sahlberg/ctdb.git`
- `http://ctdb.samba.org/packages/` (RPMs, Sources)
- Currently runs on Linux and AIX

The CTDB Project

- started in 2006
- first prototypes by Volker Lendecke, Andrew Tridgell, ...
- first usable version of CTDB: April 2007
- meanwhile: Ronnie Sahlberg project maintainer
- `git://git.samba.org/sahlberg/ctdb.git`
- `http://ctdb.samba.org/packages/` (RPMs, Sources)
- Currently runs on Linux and AIX

The CTDB Project

- started in 2006
- first prototypes by Volker Lendecke, Andrew Tridgell, ...
- first usable version of CTDB: April 2007
- meanwhile: Ronnie Sahlberg project maintainer
- `git://git.samba.org/sahlberg/ctdb.git`
- `http://ctdb.samba.org/packages/` (RPMs, Sources)
- Currently runs on Linux and AIX

CTDB Design

- one daemon `ctdbd` on each node
- `smbd` talks to local ctdbd for messaging and TDB access
- `ctdbd` handles metadata of TDBs via the network
- `ctdbd` keeps local TDB copy (LTDB) for fast data reads/writes
- persistent and normal TDBs are handled differently
- CTDB distributes public IPs across cluster nodes
- management features: Samba, NFS and other services

CTDB Design

- one daemon `ctdbd` on each node
- `smbd` talks to local ctdbd for messaging and TDB access
- `ctdbd` handles metadata of TDBs via the network
- `ctdbd` keeps local TDB copy (LTDB) for fast data reads/writes
- persistent and normal TDBs are handled differently
- CTDB distributes public IPs across cluster nodes
- management features: Samba, NFS and other services

CTDB Design

- one daemon `ctdbd` on each node
- `smbd` talks to local ctdbd for messaging and TDB access
- `ctdbd` handles metadata of TDBs via the network
- `ctdbd` keeps local TDB copy (LTDB) for fast data reads/writes
- persistent and normal TDBs are handled differently
- CTDB distributes public IPs across cluster nodes
- management features: Samba, NFS and other services

CTDB Design

- one daemon `ctdbd` on each node
- `smbd` talks to local ctdbd for messaging and TDB access
- `ctdbd` handles metadata of TDBs via the network
- `ctdbd` keeps local TDB copy (LTDB) for fast data reads/writes
- persistent and normal TDBs are handled differently
- CTDB distributes public IPs across cluster nodes
- management features: Samba, NFS and other services

CTDB Design

- one daemon `ctdbd` on each node
- `smbd` talks to local ctdbd for messaging and TDB access
- `ctdbd` handles metadata of TDBs via the network
- `ctdbd` keeps local TDB copy (LTDB) for fast data reads/writes
- persistent and normal TDBs are handled differently
- CTDB distributes public IPs across cluster nodes
- management features: Samba, NFS and other services

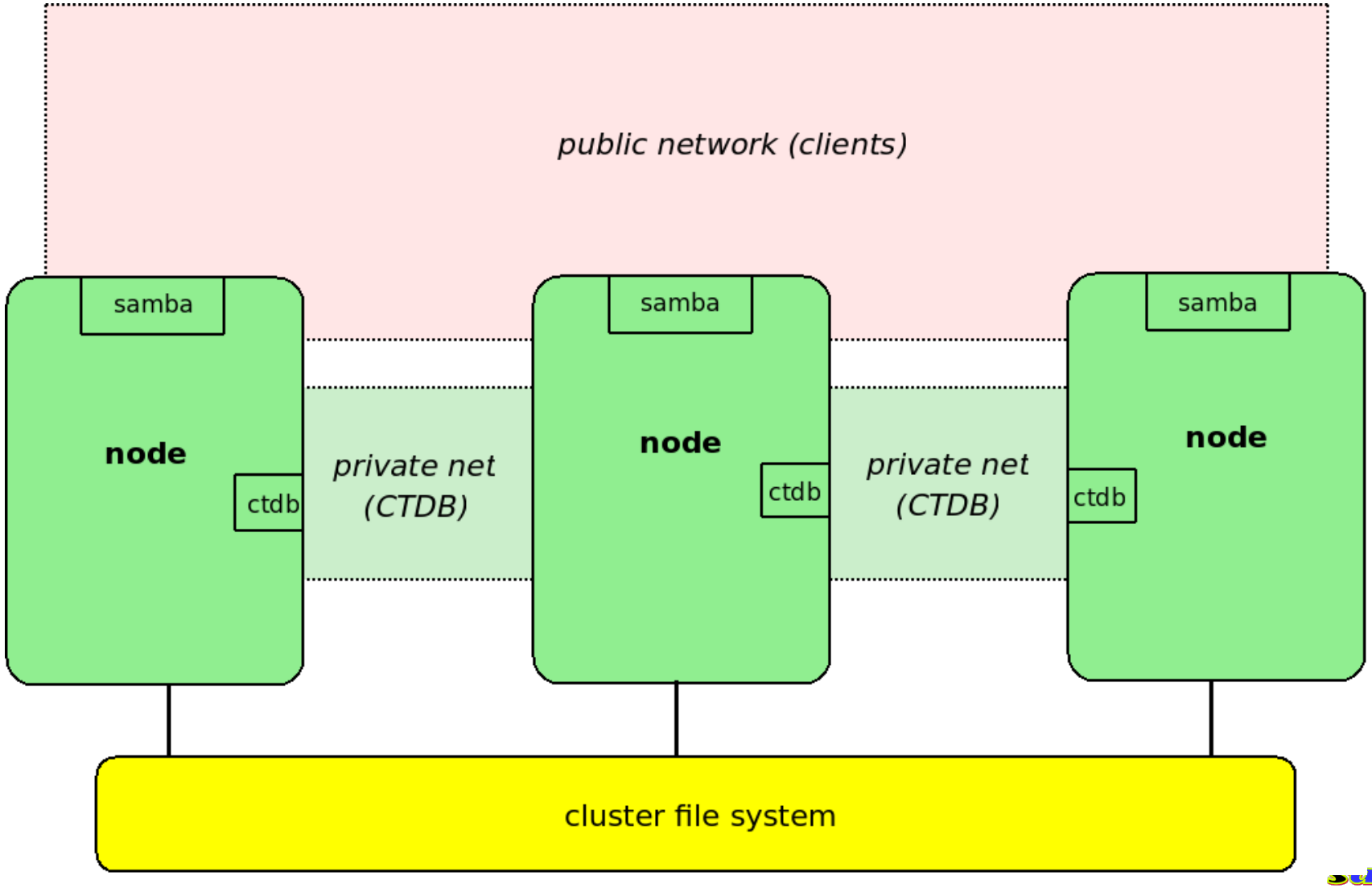
CTDB Design

- one daemon `ctdbd` on each node
- `smbd` talks to local ctdbd for messaging and TDB access
- `ctdbd` handles metadata of TDBs via the network
- `ctdbd` keeps local TDB copy (LTDB) for fast data reads/writes
- persistent and normal TDBs are handled differently
- CTDB distributes public IPs across cluster nodes
- management features: Samba, NFS and other services

CTDB Design

- one daemon `ctdbd` on each node
- `smbd` talks to local ctdbd for messaging and TDB access
- `ctdbd` handles metadata of TDBs via the network
- `ctdbd` keeps local TDB copy (LTDB) for fast data reads/writes
- persistent and normal TDBs are handled differently
- CTDB distributes public IPs across cluster nodes
- management features: Samba, NFS and other services

CTDB - Basic Setup



persistent TDBs

- complete copy in LTDB on all nodes
- read ops directly on LTDB (fast)
- write ops automatically distributed to all nodes (slow)
- $\Rightarrow$ data integrity and read performance guaranteed

normal TDBs

- some records may be lost
- keep only needed records in LTDB
- most records are only ever accessed by one node
- only one node has current copy of a record (*data master*)
- before accessing a record, switch data master role
- $\Rightarrow$ good R/W performance, and sufficient data integrity

Performance Figures

By Andrew Tridgell and Ronnie Sahlberg, Linux Conf Australia 2008

32 client smbtorture NBENCH test

- 1 node: 109 MBytes/sec
- 2 nodes: 210 MBytes/sec
- 3 nodes: 278 MBytes/sec
- 4 nodes: 308 MBytes/sec

Recovery

- what happens when a node goes down?
- data master for some records will be lost
- one node (*recovery master*) performs *recovery*
- recovery master collects most recent copy of all records from all nodes
- at the end, the recovery master is data master for all records

Recovery

- what happens when a node goes down?
- data master for some records will be lost
- one node (*recovery master*) performs *recovery*
- recovery master collects most recent copy of all records from all nodes
- at the end, the recovery master is data master for all records

Recovery

- what happens when a node goes down?
- data master for some records will be lost
- one node (*recovery master*) performs *recovery*
- recovery master collects most recent copy of all records from all nodes
- at the end, the recovery master is data master for all records

Recovery

- what happens when a node goes down?
- data master for some records will be lost
- one node (*recovery master*) performs *recovery*
- recovery master collects most recent copy of all records from all nodes
- at the end, the recovery master is data master for all records

Recovery

- what happens when a node goes down?
- data master for some records will be lost
- one node (*recovery master*) performs *recovery*
- recovery master collects most recent copy of all records from all nodes
- at the end, the recovery master is data master for all records

Recovery Election / Recovery Lock

- recovery master is determined by an election process
- election involves *recovery lock* file on shared storage
  nodes compete with POSIX `fcntl` byte range locks
- finally, the new recovery master holds lock on the recovery lock file
- ⇒ CTDB requires POSIX `fcntl` lock support in the cluster FS
- ⇒ CTDB has no split brain (other than the file system)

Recovery Election / Recovery Lock

- recovery master is determined by an election process
- election involves *recovery lock* file on shared storage
  nodes compete with POSIX `fcntl` byte range locks
- finally, the new recovery master holds lock on the recovery lock file
- ⇒ CTDB requires POSIX `fcntl` lock support in the cluster FS
- ⇒ CTDB has no split brain (other than the file system)

Recovery Election / Recovery Lock

- recovery master is determined by an election process
- election involves *recovery lock* file on shared storage
  nodes compete with POSIX `fcntl` byte range locks
- finally, the new recovery master holds lock on the recovery lock file
- ⇒ CTDB requires POSIX `fcntl` lock support in the cluster FS
- ⇒ CTDB has no split brain (other than the file system)

Recovery Election / Recovery Lock

- recovery master is determined by an election process
- election involves *recovery lock* file on shared storage
  nodes compete with POSIX `fcntl` byte range locks
- finally, the new recovery master holds lock on the recovery lock file
- ⇒ CTDB requires POSIX `fcntl` lock support in the cluster FS
- ⇒ CTDB has no split brain (other than the file system)

Recovery Election / Recovery Lock

- recovery master is determined by an election process
- election involves *recovery lock* file on shared storage
  nodes compete with POSIX `fcntl` byte range locks
- finally, the new recovery master holds lock on the recovery lock file
- ⇒ CTDB requires POSIX `fcntl` lock support in the cluster FS
- ⇒ CTDB has no split brain (other than the file system)

Clustered File System - Requirements

- file system : black box
- storage: fibre channel, iSCSI, drbd, ...
- simulatneous writes from all nodes
- coherent POSIX `fcntl` byte range lock support
- use `ping_pong` test to verify

Clustered File System - Requirements

- file system : black box
- storage: fibre channel, iSCSI, drbd, ...
- simulatneous writes from all nodes
- coherent POSIX `fcntl` byte range lock support
- use `ping_pong` test to verify

Clustered File System - Requirements

- file system : black box
- storage: fibre channel, iSCSI, drbd, ...
- simulatneous writes from all nodes
- coherent POSIX `fcntl` byte range lock support
- use `ping_pong` test to verify

Clustered File System - Requirements

- file system : black box
- storage: fibre channel, iSCSI, drbd, ...
- simulatneous writes from all nodes
- coherent POSIX `fcntl` byte range lock support
- use `ping_pong` test to verify

Clustered File System - Requirements

- file system : black box
- storage: fibre channel, iSCSI, drbd, ...
- simulatneous writes from all nodes
- coherent POSIX `fcntl` byte range lock support
- use `ping_pong` test to verify

Special File Systems

- General Parallel File System GPFS (IBM): OK
- Global File System GFS(2) (Red Hat): OK
- GNU Cluster File System GlusterFS: OK
- Lustre (Sun): OK
- Oracle Cluster File System OCFS(2): OK (new!)

Special File Systems

- General Parallel File System GPFS (IBM): OK
- Global File System GFS(2) (Red Hat): OK
- GNU Cluster File System GlusterFS: OK
- Lustre (Sun): OK
- Oracle Cluster File System OCFS(2): OK (new!)

Special File Systems

- General Parallel File System GPFS (IBM): OK
- Global File System GFS(2) (Red Hat): OK
- GNU Cluster File System GlusterFS: OK
- Lustre (Sun): OK
- Oracle Cluster File System OCFS(2): OK (new!)

Special File Systems

- General Parallel File System GPFS (IBM): OK
- Global File System GFS(2) (Red Hat): OK
- GNU Cluster File System GlusterFS: OK
- Lustre (Sun): OK
- Oracle Cluster File System OCFS(2): OK (new!)

Special File Systems

- General Parallel File System GPFS (IBM): OK
- Global File System GFS(2) (Red Hat): OK
- GNU Cluster File System GlusterFS: OK
- Lustre (Sun): OK
- Oracle Cluster File System OCFS(2): OK (new!)

CTDB - Configuration

- central file: `/etc/sysconfig/ctdb`
- must set: `CTDB_RECOVERY_LOCK`
- fill `/etc/ctdb/nodes` with internal addresses
  same file on all nodes!

example `/etc/ctdb/nodes`

```
10.0.0.10
10.0.0.11
10.0.0.12
10.0.0.13
```

CTDB - Configuration

- central file: `/etc/sysconfig/ctdb`
- must set: `CTDB_RECOVERY_LOCK`
- fill `/etc/ctdb/nodes` with internal addresses
  same file on all nodes!

example `/etc/ctdb/nodes`

```
10.0.0.10
10.0.0.11
10.0.0.12
10.0.0.13
```

CTDB - Configuration

- central file: `/etc/sysconfig/ctdb`
- must set: `CTDB_RECOVERY_LOCK`
- fill `/etc/ctdb/nodes` with internal addresses
  same file on all nodes!

example `/etc/ctdb/nodes`

```
10.0.0.10
10.0.0.11
10.0.0.12
10.0.0.13
```

CTDB - Configuration

- central file: `/etc/sysconfig/ctdb`
- must set: `CTDB_RECOVERY_LOCK`
- fill `/etc/ctdb/nodes` with internal addresses
  same file on all nodes!

example `/etc/ctdb/nodes`

```
10.0.0.10
10.0.0.11
10.0.0.12
10.0.0.13
```

CTDB - Configuration

- central file: `/etc/sysconfig/ctdb`
- must set: `CTDB_RECOVERY_LOCK`
- fill `/etc/ctdb/nodes` with internal addresses
  same file on all nodes!

example `/etc/ctdb/nodes`

```
10.0.0.10
10.0.0.11
10.0.0.12
10.0.0.13
```

CTDB - Public Addresses

- set `CTDB_PUBLIC_ADDRESSES` in `/etc/sysconfig/ctdb`
- typical value `/etc/ctdb/public_addresses`

example `/etc/ctdb/public_addresses`

```
192.168.111.10/24 eth0
192.168.111.11/24 eth0
192.168.111.12/24 eth0
192.168.111.13/24 eth0
```

- need not be the same on all nodes
- need not even be present on all nodes (management node...)

CTDB - Public Addresses

- set `CTDB_PUBLIC_ADDRESSES` in `/etc/sysconfig/ctdb`
- typical value `/etc/ctdb/public_addresses`

example `/etc/ctdb/public_addresses`

```
192.168.111.10/24 eth0
192.168.111.11/24 eth0
192.168.111.12/24 eth0
192.168.111.13/24 eth0
```

- need not be the same on all nodes
- need not even be present on all nodes (management node...)

CTDB - Public Addresses

- set `CTDB_PUBLIC_ADDRESSES` in `/etc/sysconfig/ctdb`
- typical value `/etc/ctdb/public_addresses`

example `/etc/ctdb/public_addresses`

```
192.168.111.10/24 eth0
192.168.111.11/24 eth0
192.168.111.12/24 eth0
192.168.111.13/24 eth0
```

- need not be the same on all nodes
- need not even be present on all nodes (management node...)

CTDB - Public Addresses

- set `CTDB_PUBLIC_ADDRESSES` in `/etc/sysconfig/ctdb`
- typical value `/etc/ctdb/public_addresses`

example `/etc/ctdb/public_addresses`

```
192.168.111.10/24 eth0
192.168.111.11/24 eth0
192.168.111.12/24 eth0
192.168.111.13/24 eth0
```

- need not be the same on all nodes
- need not even be present on all nodes (management node...)

CTDB - Public Addresses

- set `CTDB_PUBLIC_ADDRESSES` in `/etc/sysconfig/ctdb`
- typical value `/etc/ctdb/public_addresses`

example `/etc/ctdb/public_addresses`

```
192.168.111.10/24 eth0
192.168.111.11/24 eth0
192.168.111.12/24 eth0
192.168.111.13/24 eth0
```

- need not be the same on all nodes
- need not even be present on all nodes (management node...)

CTDB - Public Addresses

- set `CTDB_PUBLIC_ADDRESSES` in `/etc/sysconfig/ctdb`
- typical value `/etc/ctdb/public_addresses`

example `/etc/ctdb/public_addresses`

```
192.168.111.10/24 eth0
192.168.111.11/24 eth0
192.168.111.12/24 eth0
192.168.111.13/24 eth0
```

- need not be the same on all nodes
- need not even be present on all nodes (management node...)

IP Failover

- HEALTHY nodes get IP addresses from their public pool
- when a node goes done: public IPs moved to other nodes
- CTDB distributes the public IPs equally among healthy nodes
- with round robin DNS $\Rightarrow$ HA and load balancing
- speed up client reconnects with *tickle ACKs*!

IP Failover

- HEALTHY nodes get IP addresses from their public pool
- when a node goes done: public IPs moved to other nodes
- CTDB distributes the public IPs equally among healthy nodes
- with round robin DNS $\Rightarrow$ HA and load balancing
- speed up client reconnects with *tickle ACKs*!

IP Failover

- HEALTHY nodes get IP addresses from their public pool
- when a node goes done: public IPs moved to other nodes
- CTDB distributes the public IPs equally among healthy nodes
- with round robin DNS $\Rightarrow$ HA and load balancing
- speed up client reconnects with *tickle ACKs*!

IP Failover

- HEALTHY nodes get IP addresses from their public pool
- when a node goes done: public IPs moved to other nodes
- CTDB distributes the public IPs equally among healthy nodes
- with round robin DNS $\Rightarrow$ HA and load balancing
- speed up client reconnects with *tickle ACKs*!

IP Failover

- HEALTHY nodes get IP addresses from their public pool
- when a node goes done: public IPs moved to other nodes
- CTDB distributes the public IPs equally among healthy nodes
- with round robin DNS $\Rightarrow$ HA and load balancing
- speed up client reconnects with *tickle ACKs*!

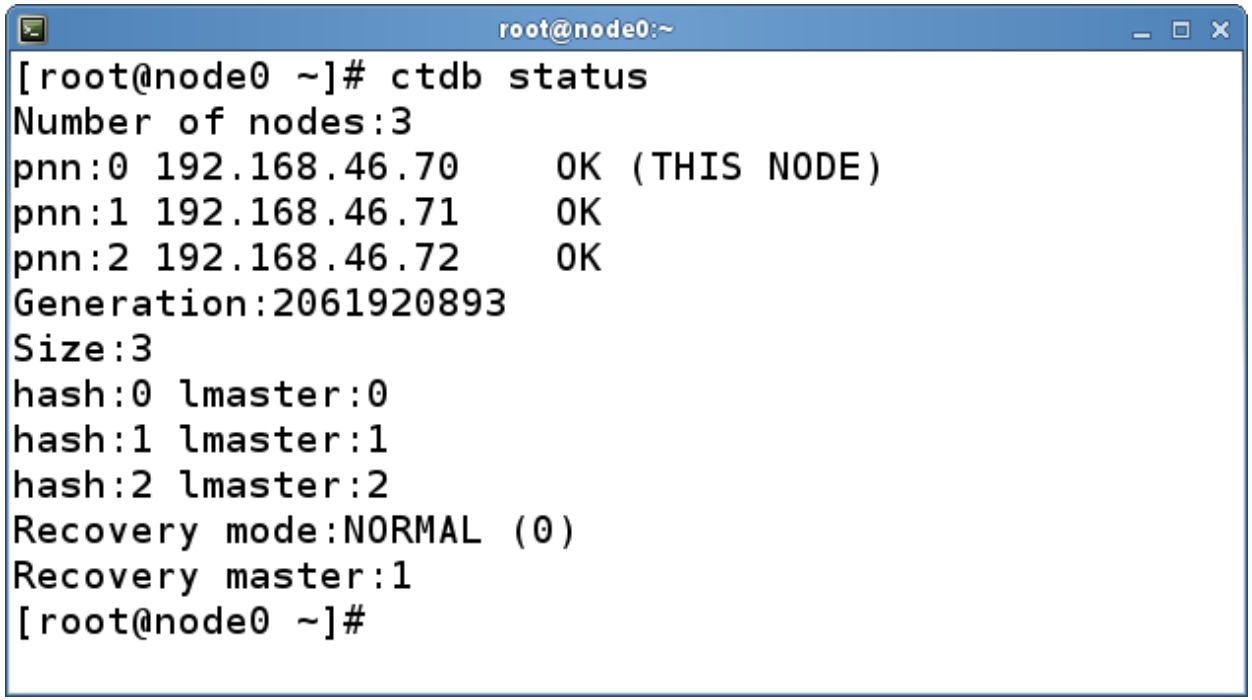
CTDB Toolbox

- `ctdb` – control `ctdbd`
- `onnode` – execute programs on selected nodes

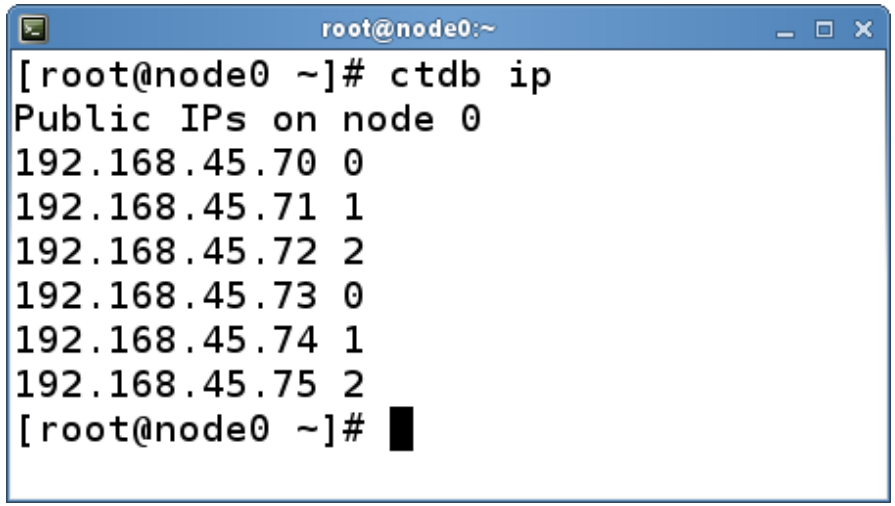
CTDB Toolbox

- `ctdb` – control `ctdbd`
- `onnode` – execute programs on selected nodes

ctdb status


root@node0:~
[root@node0 ~]# ctdb status
Number of nodes:3
pnn:0 192.168.46.70   OK (THIS NODE)
pnn:1 192.168.46.71   OK
pnn:2 192.168.46.72   OK
Generation:2061920893
Size:3
hash:0 lmaster:0
hash:1 lmaster:1
hash:2 lmaster:2
Recovery mode:NORMAL (0)
Recovery master:1
[root@node0 ~]#

ctdb ip


root@node0:~
[root@node0 ~]# ctdb ip
Public IPs on node 0
192.168.45.70 0
192.168.45.71 1
192.168.45.72 2
192.168.45.73 0
192.168.45.74 1
192.168.45.75 2
[root@node0 ~]#

CTDB manages ...

- CTDB can manage several services
- i.e. start, stop, monitor them
- controlled by sysconfig variables `CTDB_MANAGES_`*`SERVICE`*
- management performed by scripts in `/etc/ctdb/events.d`
- managed services should be removed from the runlevels

CTDB manages ...

- CTDB can manage several services
- i.e. start, stop, monitor them
- controlled by sysconfig variables `CTDB_MANAGES_`*`SERVICE`*
- management performed by scripts in `/etc/ctdb/events.d`
- managed services should be removed from the runlevels

CTDB manages ...

- CTDB can manage several services
- i.e. start, stop, monitor them
- controlled by sysconfig variables `CTDB_MANAGES_`*`SERVICE`*
- management performed by scripts in `/etc/ctdb/events.d`
- managed services should be removed from the runlevels

CTDB manages ...

- CTDB can manage several services
- i.e. start, stop, monitor them
- controlled by sysconfig variables `CTDB_MANAGES_`*`SERVICE`*
- management performed by scripts in `/etc/ctdb/events.d`
- managed services should be removed from the runlevels

CTDB manages ...

- CTDB can manage several services
- i.e. start, stop, monitor them
- controlled by sysconfig variables `CTDB_MANAGES_`*`SERVICE`*
- management performed by scripts in `/etc/ctdb/events.d`
- managed services should be removed from the runlevels

CTDB manages ...

- CTDB_MANAGES_SAMBA
- CTDB_MANAGES_WINBIND
- CTDB_MANAGES_NFS
- CTDB_MANAGES_VSFTPD
- CTDB_MANAGES_HTTPD

Outline

Getting A Clustered Samba

- in vanilla Samba code since Samba 3.3 (January 2009)
- precompiled packages from `http://www.enterprisesamba.org/`
- configure `--with-cluster-support`
- add `idmap_tdb2` to `--with-shared-modules`
- verify that `gpfs.so` is built for GPFS usage

Getting A Clustered Samba

- in vanilla Samba code since Samba 3.3 (January 2009)
- precompiled packages from `http://www.enterprisesamba.org/`
- configure `--with-cluster-support`
- add `idmap_tdb2` to `--with-shared-modules`
- verify that `gpfs.so` is built for GPFS usage

Getting A Clustered Samba

- in vanilla Samba code since Samba 3.3 (January 2009)
- precompiled packages from `http://www.enterprisesamba.org/`
- configure `--with-cluster-support`
- add `idmap_tdb2` to `--with-shared-modules`
- verify that `gpfs.so` is built for GPFS usage

Getting A Clustered Samba

- in vanilla Samba code since Samba 3.3 (January 2009)
- precompiled packages from `http://www.enterprisesamba.org/`
- configure `--with-cluster-support`
- add `idmap_tdb2` to `--with-shared-modules`
- verify that `gpfs.so` is built for GPFS usage

Getting A Clustered Samba

- in vanilla Samba code since Samba 3.3 (January 2009)
- precompiled packages from `http://www.enterprisesamba.org/`
- configure `--with-cluster-support`
- add `idmap_tdb2` to `--with-shared-modules`
- verify that `gpfs.so` is built for GPFS usage

Samba Configuration

identical configuration on all nodes

- `clustering = yes`
- `passdb backend = tdbsam`
- `groupdb:backend = tdb`
- `idmap backend = tdb2`
- `vfs objects = fileid`
  `fileid:algorithm = fsid / fsname`
- no need to change `private dir`
- if `CTDB_MANAGES_SAMBA`, do *not* set `interfaces` or `bind interfaces only`

Samba Configuration

identical configuration on all nodes

- `clustering = yes`
- `passdb backend = tdbsam`
- `groupdb:backend = tdb`
- `idmap backend = tdb2`
- `vfs objects = fileid`
  `fileid:algorithm = fsid / fsname`
- no need to change `private dir`
- if `CTDB_MANAGES_SAMBA`, do *not* set `interfaces` or `bind interfaces only`

Samba Configuration

identical configuration on all nodes

- `clustering = yes`
- `passdb backend = tdbsam`
- `groupdb:backend = tdb`
- `idmap backend = tdb2`
- `vfs objects = fileid`
  `fileid:algorithm = fsid / fsname`
- no need to change `private dir`
- if `CTDB_MANAGES_SAMBA`, do *not* set `interfaces` or `bind interfaces only`

Samba Configuration

identical configuration on all nodes

- `clustering = yes`
- `passdb backend = tdbsam`
- `groupdb:backend = tdb`
- `idmap backend = tdb2`
- `vfs objects = fileid`
  `fileid:algorithm = fsid / fsname`
- no need to change `private dir`
- if `CTDB_MANAGES_SAMBA`, do *not* set `interfaces` or `bind interfaces only`

Samba Configuration

identical configuration on all nodes

- `clustering = yes`
- `passdb backend = tdbsam`
- `groupdb:backend = tdb`
- `idmap backend = tdb2`
- `vfs objects = fileid`
  `fileid:algorithm = fsid / fsname`
- no need to change `private dir`
- if `CTDB_MANAGES_SAMBA`, do *not* set `interfaces` or `bind interfaces only`

Samba Configuration

identical configuration on all nodes

- `clustering = yes`
- `passdb backend = tdbsam`
- `groupdb:backend = tdb`
- `idmap backend = tdb2`
- `vfs objects = fileid`
  `fileid:algorithm = fsid / fsname`
- no need to change `private dir`
- if `CTDB_MANAGES_SAMBA`, do *not* set `interfaces` or `bind interfaces only`

Samba Configuration

identical configuration on all nodes

- `clustering = yes`
- `passdb backend = tdbsam`
- `groupdb:backend = tdb`
- `idmap backend = tdb2`
- `vfs objects = fileid`
  `fileid:algorithm = fsid / fsname`
- no need to change `private dir`
- if `CTDB_MANAGES_SAMBA`, do *not* set `interfaces` or `bind interfaces only`

Samba Configuration

identical configuration on all nodes

- `clustering = yes`
- `passdb backend = tdbsam`
- `groupdb:backend = tdb`
- `idmap backend = tdb2`
- `vfs objects = fileid`
  `fileid:algorithm = fsid / fsname`
- no need to change `private dir`
- if `CTDB_MANAGES_SAMBA`, do *not* set `interfaces` or `bind interfaces only`

example smb.conf

```
[global]
    clustering = yes
    netbios name = smbcluster
    workgroup = mydomain
    security = ads
    passdb backend = tdbsam

    groupdb:backend = tdb

    idmap backend = tdb2
    idmap uid = 1000000-2000000
    idmap gid = 1000000-2000000


[share]
    path = /cluster_storage/share
    writeable = yes
    vfs objects = fileid
    fileid:algorithm = fsname
```

Registry Configuration

- store config in Samba's registry
- `HKLM\Software\Samba\smbconf`
- subkey $\Leftrightarrow$ section
- value $\Leftrightarrow$ parameter
- stored in `registry.tdb` $\Rightarrow$ distributed across cluster by CTDB
- $\Rightarrow$ means of easily managing the whole Samba cluster

Registry Configuration

- store config in Samba's registry
- `HKLM\Software\Samba\smbconf`
- subkey ⇔ section
- value ⇔ parameter
- stored in `registry.tdb` ⇒ distributed across cluster by CTDB
- ⇒ means of easily managing the whole Samba cluster

Registry Configuration

- store config in Samba's registry
- `HKLM\Software\Samba\smbconf`
- subkey $\Leftrightarrow$ section
- value $\Leftrightarrow$ parameter
- stored in `registry.tdb` $\Rightarrow$ distributed across cluster by CTDB
- $\Rightarrow$ means of easily managing the whole Samba cluster

Registry Configuration

- store config in Samba's registry
- `HKLM\Software\Samba\smbconf`
- subkey ⇔ section
- value ⇔ parameter
- stored in `registry.tdb` ⇒ distributed across cluster by CTDB
- ⇒ means of easily managing the whole Samba cluster

Registry Configuration

- store config in Samba's registry
- `HKLM\Software\Samba\smbconf`
- subkey ⇔ section
- value ⇔ parameter
- stored in `registry.tdb` ⇒ distributed across cluster by CTDB
- ⇒ means of easily managing the whole Samba cluster

Registry Configuration

- store config in Samba's registry
- `HKLM\Software\Samba\smbconf`
- subkey $\Leftrightarrow$ section
- value $\Leftrightarrow$ parameter
- stored in `registry.tdb` $\Rightarrow$ distributed across cluster by CTDB
- $\Rightarrow$ means of easily managing the whole Samba cluster

Activation of Registry Configuration

- `registry shares = yes`
- `include = registry`
- `config backend = registry`

smb.conf for cluster usage

```
[global]
    clustering = yes
    include = registry
```

Activation of Registry Configuration

- `registry shares = yes`
- `include = registry`
- `config backend = registry`

smb.conf for cluster usage

```
[global]
    clustering = yes
    include = registry
```

Activation of Registry Configuration

- `registry shares = yes`
- `include = registry`
- `config backend = registry`

smb.conf for cluster usage

```
[global]
    clustering = yes
    include = registry
```

Activation of Registry Configuration

- `registry shares = yes`
- `include = registry`
- `config backend = registry`

smb.conf for cluster usage

```
[global]
    clustering = yes
    include = registry
```

Activation of Registry Configuration

- `registry shares = yes`
- `include = registry`
- `config backend = registry`

smb.conf for cluster usage

```
[global]
    clustering = yes
    include = registry
```

net conf

Manage the whole samba cluster with one command:

```
net conf list          Dump the complete configuration in smb.conf format.
net conf listshares    List the share names.
net conf import        Import configuration from file in smb.conf format.
net conf drop          Delete the complete configuration.
net conf showshare     Show the definition of a share.
net conf addshare      Create a new share.
net conf delshare      Delete a share.
net conf setparm       Store a parameter.
net conf getparm       Retrieve the value of a parameter.
net conf delparm       Delete a parameter.
net conf getincludes   Show the includes of a share definition.
net conf setincludes   Set includes for a share.
net conf delincludes   Delete includes from a share definition.
```

Time for some movies?...

Thank you very much!