CTDB Stories

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Samba Team
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CTDB Project

Motivation: Support for clustered Samba

- Multiple nodes active simultaneously
- Communication between nodes (heartbeat, failover)
- Share databases between nodes

Features:

- Volatile and Persistent databases
- IP failover and load balancing
- Service monitoring

Community:

- `http://ctdb.samba.org`
- `git://git.samba.org/ctdb.git`,
  `git://git.samba.org/samba.git`

Headlines

- Merging CTDB tree in Samba tree
- Development Stories
  - High hopcount bug
  - Getting lock scheduling right
  - All nodes banned on single node failure
- Regression Stories
  - Real time or not
  - Fixing compiler warnings

Story of the Merge

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SambaXP 2013

- Merge CTDB in Samba tree?
  - Remove duplication of talloc, tdb, tevent, replace libraries
  - Autobuild testing of clustered Samba
  - Leverage off Samba release process

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Nov 2013

CTDB tree merged with Samba

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Nov 2013

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SambaXP 2014

- To Do
  - Create waf build for CTDB, Clustered Samba
  - Setting up clustered samba instance for autobuild
  - Split monolithic code

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Story of the Merge

Step 1

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June 2014

CTDB standalone waf build commited.

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- Clean up CTDB logging

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- Hook CTDB into top level using `--with-cluster-support`

Story of the Merge

November 2014

CTDB build integrated into toplevel build.

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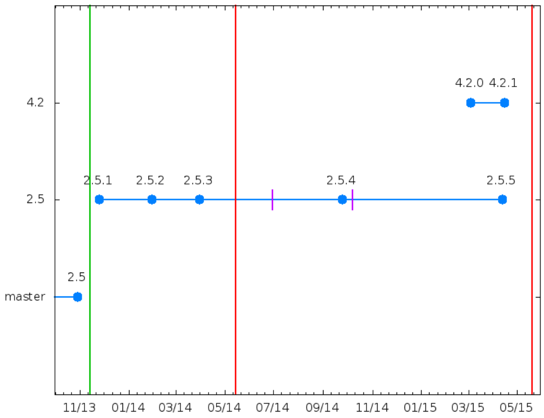

CTDB Releases

- 2.5.4 (September 2014) - 156 patches
  - Support for TDB robust mutexes
  - Add ctdb detach
  - Avoid running ctdb helpers at real-time priority
  - Improved vacuuming performance
- 2.5.5 (April 2015) - 119 patches
  - Fix handling of IPv6 addresses
  - Fix regression in socket handling code
  - Make statd-callout scalable

Developers

Contributions in 2014

196	Martin Schwenke
184	Amitay Isaacs
55	Michael Adam
10	Volker Lendecke
3	Srikrishan Malik
3	Andrew Bartlett
2	Stefan Metzmacher
2	Gregor Beck
2	Bjorn Baumbach
1	Matthias Dieter Wallnofer
1	Jeremy Allison
1	Ira Cooper
1	David Disseldorp

Developers

Contributions since Jan 2015

118	Martin Schwenke
15	Amitay Isaacs
12	Volker Lendecke
3	Rajesh Joseph
1	Michael Adam
1	Led
1	Jelmer Vernooij
1	David Disseldorp
1	Christof Schmitt

High hopcount bug

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Problem

Logs filled with entries like:

```
ctdbd: High hopcount 2823099 dbid:0x7a19d84d key:0x6f9f65c4
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```
static void ctdb_call_send_redirect(ctdb, ctdb_db, key, c, header)
{
    uint32_t lmaster = ctdb_lmaster(ctdb, &key);

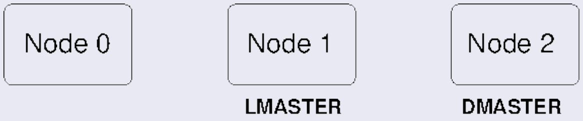
    c->hdr.destnode = lmaster;
    if (ctdb->pnn == lmaster) {
        c->hdr.destnode = header->dmaster;
    }
    c->hopcount++;

    if (c->hopcount%100 > 95) {
        DEBUG(DEBUG_WARNING,("High hopcount ..."));
    }

    ctdb_queue_packet(ctdb, &c->hdr);
}
```

High hopcount bug

Record Migration



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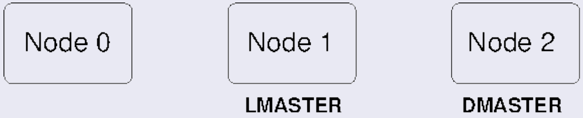

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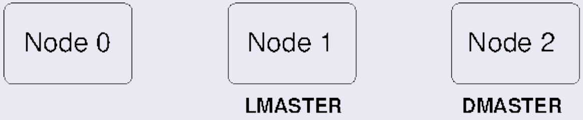

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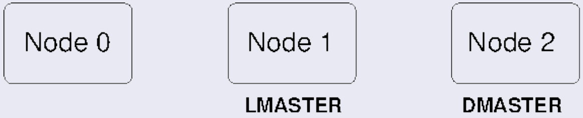

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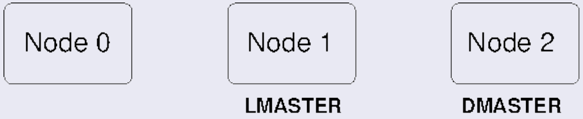

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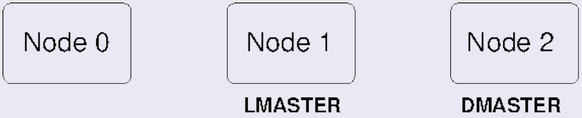

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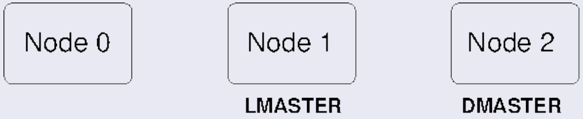

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- Reply to Node 0 (DMASTER_REPLY)
- Reply to Client (REPLY_CALL)

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UPDATE db[notify_index.tdb]: store: hash[0x0aa13d47] rsn[9620] dmaster[1]
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- Node 0 requests the record. Node 1 updates DMASTER.

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UPDATE db[notify_index.tdb]: store: hash[0x0aa13d47] rsn[9640] dmaster[1]
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- And Node 1 migrates the record to Node 0
- On Node 0 CTDB tries to grab the record lock
  - Cannot get a lock in non-blocking mode
  - Creates a lock request

High hopcount bug

- Meanwhile, more record requests queue up

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```
Waiting reqid:732 key:0x0aa13d47
Waiting reqid:684 key:0x0aa13d47
Waiting reqid:715 key:0x0aa13d47
Waiting reqid:701 key:0x0aa13d47
```

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- Soon after high hopcount messages are logged on Node 0

```
High hopcount 97 key:0x0aa13d47 reqid=00004771 pnn:0 src:1 lmaster:1
High hopcount 99 key:0x0aa13d47 reqid=00004771 pnn:0 src:1 lmaster:1
High hopcount 196 key:0x0aa13d47 reqid=000039f9 pnn:0 src:0 lmaster:1
High hopcount 198 key:0x0aa13d47 reqid=000039f9 pnn:0 src:0 lmaster:1
```

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High hopcount 198 key:0x0aa13d47 reqid=000039f9 pnn:0 src:0 lmaster:1
```

- These record requests bounce very quickly. After 2 seconds:

```
High hopcount 955596 key:0x0aa13d47 reqid=000039f9 pnn:0 src:0 lmaster:1
High hopcount 955598 key:0x0aa13d47 reqid=000039f9 pnn:0 src:0 lmaster:1
High hopcount 955597 key:0x0aa13d47 reqid=00004771 pnn:0 src:1 lmaster:1
High hopcount 955599 key:0x0aa13d47 reqid=00004771 pnn:0 src:1 lmaster:1
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High hopcount bug

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  - Node 0 says Node 1 is DMASTER
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Solution

Avoid processing record requests for record in migration

Getting Lock Scheduling Right

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Locks in CTDB

- Record locks
  - To modify a record, CTDB tries to grab non-blocking lock
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Getting Lock Scheduling Right

Locks in CTDB

- Record locks
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- Database locks
  - For database recovery, CTDB needs to freeze all databases

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- Multiple requests for different records
- Multiple requests for same record
- There are multiple databases
- Freeze requests are handled independently

Getting Lock Scheduling Right

- New locking API abstaction - Naive approach

Getting Lock Scheduling Right

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Solution

- Active queue is full and freeze lock requests are pending
- Freeze lock requests need to be scheduled immediately

Getting Lock Scheduling Right

Problem

Performance is not good when record locking is in use

Getting Lock Scheduling Right

Problem

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Solution

- A single limit on active records kills performance for locking requests across multiple databases

Getting Lock Scheduling Right

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- Rely on kernel to do “fair scheduling”

Getting Lock Scheduling Right

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- Implement per database limits for active lock requests

Problem

There are multiple lock processes waiting for the same record

Solution

- Rely on kernel to do “fair scheduling”
- Before scheduling a lock request, check if there is an active lock request for the same record

Getting Lock Scheduling Right

Problem

CTDB is consuming 100% CPU under heavy load

Getting Lock Scheduling Right

Problem

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Solution

- Active and pending lock queues are implemented as linked lists

Getting Lock Scheduling Right

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Better Solution

- Use better data structure for checking active lock requests

All nodes banned on single node failure

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- Recreate after disabling TDB robust mutexes

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- CTDB fails to freeze smbXsrv_session_global.tdb

All nodes banned on single node failure

- CTDB fails to freeze smbXsrv_session_global.tdb

```
ctdbd-lock: /usr/bin/ctdb_lock_helper smbXsrv_session_global.tdb.0 168 223318
ctdbd-lock: /usr/bin/ctdb_lock_helper smbXsrv_tcon_global.tdb.0 168 EOF
ctdbd-lock: /usr/sbin/smbd smbXsrv_tcon_global.tdb.0 251880 251880 W
ctdbd-lock: /usr/bin/ctdb_lock_helper locking.tdb.0 168 EOF
ctdbd-lock: /usr/bin/ctdb_lock_helper smbXsrv_open_global.tdb.0 168 EOF
ctdbd-lock: /usr/bin/ctdb_lock_helper cnscm_monitoring.tdb.0 168 EOF
ctdbd-lock: /usr/sbin/smbd smbXsrv_session_global.tdb.0 223320 223320
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```

- Samba process is holding a lock

All nodes banned on single node failure

- Stack trace for relevant samba process

```
#0  0x00007fde05236218 in poll () from /lib64/libc.so.6
#1  0x00007fde0863a93c in poll_one_fd ()
#2  0x00007fde0861146b in ctdb_packet_fd_read_sync_timeout ()
#3  0x00007fde08611c0d in ctdb_packet_fd_read_sync ()
#4  0x00007fde086126fa in ctdb_read_req ()
#5  0x00007fde08612eae in ctdbd_parse ()
#6  0x00007fde0862184d in db_ctdb_parse_record ()
#7  0x00007fde0861d9d4 in dbwrap_parse_record ()
#8  0x00007fde0861dc2a in dbwrap_fetch ()
#9  0x00007fde086250fd in dbwrap_watch_record_stored ()
#10 0x00007fde0861dc86 in dbwrap_record_delete ()
#11 0x00007fde083887bd in smbXsrv_session_logoff ()
#12 0x00007fde083892aa in smbXsrv_session_logoff_all_callback ()
#13 0x00007fde08626389 in db_rbt_traverse_internal ()
#14 0x00007fde086264da in db_rbt_traverse ()
#15 0x00007fde0861d96a in dbwrap_traverse ()
#16 0x00007fde08389918 in smbXsrv_session_logoff_all ()
#17 0x00007fde088e41a0 in exit_server_common ()
#18 0x00007fde088e462e in smbd_exit_server_cleanly ()
#19 0x00007fde083609e2 in exit_server_cleanly ()
```

All nodes banned on single node failure

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- Samba is holding a record lock (`smbXsrv_session_global.tdb`)

All nodes banned on single node failure

- Samba is holding a record lock (`smbXsrv_session_global.tdb`)
- And waiting for another record (`dbwatchers.tdb`)

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  - As soon as database is frozen, recover database
  - Process all pending call requests for that database

Real time or not

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- `CTDB_MANAGES_SAMBA=yes`

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- All event scripts now run with real-time priority
- `CTDB_MANAGES_SAMBA=yes`
- In 50.samba, `startup` event starts smbd

Fixing compiler warnings

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- Samba not getting scheduled to read from CTDB
- If `write()` calls fails with `EAGAIN`, back off

Questions/Comments?