SMB Witness Service

In Samba CTDB Clusters

Stefan Metzmacher <metze@samba.org>

Samba Team / SerNet

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https://samba.org/~metze/presentations/2024/SambaXP/

Topics

- What is the Service Witness Protocol [MS-SWN]
- Examples how it works
- rpcd_witness design
- Some strange things a Windows client is doing.
- How to configure rpcd_witness
- net witness commands
- Questions? Feedback!

What is the Service Witness Protocol [MS-SWN]

- The Service Witness Protocol [MS-SWN]:
  - Provides a way to notify SMB3 clients about cluster failures
  - Either network interface or node failures
  - Or planed downtimes or loadbalancing by administrators
- The protocol itself is independend of SMB3:
  - It is based on DCERPC over TCP (ncacn_ip_tcp)
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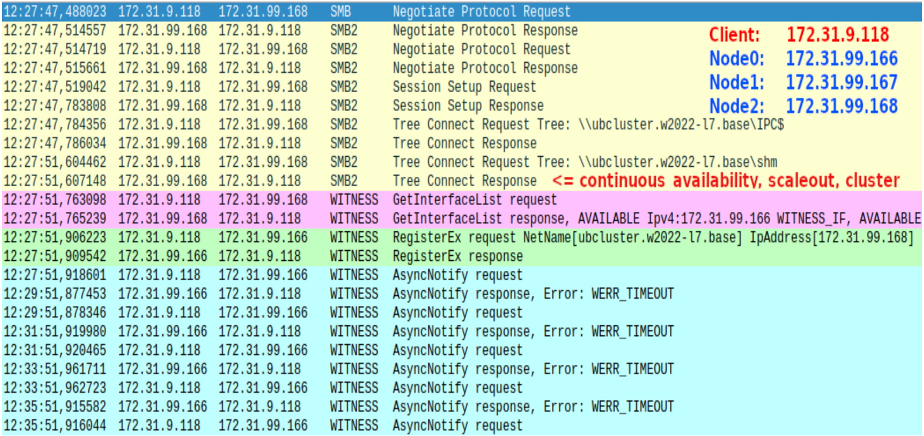
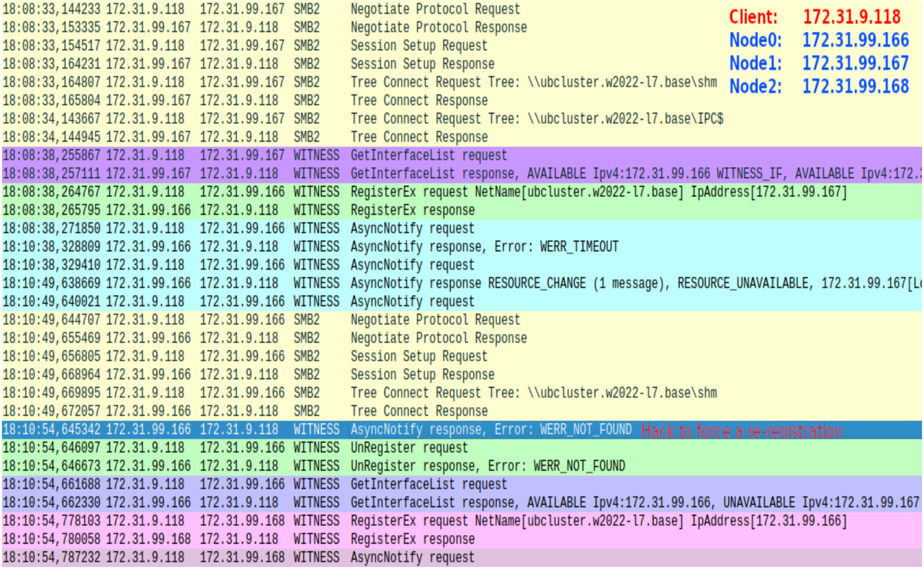
Basic flow of a client connecting with witness



Client: 172.31.9.118
Node0: 172.31.99.166
Node1: 172.31.99.167
Node2: 172.31.99.168

```
12:27:47,488023 172.31.9.118   172.31.99.168  SMB      Negotiate Protocol Request
12:27:47,514557 172.31.99.168  172.31.9.118   SMB2     Negotiate Protocol Response
12:27:47,514719 172.31.9.118   172.31.99.168  SMB2     Negotiate Protocol Request
12:27:47,515661 172.31.99.168  172.31.9.118   SMB2     Negotiate Protocol Response
12:27:47,519042 172.31.9.118   172.31.99.168  SMB2     Session Setup Request
12:27:47,783808 172.31.99.168  172.31.9.118   SMB2     Session Setup Response
12:27:47,784356 172.31.9.118   172.31.99.168  SMB2     Tree Connect Request Tree: \\ubcluster.w2022-l7.base\IPC$
12:27:47,786034 172.31.99.168  172.31.9.118   SMB2     Tree Connect Response
12:27:51,604462 172.31.9.118   172.31.99.168  SMB2     Tree Connect Request Tree: \\ubcluster.w2022-l7.base\shm
12:27:51,607148 172.31.99.168  172.31.9.118   SMB2     Tree Connect Response  <= continuous availability, scaleout, cluster
12:27:51,763098 172.31.9.118   172.31.99.168  WITNESS  GetInterfaceList request
12:27:51,765239 172.31.99.168  172.31.9.118   WITNESS  GetInterfaceList response, AVAILABLE Ipv4:172.31.99.166 WITNESS_IF, AVAILABLE
12:27:51,906223 172.31.9.118   172.31.99.166  WITNESS  RegisterEx request NetName[ubcluster.w2022-l7.base] IpAddress[172.31.99.168]
12:27:51,909542 172.31.99.166  172.31.9.118   WITNESS  RegisterEx response
12:27:51,918601 172.31.9.118   172.31.99.166  WITNESS  AsyncNotify request
12:29:51,877453 172.31.99.166  172.31.9.118   WITNESS  AsyncNotify response, Error: WERR_TIMEOUT
12:29:51,878346 172.31.9.118   172.31.99.166  WITNESS  AsyncNotify request
12:31:51,919980 172.31.99.166  172.31.9.118   WITNESS  AsyncNotify response, Error: WERR_TIMEOUT
12:31:51,920465 172.31.9.118   172.31.99.166  WITNESS  AsyncNotify request
12:33:51,961711 172.31.99.166  172.31.9.118   WITNESS  AsyncNotify response, Error: WERR_TIMEOUT
12:33:51,962723 172.31.9.118   172.31.99.166  WITNESS  AsyncNotify request
12:35:51,915582 172.31.99.166  172.31.9.118   WITNESS  AsyncNotify response, Error: WERR_TIMEOUT
12:35:51,916044 172.31.9.118   172.31.99.166  WITNESS  AsyncNotify request
```

Resource-Unavailable flow



```
18:08:33,144233 172.31.9.118   172.31.99.167 SMB2     Negotiate Protocol Request
18:08:33,153335 172.31.99.167  172.31.9.118  SMB2     Negotiate Protocol Response
18:08:33,154517 172.31.9.118   172.31.99.167 SMB2     Session Setup Request
18:08:33,164231 172.31.99.167  172.31.9.118  SMB2     Session Setup Response
18:08:33,164807 172.31.9.118   172.31.99.167 SMB2     Tree Connect Request Tree: \\ubcluster.w2022-l7.base\shm
18:08:33,165804 172.31.99.167  172.31.9.118  SMB2     Tree Connect Response
18:08:34,143667 172.31.9.118   172.31.99.167 SMB2     Tree Connect Request Tree: \\ubcluster.w2022-l7.base\IPC$
18:08:34,144945 172.31.99.167  172.31.9.118  SMB2     Tree Connect Response
18:08:38,255867 172.31.9.118   172.31.99.167 WITNESS  GetInterfaceList request
18:08:38,257111 172.31.99.167  172.31.9.118  WITNESS  GetInterfaceList response, AVAILABLE Ipv4:172.31.99.166 WITNESS_IF, AVAILABLE Ipv4:172.3
18:08:38,264767 172.31.9.118   172.31.99.166 WITNESS  RegisterEx request NetName[ubcluster.w2022-l7.base] IpAddress[172.31.99.167]
18:08:38,265795 172.31.99.166  172.31.9.118  WITNESS  RegisterEx response
18:08:38,271850 172.31.9.118   172.31.99.166 WITNESS  AsyncNotify request
18:10:38,328809 172.31.99.166  172.31.9.118  WITNESS  AsyncNotify response, Error: WERR_TIMEOUT
18:10:38,329410 172.31.9.118   172.31.99.166 WITNESS  AsyncNotify request
18:10:49,638669 172.31.99.166  172.31.9.118  WITNESS  AsyncNotify response RESOURCE_CHANGE (1 message), RESOURCE_UNAVAILABLE, 172.31.99.167[L
18:10:49,640021 172.31.9.118   172.31.99.166 WITNESS  AsyncNotify request
18:10:49,644707 172.31.9.118   172.31.99.166 SMB2     Negotiate Protocol Request
18:10:49,655469 172.31.99.166  172.31.9.118  SMB2     Negotiate Protocol Response
18:10:49,656805 172.31.9.118   172.31.99.166 SMB2     Session Setup Request
18:10:49,668964 172.31.99.166  172.31.9.118  SMB2     Session Setup Response
18:10:49,669895 172.31.9.118   172.31.99.166 SMB2     Tree Connect Request Tree: \\ubcluster.w2022-l7.base\shm
18:10:49,672057 172.31.99.166  172.31.9.118  SMB2     Tree Connect Response
18:10:54,645342 172.31.99.166  172.31.9.118  WITNESS  AsyncNotify response, Error: WERR_NOT_FOUND
18:10:54,646097 172.31.9.118   172.31.99.166 WITNESS  UnRegister request
18:10:54,646673 172.31.99.166  172.31.9.118  WITNESS  UnRegister response, Error: WERR_NOT_FOUND
18:10:54,661688 172.31.9.118   172.31.99.166 WITNESS  GetInterfaceList request
18:10:54,662330 172.31.99.166  172.31.9.118  WITNESS  GetInterfaceList response, AVAILABLE Ipv4:172.31.99.166, UNAVAILABLE Ipv4:172.31.99.167
18:10:54,778103 172.31.9.118   172.31.99.168 WITNESS  RegisterEx request NetName[ubcluster.w2022-l7.base] IpAddress[172.31.99.166]
18:10:54,780058 172.31.99.168  172.31.9.118  WITNESS  RegisterEx response
18:10:54,787232 172.31.9.118   172.31.99.168 WITNESS  AsyncNotify request
```

Hack to force a re-registration

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Node0: 172.31.99.166
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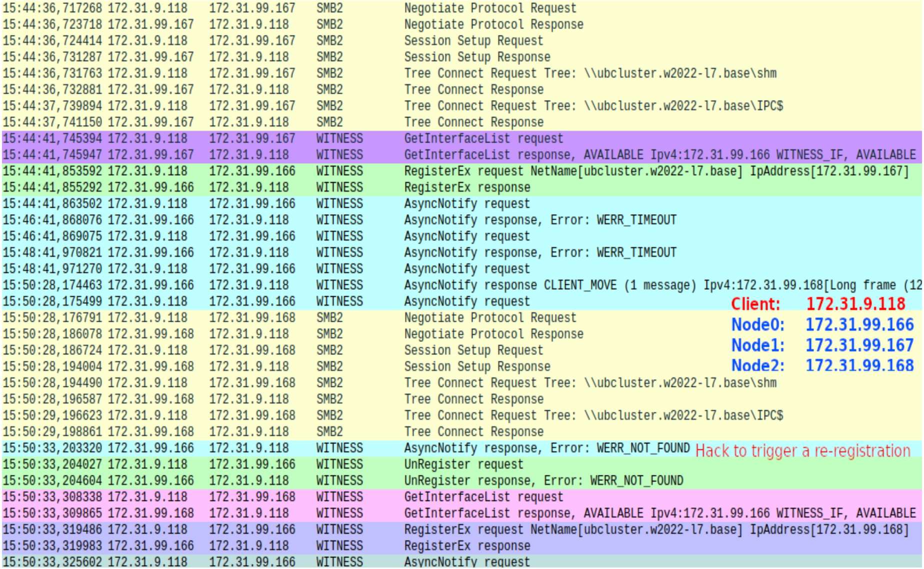
Client-Move flow



```
15:44:36,717268 172.31.9.118   172.31.99.167  SMB2      Negotiate Protocol Request
15:44:36,723718 172.31.99.167  172.31.9.118   SMB2      Negotiate Protocol Response
15:44:36,724414 172.31.9.118   172.31.99.167  SMB2      Session Setup Request
15:44:36,731287 172.31.99.167  172.31.9.118   SMB2      Session Setup Response
15:44:36,731763 172.31.9.118   172.31.99.167  SMB2      Tree Connect Request Tree: \\ubcluster.w2022-l7.base\shm
15:44:36,732881 172.31.99.167  172.31.9.118   SMB2      Tree Connect Response
15:44:37,739894 172.31.9.118   172.31.99.167  SMB2      Tree Connect Request Tree: \\ubcluster.w2022-l7.base\IPC$
15:44:37,741150 172.31.99.167  172.31.9.118   SMB2      Tree Connect Response
15:44:41,745394 172.31.9.118   172.31.99.167  WITNESS   GetInterfaceList request
15:44:41,745947 172.31.99.167  172.31.9.118   WITNESS   GetInterfaceList response, AVAILABLE Ipv4:172.31.99.166 WITNESS_IF, AVAILABLE
15:44:41,853592 172.31.9.118   172.31.99.166  WITNESS   RegisterEx request NetName[ubcluster.w2022-l7.base] IpAddress[172.31.99.167]
15:44:41,855292 172.31.99.166  172.31.9.118   WITNESS   RegisterEx response
15:44:41,863502 172.31.9.118   172.31.99.166  WITNESS   AsyncNotify request
15:46:41,868076 172.31.99.166  172.31.9.118   WITNESS   AsyncNotify response, Error: WERR_TIMEOUT
15:46:41,869075 172.31.9.118   172.31.99.166  WITNESS   AsyncNotify request
15:48:41,970821 172.31.99.166  172.31.9.118   WITNESS   AsyncNotify response, Error: WERR_TIMEOUT
15:48:41,971270 172.31.9.118   172.31.99.166  WITNESS   AsyncNotify request
15:50:28,174463 172.31.99.166  172.31.9.118   WITNESS   AsyncNotify response CLIENT_MOVE (1 message) Ipv4:172.31.99.168[Long frame (12
15:50:28,175499 172.31.9.118   172.31.99.166  WITNESS   AsyncNotify request
15:50:28,176791 172.31.9.118   172.31.99.168  SMB2      Negotiate Protocol Request
15:50:28,186078 172.31.99.168  172.31.9.118   SMB2      Negotiate Protocol Response
15:50:28,186724 172.31.9.118   172.31.99.168  SMB2      Session Setup Request
15:50:28,194004 172.31.99.168  172.31.9.118   SMB2      Session Setup Response
15:50:28,194490 172.31.9.118   172.31.99.168  SMB2      Tree Connect Request Tree: \\ubcluster.w2022-l7.base\shm
15:50:28,196587 172.31.99.168  172.31.9.118   SMB2      Tree Connect Response
15:50:29,196623 172.31.9.118   172.31.99.168  SMB2      Tree Connect Request Tree: \\ubcluster.w2022-l7.base\IPC$
15:50:29,198861 172.31.99.168  172.31.9.118   SMB2      Tree Connect Response
15:50:33,203320 172.31.99.166  172.31.9.118   WITNESS   AsyncNotify response, Error: WERR_NOT_FOUND
15:50:33,204027 172.31.9.118   172.31.99.166  WITNESS   UnRegister request
15:50:33,204604 172.31.99.166  172.31.9.118   WITNESS   UnRegister response, Error: WERR_NOT_FOUND
15:50:33,308338 172.31.9.118   172.31.99.168  WITNESS   GetInterfaceList request
15:50:33,309865 172.31.99.168  172.31.9.118   WITNESS   GetInterfaceList response, AVAILABLE Ipv4:172.31.99.166 WITNESS_IF, AVAILABLE
15:50:33,319486 172.31.9.118   172.31.99.166  WITNESS   RegisterEx request NetName[ubcluster.w2022-l7.base] IpAddress[172.31.99.168]
15:50:33,319983 172.31.99.166  172.31.9.118   WITNESS   RegisterEx response
15:50:33,325602 172.31.9.118   172.31.99.166  WITNESS   AsyncNotify request
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Hack to trigger a re-registration

rpcd_witness design (Part 1)

- We had some source3/rpc_server rewrites in the last years
  - The merge to dcesrv_core.c by Samuel Cabrero
  - The samba-dcerpcd infrastructure by Volker Lendecke
- We can now have isolated service binaries
  - /usr/libexec/samba/rpcd_
  - With 'rpc start on demand helpers = no' we support ncacn_ip_tcp
- Simple async responses are possible
  - If we do not care about user impersonation

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rpcd_witness design (Part 2)

- We had some witness service prototypes implemented in the past
  - By Gregor Beck/Stefan Metzmacher
  - By Günther Deschner/Jose A. Rivera
  - By David Disseldorp/Samuel Cabrero
- The interaction with ctdbd is important
  - But it was missing in 2 prototypes
  - And 1 prototype tried to implement too much in ctdbd itself
- Finally I came up with a very simple ctdbd change
  - It was trivial to add CTDB_SRVID_IPREALLOCATED notifications to ctdbd
- Each rpcd_witness instance just needs this:
  - Load all addresses of the whole cluster at start
  - Wait for CTDB_SRVID_IPREALLOCATED to be posted
  - Reload all addresses of the whole cluster
  - Compare the changes in the list in order to notice changes

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rpcd_witness design (Part 3)

- rpcd_witness needs support for ncacn_ip_tcp
  - So it requires 'rpc start on demand helpers = no'
  - We also register each connection with ctdbd to get tickle-acks
- Each Register[Ex]() results in a global registration
  - They are stored in rpcd_witness_registration.tdb
  - With the registration context/policy handle as key
  - And the server_id (node+pid) also in the content
- This allows 'net witness' commands to work
  - List registrations
  - Send specific administrative actions to the individual registrations
  - See later slides for more details and examples

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Windows clients behave in strange ways (Part 1)

- The SMB2 Tree Connect response has flags for cluster capabilities:
  - SMB2_SHARE_CAP_CONTINUOUS_AVAILABILITY
  - SMB2_SHARE_CAP_SCALEOUT
  - SMB2_SHARE_CAP_CLUSTER
  - SMB2_SHARE_CAP_ASYMMETRIC
- SMB2_SHARE_CAP_CLUSTER:
  - This is the indication the [MS-SWN] service runs on the server
  - And the client should make use of it when using the connected share
  - Sadly only effective together with SMB2_SHARE_CAP_CONTINUOUS_AVAILABILITY
- SMB2_SHARE_CAP_SCALEOUT:
  - Means the cluster can have more that one active node at a time

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Windows clients behave in strange ways (Part 2)

- SMB2_SHARE_CAP_CONTINUOUS_AVAILABILITY:
  - This indicates that the share is always available
  - The client should try to reconnect (maybe to other nodes) fast
  - Windows clients also use this as trigger to request presistent handles
  - Even is the server does not provide SMB2_CAP_PERSISTENT_HANDLES
  - Each open generates a warning in the client event log
- SMB2_SHARE_CAP_ASYMMETRIC:
  - This is used to indicate that a share is attached to a disk owner
  - Other nodes act as proxy.
  - It means the client uses separate set of connections for the share
  - The client might connect to a different cluster node
  - And provides a share name for RegisterEx()

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Windows clients behave in strange ways (Part 3)

- After a AsyncNotify response there is no re-registration
  - A Windows client reacts on a RESOURCE_CHANGE, CLIENT_MOVE, SHARE_MOVE.
  - It reconnects the SMB3 connection if required
  - But it does not call Register[Ex]() for the new connection
- We use a trick in order to force a re-registration
  - 5 seconds after a RESOURCE_CHANGE, CLIENT_MOVE, SHARE_MOVE.
  - we return AsyncNotify with STATUS_NOT_FOUND
  - This triggers a re-registration

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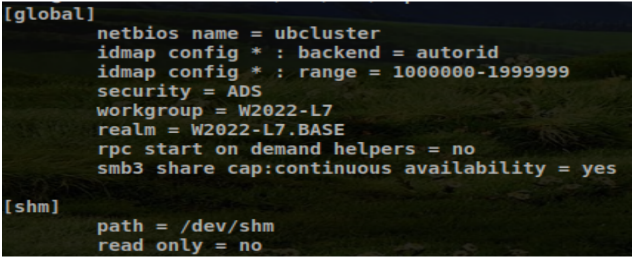
Basic smb.conf options for rpcd_witness

net conf list output:



```
[global]
        netbios name = ubcluster
        idmap config * : backend = autorid
        idmap config * : range = 1000000-1999999
        security = ADS
        workgroup = W2022-L7
        realm = W2022-L7.BASE
        rpc start on demand helpers = no
        smb3 share cap:continuous availability = yes

[shm]
        path = /dev/shm
        read only = no
```

rpcd_witness via 47.samba-dcerpcd

- There is a 47.samba-dcerpcd script for ctdbd
  - 'ctdb event script enable legacy 47.samba-dcerpcd'
  - This tries to start the samba-dcerpd (systemd service)
  - This is needed for 'rpc start on demand helpers = no'

net witness commands

- net witness list
  - List witness registrations from rpcd_witness_registration.tdb
- net witness client-move
  - Generate client move notifications for witness registrations to a new ip or node
- net witness share-move
  - Generate share move notifications for witness registrations to a new ip or node
- net witness force-unregister
  - Force unregistrations for witness registrations
- net witness force-response
  - Force an AsyncNotify response based on json input (mostly for testing)

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  - Generate client move notifications for witness registrations to a new ip or node
- net witness share-move
  - Generate share move notifications for witness registrations to a new ip or node
- net witness force-unregister
  - Force unregistrations for witness registrations
- net witness force-response
  - Force an AsyncNotify response based on json input (mostly for testing)

net witness commands

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  - List witness registrations from rpcd_witness_registration.tdb
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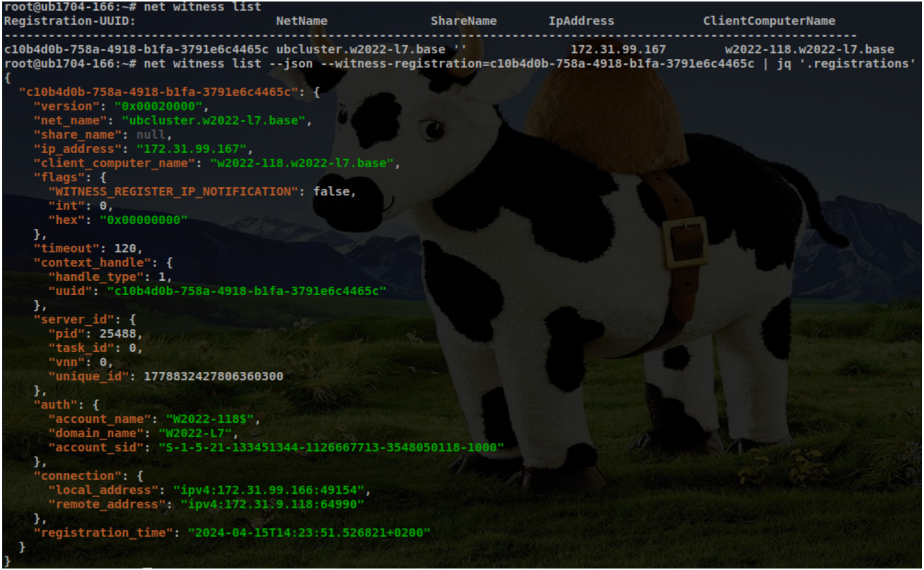
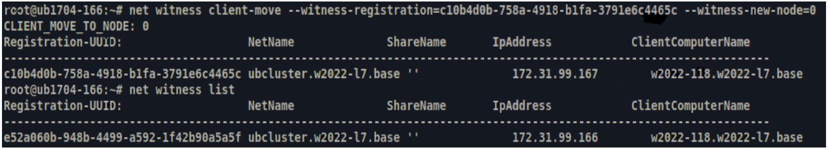
net witness list example



```
root@ub1704-166:~# net witness list
Registration-UUID:                   NetName              ShareName       IpAddress            ClientComputerName
--------------------------------------------------------------------------------------------------------------------
c10b4d0b-758a-4918-b1fa-3791e6c4465c ubcluster.w2022-l7.base ''              172.31.99.167        w2022-118.w2022-l7.base
root@ub1704-166:~# net witness list --json --witness-registration=c10b4d0b-758a-4918-b1fa-3791e6c4465c | jq '.registrations'
{
  "c10b4d0b-758a-4918-b1fa-3791e6c4465c": {
    "version": "0x00020000",
    "net_name": "ubcluster.w2022-l7.base",
    "share_name": null,
    "ip_address": "172.31.99.167",
    "client_computer_name": "w2022-118.w2022-l7.base",
    "flags": {
      "WITNESS_REGISTER_IP_NOTIFICATION": false,
      "int": 0,
      "hex": "0x00000000"
    },
    "timeout": 120,
    "context_handle": {
      "handle_type": 1,
      "uuid": "c10b4d0b-758a-4918-b1fa-3791e6c4465c"
    },
    "server_id": {
      "pid": 25488,
      "task_id": 0,
      "vnn": 0,
      "unique_id": 1778832427806360300
    },
    "auth": {
      "account_name": "W2022-118$",
      "domain_name": "W2022-L7",
      "account_sid": "S-1-5-21-133451344-1126667713-3548050118-1000"
    },
    "connection": {
      "local_address": "ipv4:172.31.99.166:49154",
      "remote_address": "ipv4:172.31.9.118:64990"
    },
    "registration_time": "2024-04-15T14:23:51.526821+0200"
  }
}
```

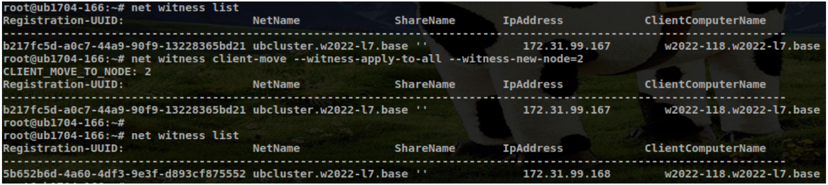
net witness client-move examples

Example 1: with given registration id



```
root@ub1704-166:~# net witness client-move --witness-registration=c10b4d0b-758a-4918-b1fa-3791e6c4465c --witness-new-node=0
CLIENT_MOVE_TO_NODE: 0
Registration-UUID:                   NetName              ShareName       IpAddress            ClientComputerName
--------------------------------------------------------------------------------------------------------------------
c10b4d0b-758a-4918-b1fa-3791e6c4465c ubcluster.w2022-l7.base ''              172.31.99.167        w2022-118.w2022-l7.base
root@ub1704-166:~# net witness list
Registration-UUID:                   NetName              ShareName       IpAddress            ClientComputerName
--------------------------------------------------------------------------------------------------------------------
e52a060b-948b-4499-a592-1f42b90a5a5f ubcluster.w2022-l7.base ''              172.31.99.166        w2022-118.w2022-l7.base
```

Example 2: apply to all



```
root@ub1704-166:~# net witness list
Registration-UUID:                   NetName              ShareName       IpAddress            ClientComputerName
--------------------------------------------------------------------------------------------------------------------
b217fc5d-a0c7-44a9-90f9-13228365bd21 ubcluster.w2022-l7.base ''              172.31.99.167        w2022-118.w2022-l7.base
root@ub1704-166:~# net witness client-move --witness-apply-to-all --witness-new-node=2
CLIENT_MOVE_TO_NODE: 2
Registration-UUID:                   NetName              ShareName       IpAddress            ClientComputerName
--------------------------------------------------------------------------------------------------------------------
b217fc5d-a0c7-44a9-90f9-13228365bd21 ubcluster.w2022-l7.base ''              172.31.99.167        w2022-118.w2022-l7.base
root@ub1704-166:~#
root@ub1704-166:~# net witness list
Registration-UUID:                   NetName              ShareName       IpAddress            ClientComputerName
--------------------------------------------------------------------------------------------------------------------
5b652b6d-4a60-4df3-9e3f-d893cf875552 ubcluster.w2022-l7.base ''              172.31.99.168        w2022-118.w2022-l7.base
```

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- Samba 4.20.0 contains all changes
- We should hope that Windows clients get a fix
  - So that SMB2_SHARE_CAP_CONTINUOUS_AVAILABILITY without SMB2_CAP_PERSISTENT_HANDLES does not flood the clients event log

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Questions? Feedback!

- Stefan Metzmacher, `metze@samba.org`
- https://www.sernet.com
- https://samba.plus

Slides: https://samba.org/~metze/presentations/2024/SambaXP/