

September 16-18, 2024 Santa Clara, CA

# SMB Witness Service

In Samba CTDB Clusters

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2024-09-18

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



## **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)
  - It uses kerberos or NTLMSSP integrity protection





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## Basic flow of a client connecting with witness

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 Client: 172,31,9,118
12:27:47,514719	172.31.9.118	172.31.99.168	SMB2	Negotiate Protocol Request NodeO: 172 31 00 166
12:27:47,515661		172.31.9.118	SMB2	Negociate Protocol Response
12:27:47,519042		172.31.99.168	SMB2	Session Setup Request Node1: 172.31.99.167
12:27:47,783808			SMB2	Session Setup Response Node2: 172.31.99.168
12:27:47,784356		172.31.99.168	SMB2	Tree Connect Request Tree: \\ubcluster.w2022-l7.base\IPC\$
12:27:47,786034			SMB2	Tree Connect Response
12:27:51,604462			SMB2	Tree Connect Request Tree: \\ubcluster.w2022-l7.base\shm
12:27:51,607148			SMB2	Tree Connect Response <= continuous availability, scaleout, cluster
12:27:51,763098			WITNESS	GetInterfaceList request
12:27:51,765239			WITNESS	GetInterfaceList response, AVAILABLE Ipv4:172.31.99.166 WITNESS_IF, AVAILABLE
12:27:51,906223			WITNESS	RegisterEx request NetName[ubcluster.w2022-l7.base] IpAddress[172.31.99.168]
12:27:51,909542			WITNESS	RegisterEx response
12:27:51,918601		172.31.99.166	WITNESS	AsyncNotify request
12:29:51,877453				AsyncNotify response, Error: WERR_TIMEOUT
12:29:51,878346		172.31.99.166		AsyncNotify request
12:31:51,919980				AsyncNotify response, Error: WERR_TIMEOUT
12:31:51,920465		172.31.99.166		AsyncNotify request
12:33:51,961711				AsyncNotify response, Error: WERR_TIMEOUT
12:33:51,962723		172.31.99.166		AsyncNotify request
12:35:51,915582				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
                                                                                                         Client:
                                                                                                                     172.31.9.118
18:08:33,153335 172.31.99.167 172.31.9.118
                                                  Negotiate Protocol Response
                                                                                                         Node0:
                                                                                                                    172,31,99,166
18:08:33.154517 172.31.9.118 172.31.99.167 SMB2
                                                  Session Setup Request
                                                                                                          Node1:
                                                                                                                    172.31.99.167
18:08:33.164231 172.31.99.167 172.31.9.118
                                                  Session Setup Response
18:08:33,164807 172.31.9.118 172.31.99.167 SMB2
                                                  Tree Connect Request Tree: \\ubcluster.w2022-17.base\shm
                                                                                                         Node2:
                                                                                                                    172.31.99.168
18:08:33,165804 172.31.99.167 172.31.9.118
                                                  Tree Connect Response
18:08:34,143667 172.31.9.118 172.31.99.167 SMB2
                                                  Tree Connect Request Tree: \\ubcluster.w2022-17.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 IDv4:172.31.99.166 WITNESS IF, AVAILABLE IDv4:172.
                                                  RegisterEx request NetName[ubcluster.w2022-17.basel IpAddress[172.31.99.167]
18:08:38.264767 172.31.9.118 172.31.99.166 WITNESS
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
                                                  Asynchotify response, Error: WERR TIMEOUT
18:10:38,329410 172.31.9.118 172.31.99.166 WITNESS
                                                  AsyncNotify request
                                                 Asynchotify response RESOURCE CHANGE (1 message), RESOURCE UNAVAILABLE, 172.31.99.167[Lo
18:10:49,638669 172.31.99.166 172.31.9.118 WITNESS
Negotiate Protocol Request
18:10:49.644707 172.31.9.118 172.31.99.166 SMB2
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.w2022-17.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 Asynchotify response, Error: WERR NOT FOUND Hack to force a re-registration
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 IDv4:172.31.99.166, UNAVAILABLE IDv4:172.31.99.167
18:10:54,778103 172.31.9.118 172.31.99.168 WITNESS RegisterEx request NetName[ubcluster.w2022-17.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 Asynchotify request
```





#### Client-Move flow

```
15:44:36,717268 172.31.9.118
                              172.31.99.167
                                               SMR2
                                                            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
                                                            Tree Connect Request Tree: \\ubcluster.w2022-17.base\shm
15:44:36,731763 172.31.9.118
                               172.31.99.167
                                               SMB2
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
                                               SMR2
                                                            Tree Connect Request Tree: \\ubcluster.w2022-17.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
                               172.31.99.166
                                              WITNESS
                                                            RegisterEx request NetName[ubcluster.w2022-17.base] IpAddress[172.31.99.167]
15:44:41.853592 172.31.9.118
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
                               172.31.99.166
                                              WITNESS
                                                            AsyncNotify request
15:48:41.971270 172.31.9.118
                                                            AsyncNotify response CLIENT MOVE (1 message) Ipv4:172.31.99.168[Long frame (12
15:50:28,174463 172.31.99.166
                              172.31.9.118
                                              WITNESS
15:50:28,175499 172.31.9.118
                               172.31.99.166
                                              WITNESS
                                                            AsyncNotify request
                                                                                                                         172.31.9.118
                                                                                                             Client:
15:50:28,176791 172.31.9.118
                               172.31.99.168
                                               SMB2
                                                            Negotiate Protocol Request
                                                                                                             Node0:
                                                                                                                        172.31.99.166
15:50:28,186078 172,31,99,168
                              172.31.9.118
                                               SMR2
                                                            Negotiate Protocol Response
                                                                                                             Node1:
                                                                                                                        172.31.99.167
15:50:28.186724 172.31.9.118
                                               SMB2
                                                            Session Setup Request
                               172.31.99.168
                                                                                                             Node2:
                                                                                                                        172.31.99.168
15:50:28.194004 172.31.99.168
                              172.31.9.118
                                               SMB2
                                                            Session Setup Response
                                               SMB2
                                                            Tree Connect Request Tree: \\ubcluster.w2022-17.base\shm
15:50:28,194490 172.31.9.118
                               172.31.99.168
                                               SMB2
                                                            Tree Connect Response
15:50:28,196587 172.31.99.168
                              172.31.9.118
                                                            Tree Connect Request Tree: \\ubcluster.w2022-17.base\IPC$
15:50:29,196623 172.31.9.118
                               172.31.99.168
                                               SMB2
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
                                                            AsyncNotify response, Error: WERR_NOT_FOUND Hack to trigger a re-registration
                                               WITNESS
15:50:33.204027 172.31.9.118
                                              WITNESS
                                                            UnRegister request
                               172.31.99.166
                              172.31.9.118
                                              WITNESS
                                                            UnRegister response, Error: WERR NOT FOUND
15:50:33.204604 172.31.99.166
15:50:33,308338 172.31.9.118
                               172.31.99.168
                                              WITNESS
                                                            GetInterfaceList request
                                                            GetInterfaceList response, AVAILABLE Ipv4:172.31.99.166 WITNESS IF, AVAILABLE
15:50:33,309865 172.31.99.168
                              172.31.9.118
                                              WITNESS
                                                            RegisterEx request NetName[ubcluster.w2022-17.base] IpAddress[172.31.99.168]
15:50:33,319486 172.31.9.118
                               172.31.99.166
                                              WITNESS
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
```





- ► 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
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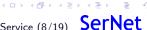
- We had some witness service prototypes implemented in the past
  - By Gregor Beck/Stefan Metzmacher
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- ► The interaction with ctdbd is important
  - ▶ But it was missing in 2 prototypes
  - And 1 prototype tried to implement too much in ctdbd itsel
- 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





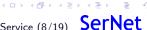
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- rpcd\_witness needs support for ncacn\_ip\_tcp
  - ► So it requires 'rpc start on demand helpers = no'
  - ▶ We also register each connection with ctdbd to get tickle-acks
- ► Each Register[Ex]() results in a global registration
  - ► They are stored 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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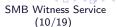




## Windows clients behave in strange ways (Part 1)

- ▶ 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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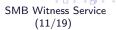




## Windows clients behave in strange ways (Part 2)

- 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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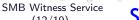
- After an AsyncNotify response there is no re-registration
  - A Windows client reacts on a RESOURCE\_CHANGE, CLIENT\_MOVE, SHARE\_MOVE.
  - It reconnects the SMB3 connection if required
  - ▶ But it does not call Register[Ex]() for the new connection
- ► We use a trick in order to force a re-registration
  - 5 seconds after a RESOURCE\_CHANGE, CLIENT\_MOVE, SHARE\_MOVE.
  - we return AsyncNotify with STATUS\_NOT\_FOUND
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- After an AsyncNotify response there is no 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 list
  - List witness registrations from rpcd\_witness\_registration.tdb







- 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 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 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

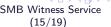






- net witness list
  - List witness registrations from rpcd\_witness\_registration.tdb
- net witness client-move
  - Generate client move notifications for witness registrations to a new ip or node
- net witness share-move
  - Generate share move notifications for witness registrations to a new ip or 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)







#### net witness list example

```
root@ub1704-166:~# net witness list
Registration-UUID:
                                                                               IpAddress
                                                                                                     ClientComputerName
                                                              ShareName
c10b4d0b-758a-4918-b1fa-3791e6c4465c ubcluster.w2022-l7.base 🗥
                                                                                  172,31,99,167
                                                                                                         w2022-118.w2022-l7.base
root@ubl704-166:~# net witness list --ison --witness-registration=cl0b4d0b-758a-4918-b1fa-3791e6c4465c | ig '.registrations'
  "c10b4d0b-758a-4918-b1fa-3791e6c4465c": {
    "net name": "ubcluster.w2022-l7.base".
    "ip address": "172.31.99.167",
    "client computer name": "w2022-118.w2022-17.base",
      "WITNESS REGISTER IP NOTIFICATION": false.
      "int": 0.
    "timeout": 120,
    "context handle": {
      "handle_type": 1,
    "server id": {
      "pid": 25488.
      "task id": 0.
      "vnn": 0.
      "unique id": 1778832427806360300
      "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

Example 1: With given registration is									
rcot@ub1704-166:~# net witness clier	b1704-166:~# net witness client-movewitness-registration=cl0b4d0b-758a-4918-b1fa-3791e6c4465cwitness-new-node=0								
CLIENT_MOVE_TO_NODE: 0									
Registration-UUYD:	NetName	ShareName	IpAddress	ClientComputerName					
c10b4d0b-758a-4918-b1fa-3791e6c4465c			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.b	172.31.99.166	w2022-118.w2022-l7.base						

#### Example 2: apply to all

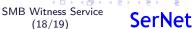
root@ub1704-166:~# net witne: Registration-UUID:	ss list NetName	ShareName	IpAddress	ClientComputerName
b217fc5d-a0c7-44a9-90f9-1322 root@ub1704-166:~# net witne CLIENT MOVE TO NODE: 2			172.31.99.167 tness-new-node=2	w2022-118.w2022-l7.base
Registration-UUID:	NetName	ShareName	IpAddress	ClientComputerName
b217fc5d-a0c7-44a9-90f9-1322 root@ub1704-166:~#		172.31.99.167	w2022-118.w2022-l7.base	
root@ub1704-166:~# net witne: Registration-UUID:	ss list NetName	ShareName	IpAddress	ClientComputerName
5b652b6d-4a60-4df3-9e3f-d893	cf875552 ubcluster.w202	172.31.99.168	w2022-118.w2022-l7.base	



#### Samba 4.20.0 and Windows clients

- Samba 4.20.0 contains all changes





#### Samba 4.20.0 and Windows clients

- 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





#### Questions? Feedback!

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

 ${\sf Slides:\ https://samba.org/\~metze/presentations/2024/SDC/}$ 

