# Object Creation



Created ON DC1

Note: Many operations including the creation of a user object increment the USN counters by more than one.

# Object Replicated



Replicated TO DC2

The object is created as a replicated update on DC2. Notice that the per-attribute originating USN and stamp (version, originating time, originating DC) are replicated from DC1 to DC2, but the per-attribute local USN and per-object *uSNChanged* are unique to DC2.

# Object Modification



Change in the replicated object on DC2 when someone changes property 2.

By this time, the current USN on DC2 has increased from 1746 to 2001. The update request that changes property 2 increments the current USN to 2002 on DC2. The request also sets the attribute’s originating USN and local USN to 2002 and creates a new stamp for the value. The version number of this properties stamp is incremented by one and is now set to 2. This is known as an originating modify.

# Change Replicated



Change made on DC2 is replicated back to the original DC1.

The replicated update increments the current USN to 5030. The per-attribute originating USN and stamp are replicated from DC2 to DC1, and the per-attribute local USN and per-object uSNChanged values are set to 5040. This is known as a replicated modify.

55

High-Watermark

The high-watermark is a value that the destination domain controller maintains to keep track of the most recent change that it has received from a specific source domain controller for an object in a specific directory partition. The source domain controller uses this value to filter the objects that it considers for replication to the destination.

Each domain controller in the enterprise has a copy of USNs it uses to track the changes it makes. Similarly, each DC in the enterprise keeps a local table where it stores the highest known USN of its replicating partners and their GUIDs. This table is known as the High-Watermark vector, and it is used to detect recent changes on replicating partners.

When requesting changes:

1. The destination domain controller sends its high-watermark value to the source domain controller.
2. The source domain controller uses the information in the high-watermark to reduce the set of objects that it must consider for replication to the destination.   
   No object whose usnChanged value is less than or equal to the high-watermark value can hold updates that the destination domain controller has not already received.

The high-watermark serves to decrease the CPU time and number of disk I/O operations that would otherwise be required to send only the changes that the destination domain controller has not yet received.

repadmin /showreps /verbose   
Look for lines that begin with “USNs:” The high-watermark USN is the number that is followed by “/OU”.

# Up-To-Dateness Vector

The table which stores originating domain controller GUIDs (database GUIDs), their USNs and a timestamp indicating the last time successful replication took place is referred to as the Up-To-Dateness vector. This vector is stored in the directory as the "replUpToDateVector" property for the appropriate Naming Context.

* The destination domain controller uses this value for tracking the originating updates that are received from all source domain controllers.
* The source domain controller uses this value to reduce the set of attributes that it sends to the destination domain controller.

When a destination domain controller requests changes for a directory partition:

1. Destination DC provides its up-to-dateness vector to the source DC
2. On the basis of this value, the source domain controller can determine that the destination does or does not have an up-to-date value (or multivalue) for an attribute, and it sends updates accordingly.
3. If the destination already has an up-to-date value, the source domain controller does not send that attribute.   
   If the source has no attributes to send for an object, it sends no information at all about that object.

The up-to-dateness vector and the high-watermark are complementary filter mechanisms that work together to decrease replication latency.

* The high-watermark prevents irrelevant objects from being considered by the source domain controller with respect to a single destination.
* The up-to-dateness vector helps the source domain controller to filter irrelevant attributes (and entire objects if all attributes are filtered) on the basis of the relationships between all sources of originating updates and a single destination.

For a specific directory partition, a domain controller maintains a high-watermark value for only those domain controllers from which it requests changes, but it maintains an up-to-dateness vector entry for every domain controller that has ever performed an originating update, which is typically every domain controller that holds a full replica of the directory partition.

# Timestamp on Up-To-Dateness Vector

Windows Server 2003 adds a new field to the UTD in which it records the last time the local DC completed a successful replication cycle with the partner domain controller. The replication cycle may have occurred directly (direct replication partner) or indirectly (transitive replication partner). The timestamp is updated whether or not the local domain controller actually received any changes from the partners.

View Up-To-Dateness vector  
repadmin /showvector

View replication latencies  
repadmin /showvector /latency

## Event Messages used to identify non-replication DC

**NTDS Replication 1862**

Non-replication DC in other site

This is a warning indicating that the local domain controller has not replicated with other domain controller(s) at a different site beyond the latency threshold of 24 hours (configurable). This may be expected if site link schedules prevent replication for more than 24 hours. If that is the case, the warning threshold should be increased to match the site link schedule.

*HKLM\System\CurrentControlSet\Services\NTDS\Parameters*

*Replicator latency error interval (hours)*

**NTDS Replication 1863**

Non-replicating domain controllers Local Site and Other Sites

This is the same as the 1862 event (above), but also includes non-replicating domain controllers in the local site. This is a warning indicating that the local domain controller has not replicated with another domain controller in the local site or at a different site beyond the latency threshold of 24 hours (configurable).

* This may be expected for inter-site partners due to closed schedules.
* For intra-site partners there are no schedules to observe, so all partner domain controllers should be up to date.   
  If this is recorded, use Repadmin and DCDiag to troubleshoot the affected partner.

**NTDS Replication 1864**

Summary of domain controllers in the Local Site Not Replicating

This is a summary message of domain controllers from the local site that are no longer replicating. The totals are broken out by length of time. Additionally, the number of domain controllers that have not replicated beyond the tombstone lifetime are reported along with the current tombstone lifetime setting for the forest.

**NTDS Replication 1865**

Domain Controllers That Have Not Replicated Beyond the Tombstone Lifetime

When a domain controller that has not replicated beyond the tombstone lifetime attempts to replicate, it is blocked and this event is reported.

# How Up-To-Dateness Vector and High watermark Changed in Replication

1. Current State  
   
2. Modifying on DC2  
     
   User added to DC2, so DC2 USN incremented by one.
3. Replication to DC1  
     
   DC2 send the change. DC1 did replication by comparing the last USN it knew for DC2 with the current one. DC1’s USN increments by one.
4. Replication request from DC4  
     
   DC4 sends a GetChange request to DC1 including:
   1. NC for which changes are request from
   2. Highest known USN value of DC1
   3. Number of values requested by the domain controller
   4. UTD Vector
   5. Send-Parents
5. Replication to DC4  
     
   The response includes:
   1. DC1 Server GUID
   2. DC1 Database GUID
   3. DC1 schema prefix table
   4. a sequence of object update entries
   5. Last Object USN Changed
   6. More data