

## [MS-WSUSOD-Diff]:

# Windows Server Update Services Protocols Overview

---

### Intellectual Property Rights Notice for Open Specifications Documentation

- **Technical Documentation.** Microsoft publishes Open Specifications documentation (“this documentation”) for protocols, file formats, data portability, computer languages, and standards support. Additionally, overview documents cover inter-protocol relationships and interactions.
- **Copyrights.** This documentation is covered by Microsoft copyrights. Regardless of any other terms that are contained in the terms of use for the Microsoft website that hosts this documentation, you can make copies of it in order to develop implementations of the technologies that are described in this documentation and can distribute portions of it in your implementations that use these technologies or in your documentation as necessary to properly document the implementation. You can also distribute in your implementation, with or without modification, any schemas, IDLs, or code samples that are included in the documentation. This permission also applies to any documents that are referenced in the Open Specifications documentation.
- **No Trade Secrets.** Microsoft does not claim any trade secret rights in this documentation.
- **Patents.** Microsoft has patents that might cover your implementations of the technologies described in the Open Specifications documentation. Neither this notice nor Microsoft's delivery of this documentation grants any licenses under those patents or any other Microsoft patents. However, a given Open Specifications document might be covered by the Microsoft [Open Specifications Promise](#) or the [Microsoft Community Promise](#). If you would prefer a written license, or if the technologies described in this documentation are not covered by the Open Specifications Promise or Community Promise, as applicable, patent licenses are available by contacting [iplg@microsoft.com](mailto:iplg@microsoft.com).
- **License Programs.** To see all of the protocols in scope under a specific license program and the associated patents, visit the [Patent Map](#).
- **Trademarks.** The names of companies and products contained in this documentation might be covered by trademarks or similar intellectual property rights. This notice does not grant any licenses under those rights. For a list of Microsoft trademarks, visit [www.microsoft.com/trademarks](http://www.microsoft.com/trademarks).
- **Fictitious Names.** The example companies, organizations, products, domain names, email addresses, logos, people, places, and events that are depicted in this documentation are fictitious. No association with any real company, organization, product, domain name, email address, logo, person, place, or event is intended or should be inferred.

**Reservation of Rights.** All other rights are reserved, and this notice does not grant any rights other than as specifically described above, whether by implication, estoppel, or otherwise.

**Tools.** The Open Specifications documentation does not require the use of Microsoft programming tools or programming environments in order for you to develop an implementation. If you have access to Microsoft programming tools and environments, you are free to take advantage of them. Certain Open Specifications documents are intended for use in conjunction with publicly available standards specifications and network programming art and, as such, assume that the reader either is familiar with the aforementioned material or has immediate access to it.

**Support.** For questions and support, please contact [dochelp@microsoft.com](mailto:dochelp@microsoft.com).

## Revision Summary

Date	Revision History	Revision Class	Comments
9/23/2011	1.0	New	Released new document.
12/16/2011	1.0	None	No changes to the meaning, language, or formatting of the technical content.
3/30/2012	2.0	Major	Updated and revised the technical content.
7/12/2012	2.0	None	No changes to the meaning, language, or formatting of the technical content.
10/25/2012	2.0	None	No changes to the meaning, language, or formatting of the technical content.
1/31/2013	2.0	None	No changes to the meaning, language, or formatting of the technical content.
8/8/2013	3.0	Major	Updated and revised the technical content.
11/14/2013	3.1	Minor	Clarified the meaning of the technical content.
2/13/2014	4.0	Major	Updated and revised the technical content.
5/15/2014	4.0	None	No changes to the meaning, language, or formatting of the technical content.
6/30/2015	5.0	Major	Significantly changed the technical content.
10/16/2015	5.0	None	No changes to the meaning, language, or formatting of the technical content.
9/26/2016	6.0	Major	Significantly changed the technical content.
6/1/2017	6.1	Minor	Clarified the meaning of the technical content.
12/15/2017	7.0	Major	Significantly changed the technical content.
11/5/2018	8.0	Major	Significantly changed the technical content.
6/3/2021	9.0	Major	Significantly changed the technical content.
10/26/2021	10.0	Major	Significantly changed the technical content.

# Table of Contents

<b>1</b>	<b>Introduction</b>	<b>5</b>
1.1	Conceptual Overview	5
1.1.1	Software Updates	5
1.1.2	Update Server	6
1.1.3	Update Client	6
1.1.4	Downstream Server (DSS)	6
1.1.5	Upstream Server (USS)	6
1.1.6	Reporting Data	7
1.2	Glossary	7
1.3	References	9
<b>2</b>	<b>Functional Architecture</b>	<b>10</b>
2.1	Overview	10
2.1.1	System Purpose	10
2.1.2	Functional Overview	11
2.1.2.1	Black Box Diagram	12
2.1.2.2	White Box Diagram	13
2.1.3	Applicability	15
2.1.4	Relevant Standards	15
2.2	Protocol Summary	16
2.3	Environment	16
2.3.1	Dependencies on This System	16
2.3.2	Dependencies on Other Systems	16
2.3.2.1	Network Connectivity	17
2.3.2.2	Underlying Protocols	17
2.3.2.3	Persistent Storage Facility	17
2.3.2.4	External Configuration System	17
2.3.2.5	External Restartable HTTP Download Service	17
2.4	Assumptions and Preconditions	18
2.5	Use Cases	18
2.5.1	Actors	18
2.5.2	Use Case Summary Diagram	18
2.5.3	Use Case Descriptions	19
2.5.3.1	Configure Update Server - Server Management Tool	19
2.5.3.2	Manage Computer Groups - WSUS Administrator	20
2.5.3.3	Approve Update - WSUS Administrator	21
2.5.3.4	Monitor Update Installation - WSUS Administrator	22
2.5.3.5	Synchronize Server - Server Management Tool	23
2.5.3.6	Configure Update Client - Computer User	24
2.5.3.7	Start Update Scan - Computer User	26
2.5.3.8	Install Updates - Computer User	27
2.6	Versioning, Capability Negotiation, and Extensibility	28
2.7	Error Handling	29
2.7.1	Failure Scenarios	29
2.7.1.1	Network Failure	29
2.7.1.2	Data Stores Corrupted	29
2.7.1.3	Update Content Corrupted	29
2.8	Coherency Requirements	30
2.8.1	Timers	30
2.8.2	Non-Timer Events	30
2.8.3	Initialization and Reinitialization Procedures	30
2.9	Security	30
2.10	Additional Considerations	31
<b>3</b>	<b>Examples</b>	<b>32</b>

3.1	Example 1: Update Synchronization to DSS.....	32
3.1.1	Registration and Authorization.....	33
3.1.2	Configuration Synchronization .....	34
3.1.3	Configuration Updates Synchronization.....	34
3.1.4	Software Updates Synchronization .....	34
3.2	Example 2: Initial Deployment Synchronization to Replica DSS.....	34
3.3	Example 3: Initial Update Synchronization to Update Client.....	35
3.4	Example 4: Differential Update Synchronization to Update Client .....	37
3.5	Example 5: Rollup of Reporting Data to USS.....	39
3.6	Example 6: Update Client Is Pointed to a New Update Server .....	40
<b>4</b>	<b>(Updated Section) Microsoft Implementations .....</b>	<b>43</b>
4.1	Product Behavior.....	43
<b>5</b>	<b>Change Tracking.....</b>	<b>44</b>
<b>6</b>	<b>Index.....</b>	<b>45</b>

# 1 Introduction

This document describes how the Windows Server Update Services (WSUS) protocols interact with each other and provide specific scenarios to highlight the WSUS design goals. The details of the communication at the protocol level are specified in the member protocol technical documents and are not duplicated in this document unless they are specifically used to clarify a concept.

It is often difficult for IT administrators to keep the computers on their organization's network updated in a timely manner with software updates that are critical for secure operation. A software update is any update, update rollup, service pack, feature pack, critical update, security update, or hotfix that improves or fixes a software product. IT administrators require centralized management for distribution of software updates. In addition to keeping software up-to-date, IT administrators require automated updates in order to test the updates before making them generally available and to provide statistics about the dissemination of the updates.

These requirements establish a feedback loop to improve administrator confidence about the compliance of the managed computers around critical and security updates. From a scalability perspective, an update service will provide a solution that tailors the updates to specific computer configurations without having to evaluate every available update. This is essential because updates that a single computer requires are based on the hardware and software configuration and usually represent a minority of all available updates. WSUS is designed to meet this need.

## 1.1 Conceptual Overview

This section provides a conceptual overview of Windows Server Update Services (WSUS). This document assumes that the reader has the following background knowledge:

- SOAP web service-based protocols
- Use of XML to package data

WSUS enables IT administrators to distribute and manage software updates from a central location to a large number of computers. Administrators are able to approve software updates to groups of computers and retrieve status reports to monitor the state of update installations across those computers. WSUS consists of one or more WSUS servers and many WSUS clients. The WSUS server enables administrators to synchronize updates from a parent WSU server, organize computers into groups for efficient update management, approve updates for installation, and generate reports on update installation activity. Multiple servers can be configured as a hierarchy to allow a variety of deployment options, either with autonomous control or with centralized control. The WSUS client can detect updates that are applicable from the available set of updates on the server, install those updates, and report installation activity back to the server.

WSUS requires communication between the WSUS client and server to enable clients to discover updates that are available on the server. In addition, WSUS requires communication between servers to propagate update information, the updates, and administrative intent in a hierarchical deployment.

### 1.1.1 Software Updates

A software update is either an update to an application or an update to a driver for a hardware device. WSUS treats any type of update the same way; it defines a software update as update metadata plus the update content. The metadata contains information about other updates that it depends on, rules that define under which conditions the update can be applied to a target computer, information about binary files that are used in the update installation process, and information about how the binary files ought to be applied on the target computer to complete the installation.

## 1.1.2 Update Server

WSUS has a hierarchical topology that consists of servers called update servers and client computers that are called update clients. An update server is a computer that implements both the Windows Server Update Services: Server-Server Protocol, as specified in [MS-WSUOSS], and the Windows Server Update Services: Client-Server Protocol, as specified in [MS-WUSP], for providing update to other update servers and client computers.

## 1.1.3 Update Client

Individual update clients report the update installation activity to its update server, as specified in [MS-WUSP] section 3.2.4. Data from individual update clients are propagated by a downstream server (DSS) to its upstream server (USS), based on the DSS and USS configuration as specified in [MS-WSUOSS] section 3.2.4.5. The reporting data provides the basis on which update installation reports can be generated by administrators to gauge the penetration and health of update distribution.

## 1.1.4 Downstream Server (DSS)

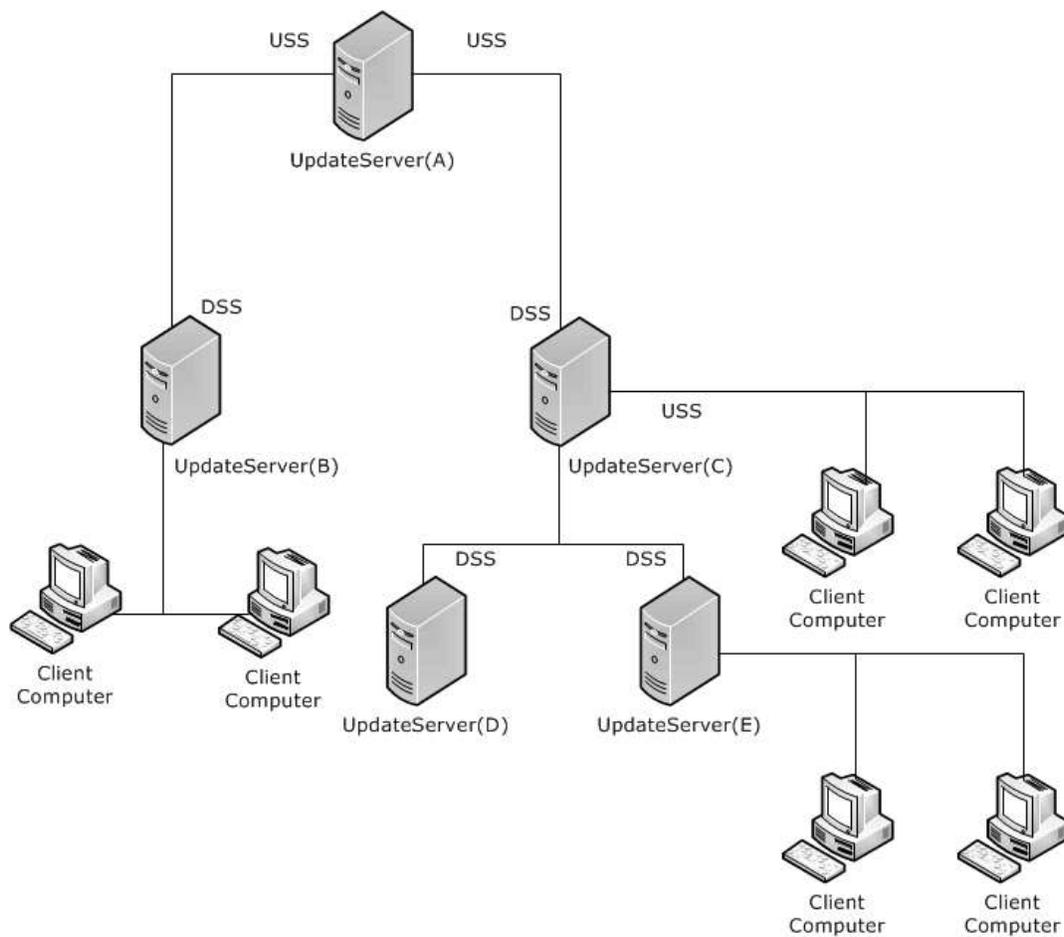
WSUS has a hierarchical topology of servers with individual child servers that are configured either as an autonomous downstream server (DSS) or as a replica DSS, as described in [MS-WSUOSS] section 1.3. A DSS synchronizes update metadata and content as specified in [MS-WSUOSS] section 3.2.4.2 and section 3.2.4.4, respectively. If the DSS is configured as a replica DSS, it additionally synchronizes the deployments, as specified in [MS-WSUOSS] section 3.2.4.3.

The update metadata, content, and deployment that are synchronized in this way on a WSUS server are used to determine available, applicable software updates for an individual update client. The protocol between an update client and its update server is specified in [MS-WUSP].

## 1.1.5 Upstream Server (USS)

A USS is an update server that provides updates to other update servers. The following figure shows an example of a WSUS hierarchy. The upstream servers in a hierarchy provide information about updates to downstream servers. Any update server in the hierarchy can serve simultaneously as a DSS with respect to its upstream server and as a USS with respect to its downstream servers.

For example, in the following figure, update server C acts as a DSS when it communicates with its upstream server A and acts as a USS when it communicates with its downstream servers D or E.



**Figure 1: Typical hierarchical topology of update servers and client computers**

An update server groups its client computers into target groups. An update server can be configured to deploy the updates to its client computers by assigning the updates to the target groups for deployment and, optionally, by specifying an installation or removal deadline. This mapping of the individual update revisions to target groups is known as a deployment.

### 1.1.6 Reporting Data

In WSUS, the term reporting data is used to describe data about update installation activity. Reporting data is generated by the update client on the target computer and it is sent to update servers. When WSUS is configured as a hierarchy, it can send the reporting data from a DSS to a USS. The reporting data provides the basis on which update installation reports can be generated by administrators to gauge the penetration and health of update distribution.

## 1.2 Glossary

This document uses the following terms:

**administrative intent:** A combination of target groups, group membership, and update approvals that defines the WSUS administrator's choices regarding which available updates should be installed on each of the managed computers.

**anchor:** An opaque data element generated by an update server to identify the occurrence of a software update-related event in a manner that distinguishes temporally separate occurrences of the event.

**client computer:** A computer that gets its updates from an update server. A client can be a desktop computer, a server, or the update server. For more information, see [MS-WUSP] and [MS-WSUSSS].

**content:** A package that contains all the associated files for an update that is to be installed on a client computer.

**deployment:** An administratively specified decision to make a specific update revision available to a specific target group.

**detectoid:** A logical condition that is evaluated on a client computer to detect the presence of software, drivers, or their updates. A detectoid is identified by a GUID and described by metadata. It is represented as an update with no associated content.

**downstream server (DSS):** An update server that synchronizes its updates from another update server.

**globally unique identifier (GUID):** A term used interchangeably with universally unique identifier (UUID) in Microsoft protocol technical documents (TDs). Interchanging the usage of these terms does not imply or require a specific algorithm or mechanism to generate the value. Specifically, the use of this term does not imply or require that the algorithms described in [RFC4122] or [C706] must be used for generating the GUID. See also universally unique identifier (UUID).

**man in the middle (MITM):** An attack that deceives a server or client into accepting an unauthorized upstream host as the actual legitimate host. Instead, the upstream host is an attacker's host that is manipulating the network so that the attacker's host appears to be the desired destination. This enables the attacker to decrypt and access all network traffic that would go to the legitimate host. The attacker is able to read, insert, and modify at-will messages between two hosts without either party knowing that the link between them is compromised.

**metadata:** XML-formatted data that defines the characteristics of an update, including its title, description, rules for determining whether the update is applicable to a client computer, and instructions for installing the update content.

**replica DSS:** A DSS that obtains both updates and update deployments from its USS.

**reporting data:** A description of update installation activity.

**SOAP:** A lightweight protocol for exchanging structured information in a decentralized, distributed environment. SOAP uses XML technologies to define an extensible messaging framework, which provides a message construct that can be exchanged over a variety of underlying protocols. The framework has been designed to be independent of any particular programming model and other implementation-specific semantics. SOAP 1.2 supersedes SOAP 1.1. See [SOAP1.2-1/2003].

**synchronization:** The process by which a downstream server (DSS) obtains update metadata, target groups, and update deployments from an upstream server (USS) in order to reconcile its state with the USS.

**target group:** A named collection of client computers whose members are defined administratively.

**update:** The combination of metadata and associated content for a software update. An update is identified by a GUID.

**update classification:** A scheme to classify updates such as Critical, Security, Service Pack, and so on. An update classification is identified by a GUID and described by metadata. It can be treated as an update with no associated content.

**update client:** A computer that implements the Windows Server Update Services: Client-Server Protocol to get updates from an update server. The client can be a desktop computer, a server, or the update server itself.

**update metadata:** A combination of XML-formatted metadata and associated content that contains information about an update.

**update server:** A computer that implements the Windows Server Update Services: Server-Server Protocol or the Windows Server Update Services: Client-Server Protocol to provide updates to client computers and other update servers.

**upstream server (USS):** An update server that provides updates to other update servers.

**WSUS administrator:** A user who deploys the latest Microsoft product updates to computers running the Windows operating system. WSUS administrators can fully manage the distribution of updates that are released through Microsoft Update to computers on their network. They are responsible for creating target group and update deployments.

### 1.3 References

[MS-GPOD] Microsoft Corporation, "Group Policy Protocols Overview".

[MS-GPOL] Microsoft Corporation, "Group Policy: Core Protocol".

[MS-WSUSSH] Microsoft Corporation, "Windows Update Services: Server-Server Protocol".

[MS-WUSP] Microsoft Corporation, "Windows Update Services: Client-Server Protocol".

[MSDN-BITS] Microsoft Corporation, "Background Intelligent Transfer Service", [http://msdn.microsoft.com/en-us/library/bb968799\(VS.85\).aspx](http://msdn.microsoft.com/en-us/library/bb968799(VS.85).aspx)

[RFC2616] Fielding, R., Gettys, J., Mogul, J., et al., "Hypertext Transfer Protocol -- HTTP/1.1", RFC 2616, June 1999, <http://www.rfc-editor.org/rfc/rfc2616.txt>

[SOAP1.2-1/2003] Gudgin, M., Hadley, M., Mendelsohn, N., et al., "SOAP Version 1.2 Part 1: Messaging Framework", W3C Recommendation, June 2003, <http://www.w3.org/TR/2003/REC-soap12-part1-20030624>

## 2 Functional Architecture

### 2.1 Overview

WSUS is composed of two protocols:

- **Windows Update Services: Client-Server Protocol**, as specified in [MS-WUSP]. This protocol enables update-client-to-update-server communication. Its purpose is to transfer update metadata, deployments, and content from an update server to an update client, and to report status information from an update client to an update server. These operations might rely on the update server that has acquired update metadata, deployments, and content from another update server by using the Windows Update Services: Server-Server Protocol.
- **Windows Update Services: Server-Server Protocol**, as specified in [MS-WSUOSS]. This protocol enables server-to-update-server communication. Its purpose is to transfer update metadata, deployments, and content from an upstream server (USS) to a downstream server (DSS), and to send aggregated status information from a DSS to a USS. These operations might rely on the DSS that has acquired status information from update clients by using the Windows Update Services: Client-Server Protocol.

#### 2.1.1 System Purpose

WSUS enables the WSUS administrator to control automated delivery of updates to computers in an environment where the computers are managed by one or more WSUS administrators. WSUS is designed to quickly and efficiently distribute updates to computers without the need for an administrator to manually install the updates.

For WSUS administrators, WSUS provides the following:

**Acts as a centralized repository for updates.** WSUS enables administrators to review available updates from one location, the update server. They can perform all the update-related activities on the server without the need to examine client computers where the updates are eventually applied.

**Provides ways to control the delivery of updates.** There is a variety of updates with varying severity. Similarly, the computers being managed have varying requirements with respect to allowing change through software updating. For example, servers running line-of-business applications have strict requirements with regard to downtime and update testing. To balance these requirements, WSUS provides administrators with tools to group computers of similar requirements together and allows or disallows installation of selected updates to such groups.

**Enables automatic update discovery, delivery, and installation on client computers.** Not all updates that are available on the update server are applicable on a given computer. The applicability of an update is based on the specific hardware and software configuration of the computer. WSUS determines update applicability automatically and only installs relevant updates on computers.

**Allows deployment options that enable distributed administration or scale-out.** In large enterprises, there can be multiple branch offices with different administrators. In addition, the total number of computers might be such that one update server cannot handle the processing load. WSUS solves this problem by allowing a deployment configuration where multiple update servers are deployed in a parent-child relationship that forms a tree. The DSS servers can be independently administered or can receive administrative intent from the USS servers.

**Provides reporting data about update installation activity.** Reporting data sets up a feedback loop for the administrator to check the update installation status. When the update servers are deployed as a hierarchy, WSUS allows for the root server to receive rolled-up reporting data from

all the client computers across the hierarchy, enabling the administrator to assess the overall health of the computing environment across the enterprise.

**Enables software update delivery and installation in a secure and scalable way.** Applying updates essentially means executing external code and placing external code on a computer. It is therefore critical that safeguards are in place to prevent attackers from leveraging these capabilities to take control of or damage the computers.

For the end user, WSUS provides the following:

**Updates software on the computer automatically or with minimal intervention.** Typically, the end user wants software to be up-to-date. WSUS allows for a scheduled discovery and installation mode where the update client periodically contacts the update server to determine whether new updates are applicable and to install the updates.

**Allows configuration options to control the update installation.** In cases where the end user requires additional control, WSUS allows client configuration options that enable manual settings.

### 2.1.2 Functional Overview

The WSUS protocols provide centralized update management in an enterprise computing environment. The protocols provides automated update discovery and delivery, and administrative control over update availability.

WSUS provides the following update functionality:

- Enable update discovery by computers
- Deliver relevant updates to computers
- Update distribution controls for administrators
- Monitor update activity

For update discovery, WSUS evaluates the rules contained in update metadata to determine whether an update is required by the target computer. Update delivery is performed through HTTP file download.

Administrators control update distribution by placing computers into target groups and creating update deployments. A target group is a collection of computers (for example, servers or desktop computers) that are defined by the WSUS administrator. The target group is used to treat a set of computers collectively rather than having to perform actions on a per-computer basis. An update deployment is an administrative intent about whether an update will be made available for a given target group. Administrators use update deployments to control the availability of updates to the computers that they manage.

Administrators can also configure a distributed server environment to manage update distribution to remote locations efficiently. Update installation is monitored by computers sending update detection and installation status using a reporting channel.

WSUS consist of the following:

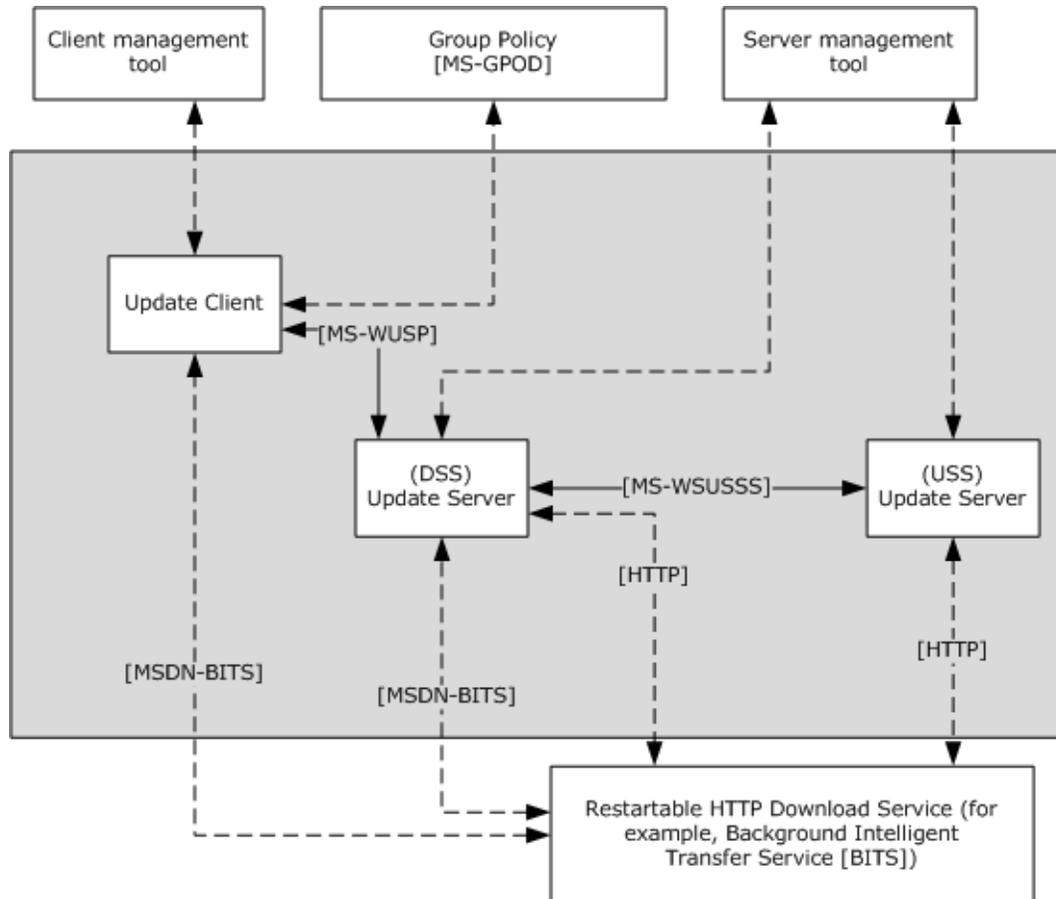
- One or more update servers that act as distribution points for updates, and receive and relay update status information. The update servers are essentially repositories for update metadata.
- One update client on each computer that is configured to receive updates. The update client communicates with an update server to discover updates and send installation information.

To discover and install updates, the update clients send a series of requests to the update server to progressively determine updates that are applicable, while excluding updates that are not applicable.

At the end of the discovery phase, the update client downloads the installation files from the update server to complete the update installation. The update client sends back information about the update detection and installation phases as events to the update server.

### 2.1.2.1 Black Box Diagram

The following diagram shows the communication in a black box relationship.



**Figure 2: Black box relationship**

WSUS is depicted in the gray box and is composed of an update client and two update servers. Specifically, the diagram depicts two update servers in the upstream server (USS) and downstream server (DSS) roles and an update client. Communication between an update client and an update server uses the Windows Update Services: Client-Server Protocol (WUSP). Communication between the DSS and USS uses the Windows Update Services: Server-Server Protocol (WSUSSS). Content download by the update client and DSS is accomplished by making requests to the Background Intelligent Transfer Service (BITS), as specified in [MSDN-BITS]. BITS relays the requests over the HTTP protocol.

The abstract data model (ADM) that represents the state of WSUS is persisted in local storage on the update client and update servers.

Update client and update server management tools can interact with WSUS in an implementation-defined manner by altering the state of the ADM elements that are part of the member protocol or by using one of the protocol initialization mechanisms.

The ADM elements for the WUSP server and ways to populate them are specified in [MS-WUSP] section 3.1.1 and section 3.1.1.1. Out of the ADM elements described, the server management tool can be used to alter the state of the **Client Computers Table**, **Target Group Table**, and the **Deployment Table** to express administrative intent.

The various initialization triggers that the server management tool can fire to initiate the Windows Server Update Services: Server-Server Protocol are specified in [MS-WSUSSS] section 3.2.3.

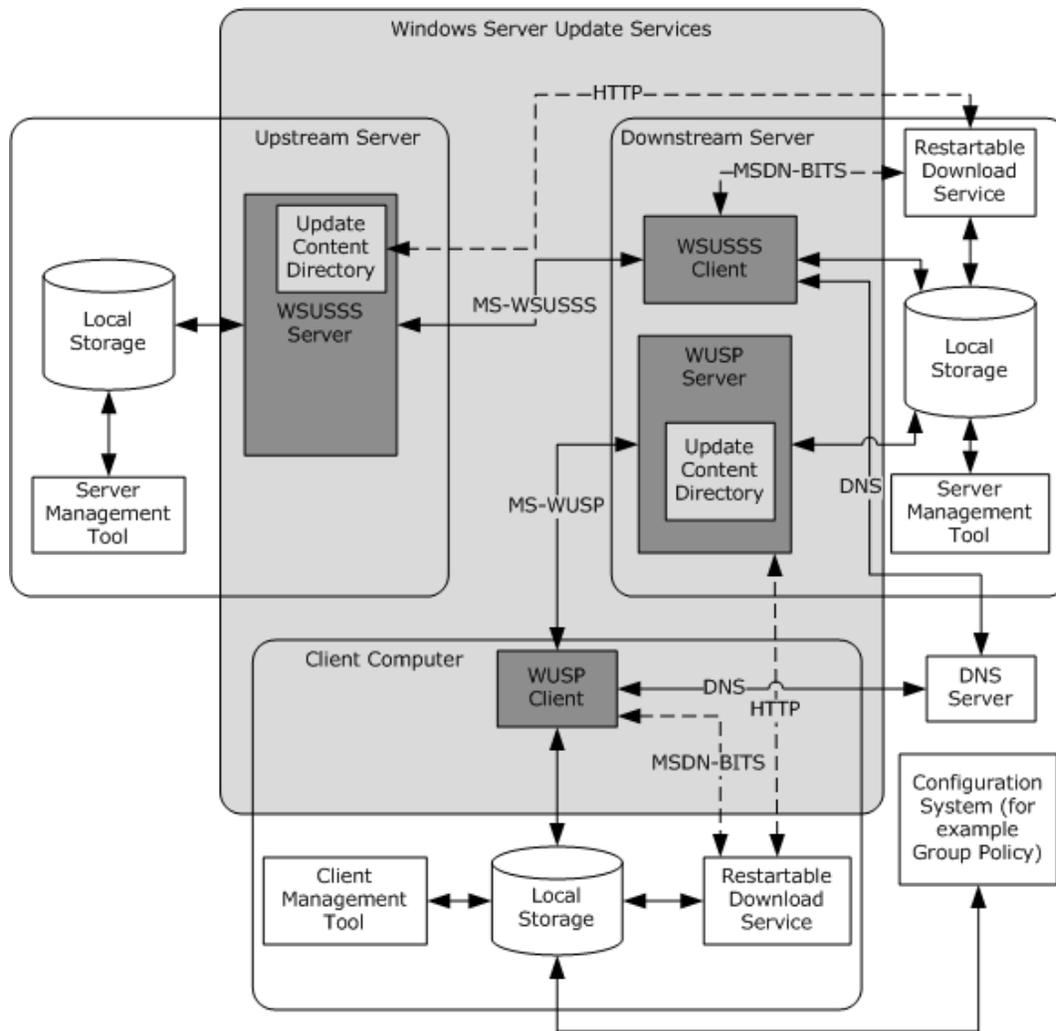
The Group Policy protocols interact with WSUS by altering the state of the ADM element **Policy Table** as specified in [MS-WUSP] section 3.2.1.

### 2.1.2.2 White Box Diagram

This section describes the primary relationship between the Windows Update Services: Client-Server Protocol (WUSP) and the Windows Update Services: Server-Server Protocol (WSUSSS). The primary relationship between the Windows Update Services: Client-Server Protocol (WUSP) and the Windows Update Services: Server-Server Protocol (WSUSSS) is based on shared data among the member protocols.

State sharing of the information passed using WSUSSS and WUSP takes place on an update server. An update server can participate in protocol exchanges with a USS or a DSS using WSUSSS as well as protocol exchanges with update clients using WUSP. WSUS maintains data for each protocol, and there is substantial overlap among the data maintained for each protocol. Data that is modified by a WSUSSS protocol exchange can be consumed by a WUSP protocol exchange, and vice versa.

The following diagram illustrates WSUS topology.



**Figure 3: Example of a WSUS topology**

An update client synchronizes updates from an update server, which can be a DSS that itself synchronizes updates from a USS. Two examples are illustrated in the preceding figure.

In the first example, a new update is introduced to the USS. The DSS initiates an update synchronization from the USS using WSUSSS, which returns the new update. The DSS adds the new update to its WSUSSS ADM. Later, the update client initiates an update synchronization from the downstream server (DSS) using WUSP. Since an update is shared data, it also appears in the DSS's WUSP data and is returned to the update client.

The second example describes data introduced from the client computer. The update client can report client computer information to the DSS by using WUSP. The DSS inserts this data into its WUSP data model. Because this data is shared with its WSUSSS data counterpart, this data (or a derivative of it) is sent to the USS by using a WSUSSS protocol exchange.

A data dependency between the protocols is introduced through the sharing of data. In the first example, the update client cannot synchronize the new update via WUSP until the DSS has synchronized it from the USS via WSUSSS. In the second example, the USS cannot learn of the client computer information until the update client has reported its client computer information to the DSS.

### 2.1.3 Applicability

WSUS is appropriate for the management of updates for groups of computers. Additionally, it is applicable to situations in which several groups of computers need to be managed separately.

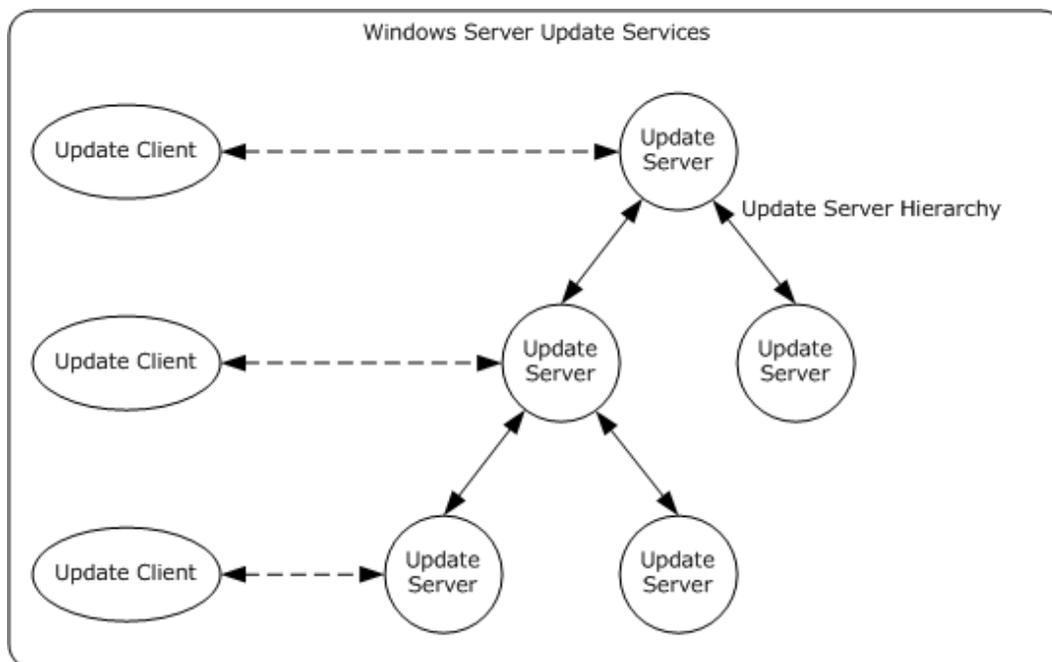
WSUS is not useful for situations in which computers that require updates are not on the network with the WSUS servers.

WSUS can be implemented in a Windows environment by enabling the update server component on computers running applicable Windows Server releases and configuring the update client on computers with Windows to communicate with the update server. For the Windows versions that WSUS supports, see section 4.

In a distributed deployment of WSUS with more than one update server, a downstream server (DSS) communicates with an upstream server (USS) to synchronize the update metadata and associated content, and optionally, administrative intent such as target groups and deployments. In addition, the DSS can be configured to relay information about the update installation information that it collected from update clients to the USS.

WSUS defines a set of internal protocols to enable server-to-server and client-to-server communication, as described in section 2.1. There are no external protocols defined by WSUS.

The following figure shows the layout of multiple update servers that are deployed as a hierarchy. Computers are configured to receive updates from one of the update servers in the hierarchy. The server-to-server communication is represented using solid lines, and client-to-server communication is represented using dashed lines. Within the context of each server pair communicating with each other, the parent server forms the USS, and the child server forms the DSS.



**Figure 4: Windows Server Update Services overview**

### 2.1.4 Relevant Standards

The Windows Server Update Services protocols use and extend the following standards:

**Hypertext Transfer Protocol - HTTP/1.1**, as specified in [RFC2616]. This protocol enables file transfer from update server to update client.

**SOAP Version 1.2 Part 1: Messaging Framework**, as specified in [SOAP1.2-1/2003]. This protocol serves as the base protocol from which most of the internal protocols for WSUS are defined.

## 2.2 Protocol Summary

The following table lists the WSUS member protocols.

Protocol name	Description	Short name
<b>Windows Update Services: Client-Server Protocol</b>	This protocol enables update discovery, delivery, and reporting facilities for communication between an update client and update server. The purpose of this protocol is to transfer update metadata, update content and deployments from an update server to an update client, and to report status information from an update client to an update server. These operations might rely on the update server having acquired update metadata and deployments from a parent update server using the Windows Update Services: Server-Server Protocol.	[MS-WUSP]
<b>Windows Update Services: Server-Server Protocol</b>	This protocol enables update synchronization, transfer of administrative intent, and relay of reporting data for communication between one update server and another update server. The purpose of this protocol is to transfer update metadata, update content and deployments from an upstream server (USS) to a downstream server (DSS), and to send aggregated status information from a DSS to a USS. These operations might rely on the DSS having acquired status information from update clients using the Windows Update Services: Client-Server Protocol.	[MS-WSUSSS]

## 2.3 Environment

The following sections identify the context in which WSUS exists. This includes the systems that use the interfaces provided by the WSUS protocols, other systems that depend on WSUS, and, as appropriate, how WSUS components communicate.

### 2.3.1 Dependencies on This System

None.

### 2.3.2 Dependencies on Other Systems

This section describes the relationships between WSUS and external components, dependencies, and other systems influenced by WSUS.

The WSUS environment requires the following:

- A networked environment
- Implementation of SOAP, HTTP, and HTTPS protocols
- A persistent storage facility
- Configuration system
- HTTP download service to download update content

### 2.3.2.1 Network Connectivity

WSUS requires a networked environment in which clients and servers are connected. However, constant connectivity is not required; client and server implementations can take advantage of intermittent periods of connectivity to communicate. This requirement is necessary because a primary function of WSUS is to transfer update-related information between clients and servers and servers and servers. If the requirement is not satisfied, WSUS will not function. A temporary loss of connectivity can be mitigated by retrying the protocol operation at a later time.

### 2.3.2.2 Underlying Protocols

All WSUS member protocols are implemented as a layer on top of other protocols. These underlying protocols include SOAP, HTTP, and HTTPS. The WSUS environment is required to provide implementations of these underlying protocols; for example, as operating system libraries. If the requirement is not met, WSUS will not function.

### 2.3.2.3 Persistent Storage Facility

WSUS requires a persistent storage facility so that abstract data models (ADMs) can be maintained. Examples of such a facility include file systems and databases. If the requirement is not satisfied, WSUS will not function.

WSUS uses a configuration system to configure update clients. Configurable aspects of update clients are specified in [MS-WUSP] sections 1.5, 2.1, 2.2.2.1.1, section 3.2.2, and section 3.2.4. An example of a configuration system is the Group Policy: Core Protocol, defined in [MS-GPOL]. It is used to control the WUSP client.

It is recommended that WSUS use a restartable HTTP download service to download files. Such a service allows interrupted HTTP downloads to be restarted. An example of such a service is:

- Background Intelligent Transfer Service [MSDN-BITS]: Used to download files associated with updates. This functionality is used in both WUSP and WSUSSS communication. These interactions are shown in the black box diagram in section 2.1.2.1, where dashed lines show a possible implementation of WSUS.

WSUS can depend on other systems or external entities to provide configuration data or other services. The relationships described in this section are not required to implement WSUS, but are examples of such relationships.

### 2.3.2.4 External Configuration System

An external system that provides configuration data can be used to configure clients of WSUS. One such system is Group Policy [MS-GPOD].

An external configuration system can influence WSUS by configuring a client's ADM values for:

- Update server
- Target groups

Configuration of these values is specified in [MS-WUSP] section 3.2.1.

### 2.3.2.5 External Restartable HTTP Download Service

The member protocols do not specify how update content files are downloaded. However, an external restartable HTTP download service that can restart interrupted downloads is typically used. One such service is the Background Intelligent Transfer Service [MSDN-BITS]. Such a service can produce a notification when a download is complete, which can be used to trigger WSUS behavior. For example,

on an update server, when an update's files finish downloading, the update can become available to update clients.

## 2.4 Assumptions and Preconditions

WSUS has the following assumptions and preconditions:

- An update client is required to be initialized with the location of its update server.
- A DSS is required to be initialized with the location of its USS.

## 2.5 Use Cases

### 2.5.1 Actors

The actors that participate in the WSUS use cases are:

**WSUS administrator:** The WSUS administrator is the individual responsible for managing the distribution of updates that are released through Microsoft Update to computers on the administrator's network. The WSUS administrator installs agents on the computers that need to be managed. The WSUS administrator approves updates, monitors the update installations, configures server(s) for updates, and synchronizes servers.

**Computer user:** A computer user is a user of a computer that is managed by the update server. The computer can include laptops, desktops, and servers. The user can be required to keep his or her computer updated with the latest security patches and service packs. The update server can require the user either to install the updates right away or to schedule the updates for a more convenient time. The computer user can also be required to configure the client and start an update scan. Optionally, all of these tasks can be automated.

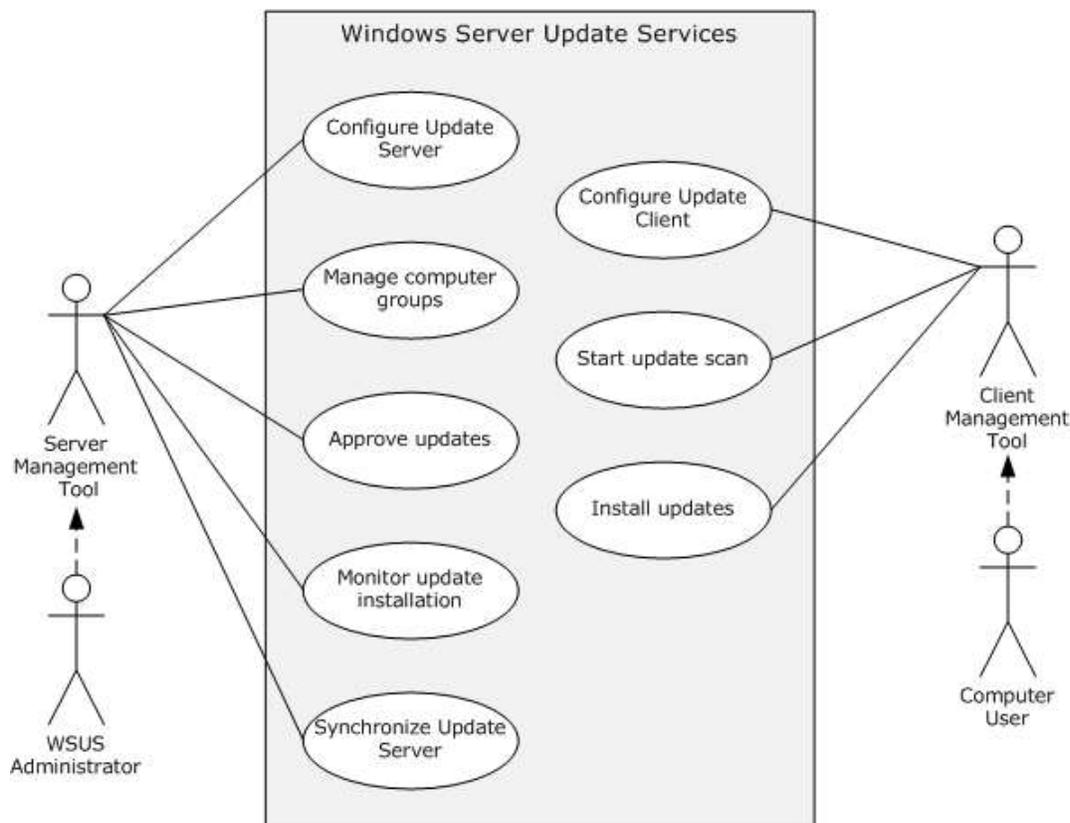
**Server management tool:** A tool that provides an administrative interface to the update server. The primary interest of the server management tool is to enable a WSUS administrator to read and update the update server configuration, display available updates, manage target groups and group membership, and approve updates. The server management tool enables the display of update installation status reports to the WSUS administrator.

**Client management tool:** A tool that provides a management interface to the update client. The primary interest of the client management tool is to enable a computer user to read and update the update client configuration, start a scan for updates, and control the download and installation of updates.

**Configuration system:** A supporting actor that is used by the WSUS administrator to assign user-specified values to distribute configuration settings that control the client's behavior. An example of such a configuration system is Group Policy, as described in [MS-GPOD].

### 2.5.2 Use Case Summary Diagram

The following diagram provides an overview of WSUS use cases with the WSUS administrator and computer user as the primary actors.



**Figure 5: Windows Server Update Services use cases**

## 2.5.3 Use Case Descriptions

### 2.5.3.1 Configure Update Server - Server Management Tool

Goal: To configure the update server according to the deployment requirements.

Configuration options include:

- Determining from where the USS receives updates.
- Whether a DSS receives only updates from the USS or update deployments also.
- Whether DSSs send detailed reporting data or just a summary of the computers they manage.
- Whether computer membership is based on groups that are assigned using client configuration or manual membership assignment on the server.
- Whether synchronization is manually triggered by the WSUS administrator or set up to run on a schedule.

Context of Use: This use case is initiated after the update server installation is complete and before the update server is used to service clients.

Direct Actor: The direct actor of this use case is the server management tool.

Primary Actor: The primary actor is the WSUS administrator.

Supporting Actors: None.

Stakeholders and Interests:

- The server management tool's primary interest for this use case is to enable a WSUS administrator to read and update the update server configuration.
- The primary interest of the WSUS administrator is to customize a Windows Server Update Services deployment to meet the requirements of the organization's environment.

Preconditions: The update server is operational.

Minimal Guarantees: None.

Success Guarantee:

- If the server configuration is successful, the update server persists configuration changes to the server's local storage.
- If the server configuration is successful, the server components that depend on the configuration use the updates configuration to determine their behavior.

Trigger: The server management tool triggers this use case on behalf of the WSUS administrator.

Main Success Scenario:

1. The server management tool identifies the relevant configuration elements that have changed.
2. The configuration is modified according to input from the WSUS administrator.
3. The configuration is successfully saved to the data store.

Extensions:

- The USS from which the update server receives updates.
- Whether the update server receives updates or update deployments from the USS.
- Whether DSSs of the update server send detailed reporting data or a summary only of the computers they manage.
- Whether computer membership is based on groups that are assigned by using client configuration or by manual membership assignment on the update server.
- Whether synchronization is manually triggered by the administrator or set up to run on a schedule.

### **2.5.3.2 Manage Computer Groups - WSUS Administrator**

Goal: To create computer target groups and establish membership of computers managed by the update server within those target groups.

Context of Use: The use case is initiated when the WSUS administrator wants to do the following:

- Create an initial plan for how updates will be delivered to computers.
- Fine-tune the plan as requirements evolve.
- Add new computers to WSUS and assign them to target groups.

Direct actor: The direct actor of this use case is the server management tool.

Primary actor: The primary actor is the WSUS administrator.

Supporting actors: None.

Stakeholders and interests:

- The server management tool's primary interest for this use case is to enable a WSUS administrator to manage target groups and group membership.
- WSUS administrators perform this use case with the intent of organizing managed computers into groups to which they can apply the updating strategy. To minimize effort, the administrator's primary interest is to manage computers that are based on classes of computers rather than individual computers.

For example, it is typical for the WSUS administrator to create separate groups for desktop computers and servers because these classes of computers have very different update requirements. Similarly, it is common for the administrator to create a test group for a representative set of computers. The administrator uses such a group to test the effects of updates and ensure normal operation before the update is rolled out generally.

Preconditions:

- The update server is operational.
- The update server is configured to use server-side targeting.

Minimal Guarantees: None.

Success Guarantee:

- For group creation, a target group entry is persisted in the server data store.
- For membership assignment, the information that associates the computer to a target group is persisted in the server data store.
- The target group and computer membership information, along with the update deployments, are used during the client detection phase (the Start Update Scan - Computer User use case, section 2.5.3.7) to determine which updates will be made available.

Trigger: The Server Management Tool initiates this use case on behalf of the WSUS administrator.

Main Success Scenario:

1. The target group creation or target group membership is obtained from the WSUS administrator.
2. This information is persisted in the server data store.

Extensions: None.

### **2.5.3.3 Approve Update - WSUS Administrator**

Goal: To approve an update to a target group either for installation or uninstallation. This is the primary use case that enables WSUS to control update delivery.

Context of Use: This use case is initiated when the WSUS administrator enables available updates to be installed or uninstalled on managed computers.

Direct Actor: The direct actor of this use case is the server management tool.

Primary Actor: The primary actor is the WSUS administrator.

Supporting Actors: None.

Stakeholders and Interests:

- The primary interest of the server management tool in this use case is to enable a WSUS administrator to display and approve available updates.
- The primary purpose of the WSUS administrator in this use case is to distribute updates to the managed computers.

Preconditions:

- The update server is operational.
- The update server is configured to be an autonomous update server.
- The update server has synchronized updates.
- Target groups have been created.

Minimal Guarantees: None.

Success Guarantees:

- The update deployment information that associates an update with a target group is persisted in the server data store.
- This information is utilized by the update server during the client detection phase, as described in use case 2.5.3.7.

Trigger: The server management tool triggers this use case on behalf of the WSUS administrator.

Main Success Scenario:

1. The update deployment information is obtained from the WSUS administrator.
2. This information is persisted in the server data store.

Extensions: None.

#### **2.5.3.4 Monitor Update Installation - WSUS Administrator**

Goal: To generate update installation and applicability reports. How WSUS is implemented determines the type of reports that are generated. Reports can vary between high-level summary reports to detailed reports for a given update or a given computer.

Context of Use: This use case is initiated when the WSUS administrator reviews which computers require updates and which have installation failures.

Direct Actor: The direct actor of this use case is the server management tool.

Primary Actor: The primary actor is the WSUS administrator.

Supporting Actors: None.

Stakeholders and Interests:

- The primary purpose of the server management tool in this use case is to enable a WSUS administrator to view update installation status reports.
- The primary purpose of the WSUS administrator in this use case is to determine the health of WSUS and the results of this update distribution strategy.

Preconditions:

- The update server is operational.
- The update server has synchronized updates.
- Computers managed by the update server have completed detection and installation of updates, as described in sections 2.5.3.7 and 2.5.3.8.

Minimal Guarantees: None.

Success Guarantees:

- Based on the report type, the update server calculates the results of the update installation and applicability and generates a formatted report.

Trigger: The server management tool triggers this use case on behalf of the WSUS administrator.

Main Success Scenario:

1. The update server collects the raw update events from the data store related to the report that is generated.
2. Any calculations required to summarize the data are performed.
3. The results are formatted and displayed in the management tool.

Extensions: None.

### **2.5.3.5 Synchronize Server - Server Management Tool**

Goal: To synchronize a DSS in an update server hierarchy with updates and deployments from a USS.

Context of Use: This use case is initiated when the WSUS administrator wants to bring the update server into synchronization with a USS. This use case can be initiated on a schedule.

Direct Actor: The direct actor for this use case is the server management tool.

Primary Actor: The primary actor for this use case is the WSUS administrator.

Supporting Actors: None.

Stakeholders and Interests:

- The primary purpose of the server synchronization component in this use case is to enable a WSUS administrator to synchronize the update server with a USS.
- The primary purpose of the WSUS administrator is to ensure uniform access to updates across the enterprise when WSUS is deployed as a hierarchy of servers.

Preconditions:

- The update server is operational.
- The update server is configured as a DSS.
- The USS is operational.
- Network connectivity is present between the DSSs and USSs.

Minimal Guarantees: None.

#### Success Guarantee:

- Updates available on the USS that are not already present on the DSS are obtained and persisted in the DSS data store.
- When the DSS is configured as a replica DSS, the computer target groups and update deployments are also obtained and persisted in the DSS data store.

#### Trigger:

- The update server triggers this use case automatically.
- In addition, the server management tool can trigger this use case on behalf of the WSUS administrator at any time.

#### Main Success Scenario:

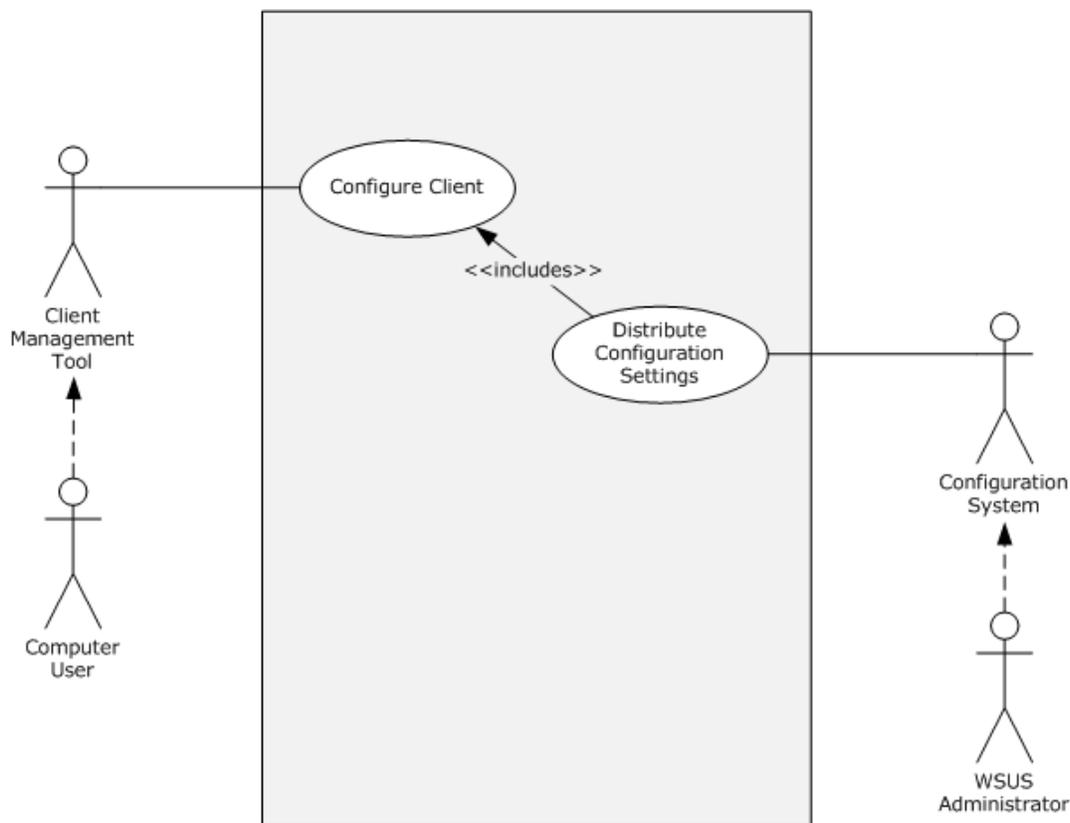
1. The DSS contacts the USS to identify new updates that have been created since the last successful synchronization. If this is the first synchronization, all updates are selected.
2. The selected updates are imported into the local data store.

#### Extensions:

- If the DSS is a replica DSS, target groups and deployments are also selected.
- If the DSS is a replica DSS, the selected target groups and deployments are created in the local data store.

### **2.5.3.6 Configure Update Client - Computer User**

The following use case diagram describes the interaction between the computer user and the WSUS administrator to update the client with user-specified settings.



**Figure 6: Configure Update Client use case**

**Goal:** To assign user-specified values to configuration settings that control the client's behavior.

**Context of Use:** This use case is initiated at any time in order to initialize or modify configurable aspects of the client's behavior.

**Direct Actor:** The direct actor of this use case is a client management tool.

**Primary Actor:** The primary actor of this use case is the WSUS administrator or the computer user.

**Supporting Actors:** A configuration system such as Group Policy.

**Stakeholders and Interests:**

- A client management tool, as described in section 2.5.1, enables a computer user to read and update the update client configuration.
- Computer users, as described in section 2.5.1, expect that after this use case is executed, the client behaves in a manner consistent with the new configuration.
- WSUS administrators, as described in section 2.5.1, can execute this use case on client computers they manage in order to apply an organizational policy regarding client configuration.

**Preconditions:**

- The client management tool is available to the computer user and can communicate with the client.

**Minimal Guarantees:**

- A failure to modify configuration settings is not destructive to previously configured settings. Previously configured settings are retained.

Success Guarantee:

- If the configuration is successful, the user-specified values of the configuration settings are persistently stored by the update client and the behavior of the update client affected by these settings is consistent with the configured values.

Trigger:

- A computer user can trigger this use case by use of a client management tool.

Main Success Scenario:

1. The computer user uses the client management tool to provide values for one or more configuration settings.
2. The client management tool communicates with the client (either directly or indirectly, for example by modifying shared state) in order to update its configuration settings with the values specified by the computer user.
3. Future operations performed by the client behave in ways that are consistent with the configured values.

Variations:

Trigger:

- The WSUS administrator can trigger this use case through a configuration system, for example, Group Policy as specified in [MS-WUSP] section 3.2.1.

Main Success Scenario (Variation):

1. The computer user uses the client management tool to provide values for one or more configuration settings.
2. The client management tool communicates with the client (either directly or indirectly, for example by modifying shared state) in order to update its configuration settings with the values specified by the computer user.
3. Future operations performed by the client behave in ways that are consistent with the configured values.

Extensions: None.

### **2.5.3.7 Start Update Scan - Computer User**

Goal: To discover changes in the set of updates available to the client computer and their deployments since the last time the use case was executed. Additionally, update metadata is retrieved from the update server for new updates. The result of the first execution of this use case on a client computer is the discovery of the entire set of updates available to the client computer, and their deployments and metadata.

Context of Use: This use case is executed periodically to poll for changes in the update set and deployments.

Direct Actor: The direct actor of this use case is a client management tool.

Primary Actor: The primary actor of this use case is a computer user.

Supporting Actors: None.

Stakeholders and Interests:

- A client management tool, as described in section 2.5.1, enables a computer user to start a scan for updates.
- Computer users, as described in section 2.5.1, expect that after this use case is executed, the results of the update scan are reported back to the computer user.
- WSUS administrators, as described in section 2.5.1 can execute this use case to understand the set of updates that are applicable to a given computer, or to understand the set of computers to which a given update is applicable.

Preconditions:

- The update client is required to know the network location of its server.
- The update client is required to be able to reach its server over the network.

Minimal Guarantees:

- If the update scan fails, the client attempts to report the failed operation back to the server.

Success Guarantee:

- If the update scan is successful, the client's update set and update deployments are synchronized with the server.
- If the update scan is successful, the client attempts to report the successful operation back to the server.

Trigger:

- A computer user can trigger this use case by use of a client management tool.
- An automated agent can trigger this use case periodically on a schedule.

Main Success Scenario:

1. The computer user triggers the use case.
2. The client communicates with the server to synchronize the update set and update deployments. This data is cached on the client.
3. The client reports success back to the server.

Extensions: None.

### **2.5.3.8 Install Updates - Computer User**

Goal: To carry out the directive that the WSUS administrator specified for each update that is applicable to the client computer. These directives include Install and Uninstall. An update installation can also result in a download of update content.

Context of Use: This use case is executed after the Start Update Scan use case (see section 2.5.3.7) in order to carry out the WSUS administrator directive that was synchronized from the server by the Start Update Scan use case.

Direct Actor: The direct actor of this use case is a client management tool.

Primary Actor: The primary actor of this use case is a computer user.

Supporting Actors: None.

Stakeholders and Interests:

- A client management tool, as described in section 2.5.1, enables a Computer User to control the download and installation of updates.
- Computer users, as described in section 2.5.1, expect that after this use case is executed, their computer is up-to-date.

Preconditions:

- The client is required to have executed the Start Update Scan use case and determined that there are applicable updates.

Minimal Guarantees:

- If the update is being installed and the download of update content is unsuccessful, the client attempts to report the failed download back to the server.
- If the update installation or removal is unsuccessful, the client will attempt to report the failed operation back to the server.

Success Guarantee:

- If the update installation (or removal) is successful, the update is installed on (or removed from) the client computer.
- If the update installation or removal is successful, the client attempts to report the successful operation back to the server.

Trigger:

- A computer user can trigger this use case by use of a client management tool.
- An automated agent can trigger this use case periodically on a schedule.

Main Success Scenario:

1. The client management tool triggers this use case.
2. If the update is to be installed, the update client downloads the update from the update server.
3. The update client reports success back to the update server.

Extensions: None.

## **2.6 Versioning, Capability Negotiation, and Extensibility**

No capability negotiation is associated with WSUS. Any deviations from the implementation of a specific version of these protocol specifications are documented in the respective protocol document. Capability negotiations between client and server implementations of these protocols are specified in the Versioning and Capability Negotiation sections in their respective technical documents. For more detailed information, see [MS-WUSP] section 1.7 and [MS-WSUSSS] section 1.7.

If the DSS or USS or client is not of a sufficiently high version to support the transfer of the data, then the client ultimately does not receive that data.

## **2.7 Error Handling**

WSUS does not define any errors beyond those that are described in the specifications of the member protocols, as described in section 2.2.

Section 3 of the member protocol specifications describes the errors that are relevant to each protocol.

The following sections describe common failure scenarios.

### **2.7.1 Failure Scenarios**

#### **2.7.1.1 Network Failure**

A common failure scenario is the inability of an update client or update server to contact an update server due to an underlying network failure. Network failures can be caused by a lack of connectivity to the update server or any number of problems in the underlying networking layers.

This failure results in an inability for update clients or update servers to synchronize updates, deployments, or target groups, or to report back client computer information. The failure is typically recognized in the subsystems that implement the protocols by inspecting error information provided by lower level operating system networking components (for example, error codes or exceptions).

Recovering from this error requires that the protocol operation be retried at a later time.

#### **2.7.1.2 Data Stores Corrupted**

This failure scenario occurs when the data store of an update client or update server becomes corrupted. This corruption can occur due to an error in the underlying storage facility or hardware, which is implementation-specific.

This failure results in an inability for update clients or update servers to retrieve stored information. This can result in data loss. The failure is typically recognized by inspecting error information that storage components provide.

To recover from this error requires resetting the data store to an empty state and resynchronizing data from a server. The data store can either be reset in manual operation or reset automatically if the implementation can recognize data store corruption; in either case this recovery is not part of the protocol itself.

#### **2.7.1.3 Update Content Corrupted**

This failure scenario occurs when the installation files that are associated with an update are corrupted or modified either due to unintentional causes, such as network unreliability, or an intentional attempt to breach security.

As a safeguard, it is recommended that the client accept content only for an update that is signed by a trusted certificate and whose hash matches the value retrieved from the update metadata, as specified in [MS-WUSP] section 5. These cryptographic techniques ensure that the client can detect corrupted content in all cases.

It is recommended that the client delete the suspect files and not attempt installation if corruption is detected during the recovery steps.

Because no change is made to the client environment, when corrupted content is encountered, there are no negative consequences from recovery.

## 2.8 Coherency Requirements

### 2.8.1 Timers

It is recommended that an update server use a timer to trigger periodic synchronization with its USS. The frequency of the timer is implementation-specific. The synchronization time and frequency will be configurable so that the WSUS administrator can set a schedule based on the administrative schedule, requirements on the timeliness of the updates, and the WSUS topology that is deployed in an environment, as specified in [MS-WSUSSS] section 3.2.3. The periodic synchronization of the update server with its USS affect update clients that are synchronizing with the update server due to the relationships between the protocols, as described in section 2.1.2.2.

Similarly, it is recommended that an update client use a timer to trigger periodic reporting to its update server. The frequency of the timer is implementation-specific. The periodic reporting of the update client to its update server affects the update server's USS due to the relationship between the protocols, as described in section 2.1.2.2.<1>

### 2.8.2 Non-Timer Events

There are no non-timer events with system-level significance.

### 2.8.3 Initialization and Reinitialization Procedures

WSUS initialization consists of the following:

- Update servers generate a globally unique identifier (GUID) to identify themselves to other update servers.
- Update clients generate a GUID to identify themselves to update servers.
- Update servers are initialized with the location, for example, the DNS name and port, of their upstream server (USS).
- Update clients are initialized with the location, for example, the DNS name and port, of their update server.

An update server or update client can be individually reinitialized without reinitializing the entire system.

## 2.9 Security

This section documents WSUS security issues that are not otherwise specified in the technical documents for the member protocols. It does not duplicate what is already in the member protocol technical documents unless there is some unique aspect that applies to WSUS as a whole.

The following high-level threats have to be considered when implementing WSUS:

- Man-in-the-middle attacks: Update metadata and administrative intent can be tampered with by man-in-the-middle attacks to deny availability of critical or security updates to DSSs or computers. Therefore, the communication channel used by the member protocols will be secured using SSL.
- Spoofing: WSUS identifies computers and DSSs using GUIDs. Given those identifiers, a malicious user can spoof reporting data for DSSs and computers in a way to mask the actual health of the computers. Therefore, the communication channel between update servers, and update client and update server, will employ some form of authentication to prevent rogue entities from masquerading as valid clients or servers.

## 2.10 Additional Considerations

There are no additional considerations.

## 3 Examples

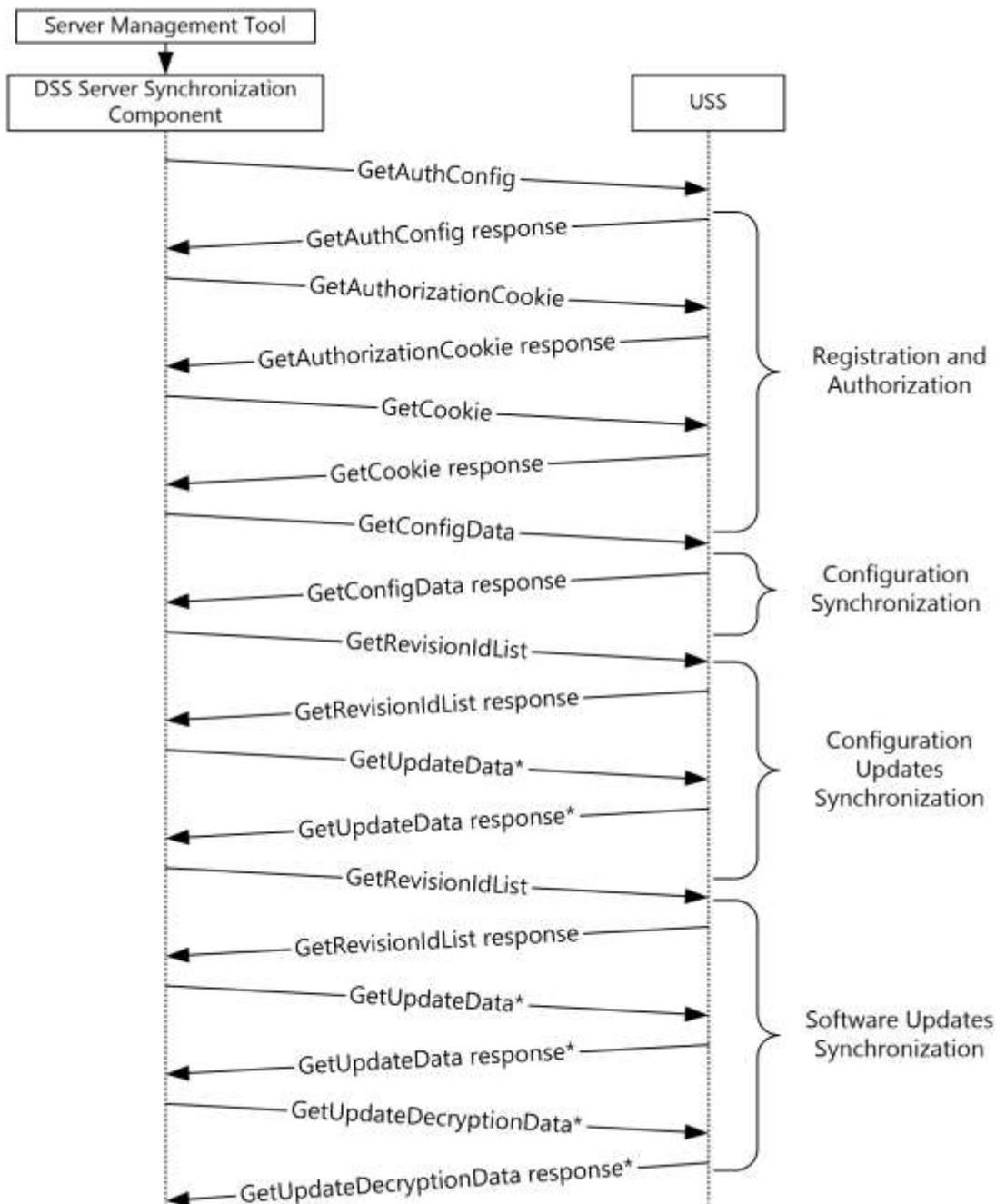
This section provides examples that describe the use of Windows Server Update Services. The examples are as follows:

- Update synchronization to a DSS
- Initial deployment synchronization to a replica DSS
- Initial update synchronization to an update client
- Differential update synchronization to an update client
- Rollup of reporting data to the USS
- Pointing the update client to a new update server

### 3.1 Example 1: Update Synchronization to DSS

This example describes the scenario where a DSS is configured to synchronize with an USS, and the synchronization is triggered by using the server management tool or triggered on a schedule from the downstream server. This scenario supports the use case in Synchronize Server - Server Management Tool 2.5.3.5.

The following sequence diagram shows the sequence of messages that are exchanged between the DSS and USS to accomplish this scenario. All communication between the USS and the DSS is initiated by the DSS and occurs over the WSUSSS member protocol.



**Figure 7: Sequence diagram for initial update synchronization to the DSS**

The phases in the message flow are described in the following sections.

### 3.1.1 Registration and Authorization

During this phase of the message exchanges, the DSS establishes its identity to the USS, and the USS provides a cookie to the DSS that is to be used for the remaining requests. If this is the first synchronization, the USS creates an entry for the DSS in its data store. The following sections in [MS-WSUSSS] specify the message details:

- Section 3.1.4.1: GetAuthConfig
- Section 3.1.4.2: GetAuthorizationCookie
- Section 3.1.4.3: GetCookie

### 3.1.2 Configuration Synchronization

During this phase, the DSS obtains the configuration data from the USS that governs the metadata and content synchronization phases of the protocol and persists this information in its data store. This is specified in [MS-WSUOSS] section 3.1.4.4.

### 3.1.3 Configuration Updates Synchronization

If this is an initial synchronization, the DSS obtains and persists the full set of categories, update classifications, and detectoids that are available on the USS. On subsequent synchronizations, the DSS obtains and persists the categories, update classifications and detectoids that have been added to the USS since the last successful synchronization. The DSS obtains the list of such updates by using a single GetRevisionIdList request, as specified in [MS-WSUOSS] section 3.1.4.5. Note that on subsequent synchronizations, the DSS has to include the anchor it received from the USS as part of the previous synchronization in the GetRevisionIdList request. The update metadata is then obtained through a series of batched GetUpdateData and GetUpdateDecryptionData requests, as specified in [MS-WSUOSS] section 3.1.4.6.

### 3.1.4 Software Updates Synchronization

If this is the initial synchronization, the DSS obtains and persists the full set of software updates that are available on the USS. The DSS first obtains the list of software updates by using a single GetRevisionIdList request. The update metadata is then obtained through a series of batched GetUpdateData and GetUpdateDecryptionData requests. This phase differs from the previous phase with respect to the type of updates that are being synchronized. The DSS controls this phase by using the parameters for the GetRevisionIdList request. On subsequent synchronizations, the DSS obtains and persists software updates that have been added to the USS since the last successful synchronization; the DSS has to include the anchor it received from the USS as part of the previous synchronization, as specified in the GetRevisionIdList request [MS-WSUOSS] section 3.1.4.5.

Additional details about message sequencing and processing for this scenario are specified in:

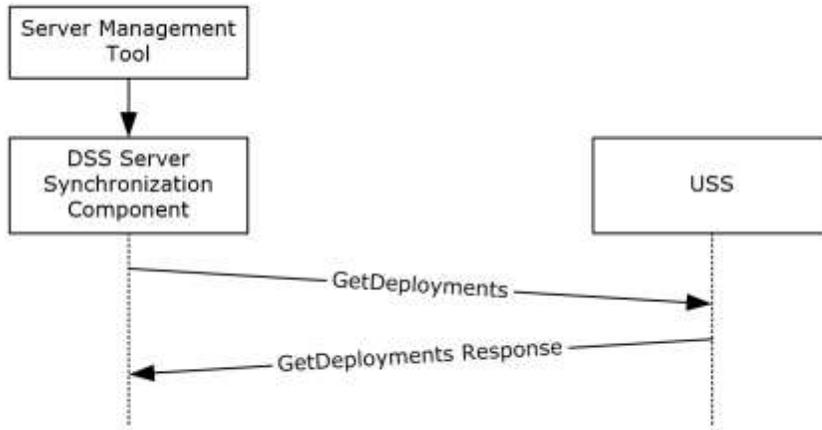
- [MS-WSUOSS] section 3.2.4.1: Authorization
- [MS-WSUOSS] section 3.2.4.2: Metadata synchronization

By the end of this scenario, the DSS has the same set of updates in its data store as the USS.

## 3.2 Example 2: Initial Deployment Synchronization to Replica DSS

When the DSS is configured as a replica of the USS, it synchronizes target groups and update deployments from the USS in addition to updates. This example describes the message exchanges that are required to accomplish this synchronization when a DSS communicates with a USS. This is a continuation of the initial update synchronization example, described in section 3.1, for a replica DSS that is specific to replica downstream servers. This scenario supports the use case in section 2.5.3.5, Synchronize Server - Server Management Tool.

The following sequence diagram shows the messages that are exchanged between the DSS and USS for this example. The messages in this sequence are part of the WSUOSS protocol [MS-WSUOSS].



**Figure 8: Sequence diagram for initial deployment synchronization to a replica DSS**

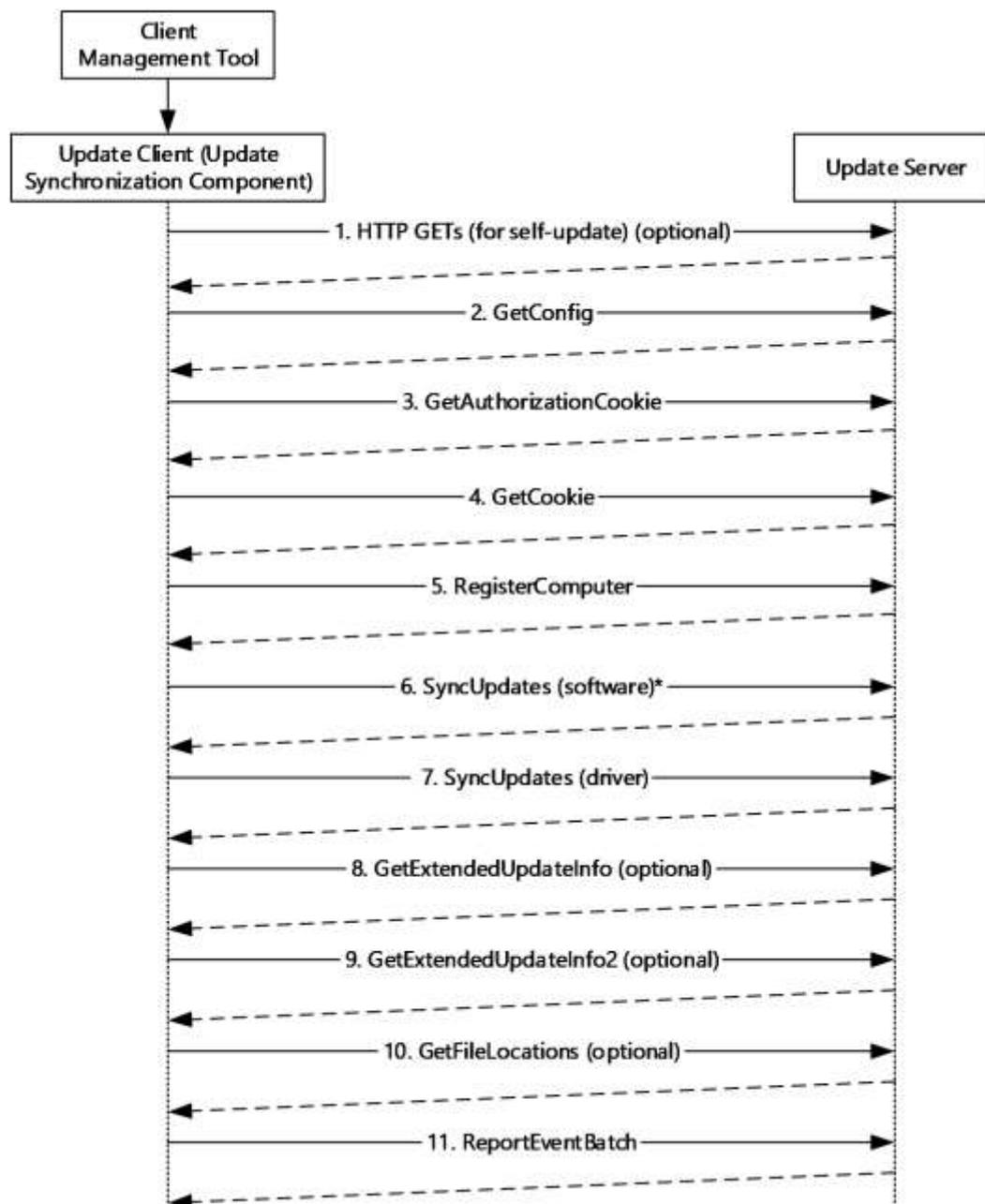
The USS provides the list of all target groups and update deployments as part of the GetDeployments response during the first synchronization. The response also contains an anchor for use in subsequent GetDeployments requests. On subsequent synchronizations, only the changes since that previous synchronization are returned. For more information about message details and processing requirements, see [MS-WSUSSS] section 3.1.4.10 and section 3.2.4.3.

### 3.3 Example 3: Initial Update Synchronization to Update Client

The goal of this example is for a particular update client to synchronize update metadata and deployments from a particular update server for the first time. In this case, the update client has no cached data from previous synchronizations with the update server. This example is part of the Start Update Scan use case (section 2.5.3.7).

This scenario can be initiated on a schedule, by an automated agent, or by a user by means of a client management tool. After this scenario occurs successfully, the update client has synchronized update metadata and deployment and can cache this data to make subsequent synchronizations faster.

The following sequence diagram illustrates the interactions between parts of WSUS during this scenario. The notes following the diagram describe the messages with reference to the [MS-WUSP] technical document.



**Figure 9: Sequence diagram for an initial update synchronization to an update client**

The message flow is as follows:

1. (Optional) The update client makes a series of HTTP GET requests to determine the availability of applicable update client software. If applicable update client software is available, it downloads the software using HTTP GET requests and updates itself. The message details are specified in [MS-WUSP] section 3.1.5.1.<2>
2. The update client sends a GetConfig message to the update server, which responds with configuration data. The message details are specified in [MS-WUSP] section 3.1.5.2.

3. The update client sends a `GetAuthorizationCookie` message to the update server, which responds with an authorization cookie. The message details are specified in [MS-WUSP] section 3.1.5.3.
4. The update client sends a `GetCookie` message to the update server, which responds with a cookie. The message details are specified in [MS-WUSP] section 3.1.5.4.

**Note** The `GetAuthorizationCookie` and `GetCookie` messages can be sent at any time during the message sequence to request a new cookie. In this example, the cookie is requested only once; however, a client implementation can renew the cookie at any time either because the cookie expired or because a fault, as specified in [MS-WUSP] section 2.2.2.4, has occurred.

5. The update client sends a `RegisterComputer` message to the update server, which responds with a `Success` message. The message details are specified in [MS-WUSP] section 3.1.5.5.
6. The update client sends a `SyncUpdates` message for updates to the update server, which responds with update information. There can be multiple iterations of this message and response. The message details are specified in [MS-WUSP] section 3.1.5.7.
7. The update client sends a `SyncUpdates` message for drivers to the update server, which responds with the driver update information. The message details are specified in [MS-WUSP] section 3.1.5.7.
8. If updates are determined to be applicable, the update client sends a `GetExtendedUpdateInfo` message to the server, which responds with extended update information for each of the new updates. The message details are specified in [MS-WUSP] section 3.1.5.9.
9. If the client determines that additional data, such as a decryption key, is required for the update, the client sends a `GetExtendedUpdateInfo2` message to the server, which responds with the extended update information for each of the new updates. The message details are specified in [MS-WUSP] section 2.2.2.2.10.
10. If there is a new update, the message `GetFileLocations` is sent and the server responds with the new file information. The message details are specified in [MS-WUSP] section 3.1.5.10.

**Note** As noted in the diagram, the `GetFileLocations` call is optional. If the `GetExtendedUpdateInfo` call can retrieve the file digests and update metadata, the `GetFileLocations` call is not needed. `GetFileLocations` is triggered either because the update server environment has changed, the cookie is invalid, or the file location has changed.

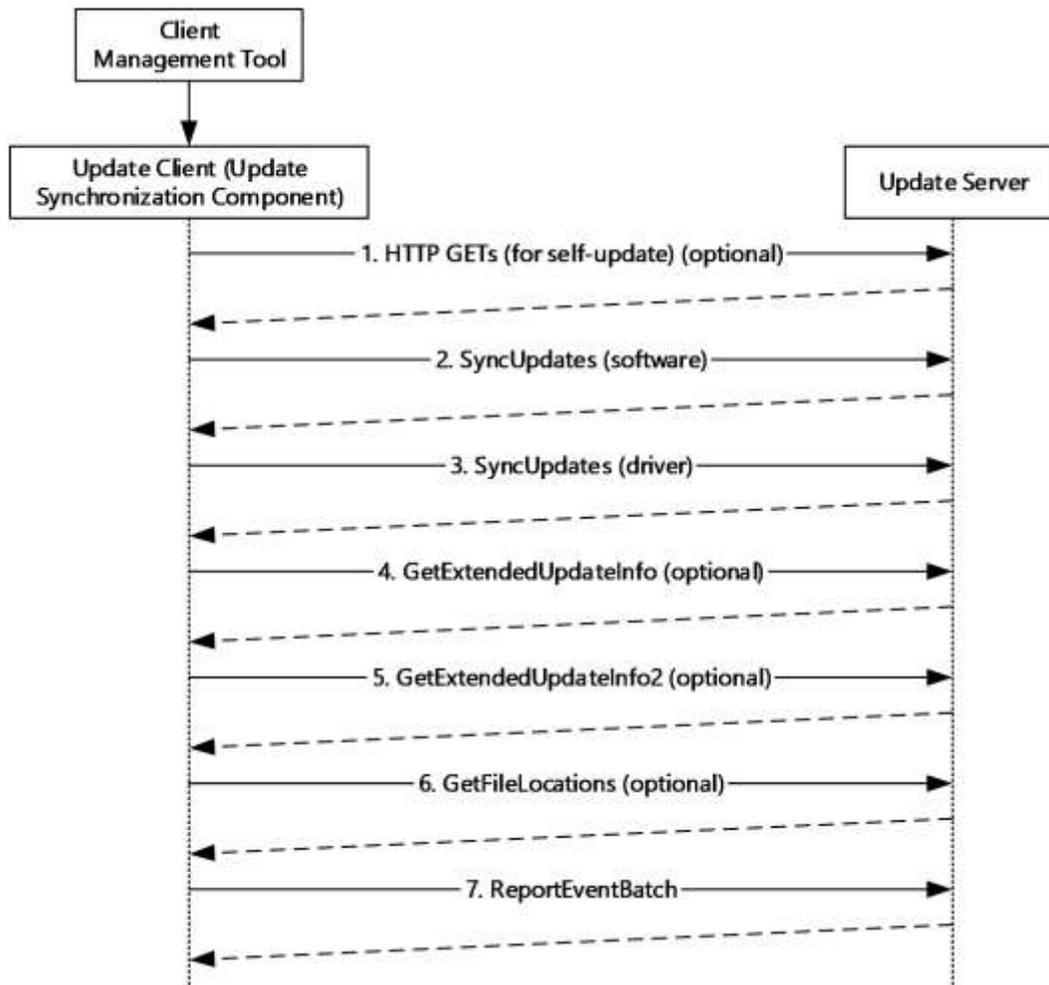
11. The update client sends a `ReportEventBatch` message to the update server, which responds with the status. The message details are specified in [MS-WUSP] section 3.1.5.11.

### 3.4 Example 4: Differential Update Synchronization to Update Client

The goal of this example is for a particular update client to synchronize update metadata and deployments from a particular update server after having already synchronized at a previous point in time. In this case, the update client has cached data from previous synchronizations with the update server, which it uses to optimize the synchronization. This example is part of the Start Update Scan use case. This scenario supports the use case described in section 2.5.3.7.

The scenario described in this example can be initiated on a schedule by an automated agent, or by a user by means of a client management tool. After this scenario occurs successfully, the update client has synchronized update metadata and deployment and can cache this data to make subsequent synchronizations faster.

The following sequence diagram illustrates the interactions between client and server during this scenario.



**Figure 10: Sequence diagram for differential update synchronization to an update client**

This sequence diagram assumes that the client has a valid authorization cookie from a previous synchronization.

This message sequence is as follows:

1. (Optional) The update client makes a series of HTTP GET requests to determine the availability of applicable update client software. If so, it downloads the software using HTTP GET requests and updates itself. The message details are specified in [MS-WUSP] section 3.1.5.1.<3>

A differential update synchronization is less likely to find applicable update client software if a previous update synchronization was performed recently.

2. The update client sends a SyncUpdates message, specified in [MS-WUSP] section 3.1.5.3 for updates to the update server, which responds with update information. There can be multiple iterations of this message and response.
3. The update client sends a SyncUpdates message for drivers to the update server, which responds with the driver update information.
4. If updates are determined to be applicable, the update client sends a GetExtendedUpdateInfo message to the server, which responds with extended update information. Message details are specified in [MS-WUSP] section 3.1.5.9.

5. If the client determines that additional data, such as a decryption key, is required for the update, the client sends a GetExtendedUpdateInfo2 message to the server, which responds with the extended update information for each of the new updates. Message details are specified in [MS-WUSP] section 2.2.2.2.10.
6. If there is a new update, the message GetFileLocations will be sent to get the new FileLocation information. The message details are specified in [MS-WUSP] section 3.1.5.10.
7. The update client sends a ReportEventBatch message to the update server, which responds with the status. Message details are specified in [MS-WUSP] section 3.1.5.11.

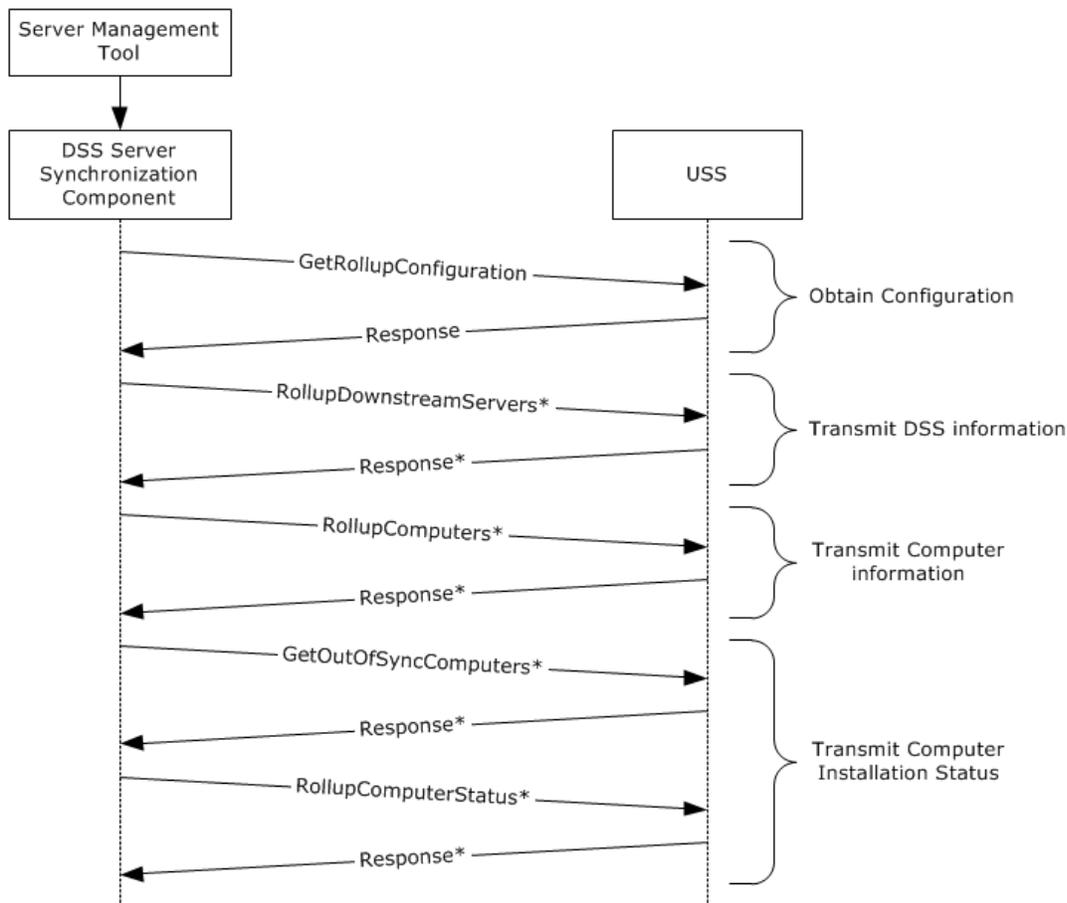
**Note** In addition to the messages shown in the diagram, a client implementation can send the messages GetAuthorizationCookie and GetCookie ([MS-WUSP] section 3.1.5.3 and section 3.1.5.4 respectively) at any time during the message sequence to request or renew a cookie. These messages are sent either because a cookie has expired or because a fault has occurred. See [MS-WUSP] section 2.2.2.4 for information on faults.

### 3.5 Example 5: Rollup of Reporting Data to USS

In this example, the goal of the scenario is for the DSS to send update installation and applicability information about the clients and descendent DSSs to the USS. This supports the Monitor Update Installation - WSUS Administrator use case described in section 2.5.3.4 by allowing the USS to collect information about all the update servers in a hierarchy when they are configured appropriately.

The conditions under which this scenario can be initiated are specified in [MS-WSUSSS] section 3.2.4.5.

The following sequence diagram shows the messages that are exchanged between the DSS and USS during this scenario when the DSS is configured as a replica DSS and the USS configuration indicates that a detailed rollup is required.



**Figure 11: Sequence diagram for rollup of reporting data to USS**

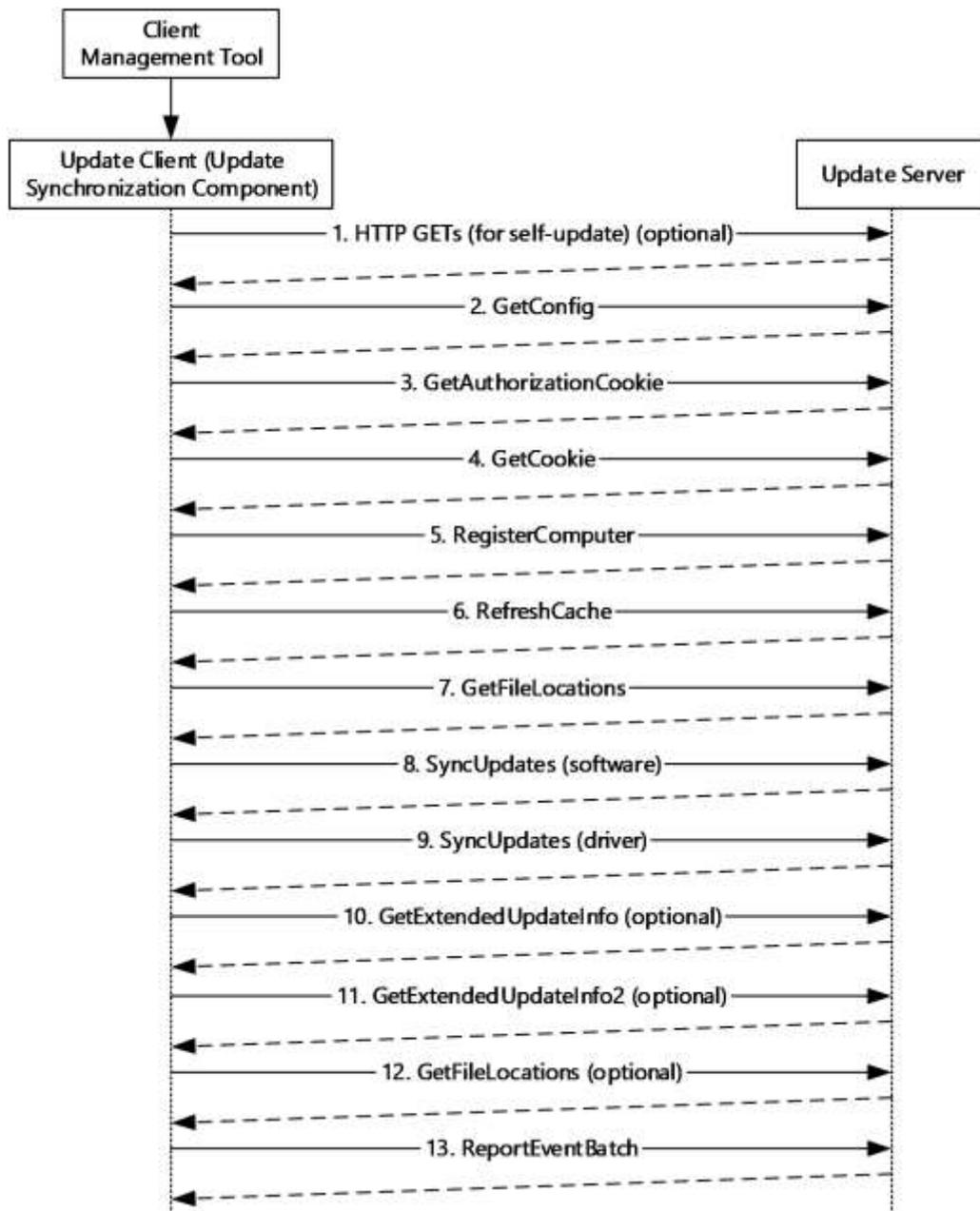
Reporting data synchronization specifies message processing and sequencing for the messages, as specified in [MS-WSUSSS] section 3.2.4.5. Because the amount of data to be sent from a DSS to USS as part of this scenario can be large, some of the messages are required to be put into batches by the DSS in order not to overwhelm the USS.

### 3.6 Example 6: Update Client Is Pointed to a New Update Server

In this example, the goal of the scenario is for a particular update client to synchronize update metadata and deployments from a different update server than it used for its previous synchronization. This is part of both the Configure Update Client and the Start Update Scan use cases. This scenario supports the Configure Update Client - Computer User use case in section 2.5.3.6 and the Start Update Scan - Computer User use case in section 2.5.3.7.

This scenario can be initiated by a WSUS administrator by means of a management system (such as described in [MS-GPOD]) or by a user by means of a client management tool. After this scenario occurs successfully, the update client has synchronized update metadata and deployment from the new update server and purged cached data from the old update server.

The following sequence diagram illustrates the interactions between client and server during this scenario. Note that in this diagram, the update client begins by attempting a differential update synchronization and then detects that its update server has changed.



**Figure 12: Sequence diagram for pointing the update client to a new update server**

The message flow is as follows:

1. (Optional) The update client makes a series of HTTP GET requests to determine the availability of applicable update client software. If applicable update client software is available, it downloads the software using HTTP GET requests and updates itself. The message details are specified in [MS-WUSP] section 3.1.5.1. <4>
2. The update client sends a GetConfig message to the update server, which responds with configuration data. Message details are specified in [MS-WUSP] section 3.1.5.2.

3. The update client sends a GetAuthorizationCookie message to the update server, which responds with an authorization cookie. Message details are specified in [MS-WUSP] section 3.1.5.3.
4. The update client sends a GetCookie message to the update server, which responds with a cookie. Message details are specified in [MS-WUSP] section 3.1.5.4.

**Note** The GetAuthorizationCookie and GetCookie messages can be sent at any time during the message sequence to request a new cookie. In this example, the cookie is requested only once; however, a client implementation can renew the cookie at any time, either because the cookie expired or because a fault, as specified in [MS-WUSP] section 2.2.2.4, has occurred.

5. The update client sends a RegisterComputer message to the update server, which responds with a Success message. Message details are specified in [MS-WUSP] section 3.1.5.5.
6. The update client sends a RefreshCache message to the update server to update its cache of mappings between compact RevisionIDs and GUIDs. Message details are specified in [MS-WUSP] section 3.1.5.8.
7. If there is a new update, the message GetFileLocations is sent and the server responds with the new file information. Message details are specified in [MS-WUSP] section 3.1.5.10.
8. The update client sends a SyncUpdates message for updates to the update server, which responds with update information. There can be multiple iterations of this message and response. Message details are specified in [MS-WUSP] section 3.1.5.7.
9. The update client sends a SyncUpdates message for drivers to the update server, which responds with the driver update information.
10. If updates are determined to be applicable, the update client sends a GetExtendedUpdateInfo message to the server, which responds with extended update information. Message details are specified in [MS-WUSP] section 3.1.5.9.
11. If the client determines that additional data, such as a decryption key, is required for the update, the client sends a GetExtendedUpdateInfo2 message to the server, which responds with the extended update information for each of the new updates. Message details are specified in [MS-WUSP] section 2.2.2.2.10.
12. If there is a new update, the message GetFileLocations will be sent to get the new FileLocation information. Message details are specified in [MS-WUSP] section 3.1.5.10.
13. The update client sends a ReportEventBatch message to the update server, which responds with the status. Message details are specified in [MS-WUSP] section 3.1.5.11.

## 4 (Updated Section) Microsoft Implementations

The information in this document is applicable to the following Microsoft products:

The terms "earlier" and "later", when used with a product version, refer to either all preceding versions or all subsequent versions, respectively. The term "through" refers to the inclusive range of versions. Applicable Microsoft products are listed chronologically in this section.

### **Windows Client**

- Windows 2000 operating system
- Windows XP operating system
- Windows Vista operating system
- Windows 7 operating system
- Windows 8 operating system
- Windows 8.1 operating system
- Windows 10 operating system

- Windows 11 operating system

### **Windows Server**

- Windows Server 2003 operating system
- Windows Server 2003 R2 operating system
- Windows Server 2008 operating system
- Windows Server 2008 R2 operating system
- Windows Server 2012 operating system
- Windows Server 2012 R2 operating system
- Windows Server 2016 operating system
- Windows Server operating system
- Windows Server 2019 operating system
- Windows Server 2022 operating system

Exceptions, if any, are noted in the following section.

### **4.1 Product Behavior**

<1> Section 2.8.1: The update client periodically reports to its update server with a randomly chosen frequency of between one time every minute and one time every fifteen minutes.

<2> Section 3.3: Self-update functionality is only available in Windows 8.1 and earlier.

<3> Section 3.4: Self-update functionality is only available in Windows 8.1 and earlier.

<4> Section 3.6: Self-update functionality is only available in Windows 8.1 and earlier.

## 5 Change Tracking

This section identifies changes that were made to this document since the last release. Changes are classified as Major, Minor, or None.

The revision class **Major** means that the technical content in the document was significantly revised. Major changes affect protocol interoperability or implementation. Examples of major changes are:

- A document revision that incorporates changes to interoperability requirements.
- A document revision that captures changes to protocol functionality.

The revision class **Minor** means that the meaning of the technical content was clarified. Minor changes do not affect protocol interoperability or implementation. Examples of minor changes are updates to clarify ambiguity at the sentence, paragraph, or table level.

The revision class **None** means that no new technical changes were introduced. Minor editorial and formatting changes may have been made, but the relevant technical content is identical to the last released version.

The changes made to this document are listed in the following table. For more information, please contact [dochelp@microsoft.com](mailto:dochelp@microsoft.com).

Section	Description	Revision class
4 Microsoft Implementations	Added Windows 11 operating system to the Windows client product applicability list.	Major

## 6 Index

### A

- Actors
  - overview 18
- Actors - overview 18
- Additional considerations 31
- Applicability 15
- Applicable protocols 16
- Approve update - WSUS administrator - overview 21
- Assumptions 18

### C

- Capability negotiation 28
- Change tracking 44
- Client update 6
- Coherency requirements
  - initialization procedures 30
  - non-timer events 30
  - reinitialization procedures 30
  - timers 30
- Communications 16
  - network connectivity 17
  - overview 16
  - with a persistent storage facility 17
  - with other systems
    - external
      - configuration system 17
      - restartable HTTP download 17
    - overview 16
    - protocols - underlying 17
  - within the system 16
  - within WSUS 16
- Component dependencies
  - external
    - configuration system 17
    - restartable HTTP download 17
  - network connectivity 17
  - overview 16
  - persistent storage facility 17
  - protocols - underlying 17
- Conceptual overview 5
- Configure update
  - client - computer user - overview 24
  - server - server management tool - overview 19
- Considerations
  - additional 31
  - security 30

### D

- Data - reporting 7
- Dependencies
  - network connectivity 17
  - overview 16
  - with a persistent storage facility 17
  - with other protocols - underlying 17
  - with other systems
    - external
      - configuration system 17
      - restartable HTTP download 17

- persistent storage facility 17
- protocols - underlying 17
- within the system 16
- within WSUS 16
- Design intent
- actors 18
- approve update - WSUS administrator 21
- configure update
  - client - computer user 24
  - server - server management tool 19
- install updates - computer user 27
- manage computer groups - WSUS administrator 20
- monitor update installation - WSUS administrator 22
- start update scan - computer user 26
- summary diagram 18
- synchronize server - server management tool 23
- use case summary diagram 18
- Differential update synchronization to update client - details 37
- Downstream server (DSS) 6

## **E**

- Environment 16
- Error handling 29
- Examples
  - differential update synchronization to update client 37
  - initial
    - deployment synchronization to replica DSS 34
    - update synchronization to update client 35
  - rollup of reporting data to USS 39
  - update
    - client is pointed to a new update server 40
    - synchronization to DSS
      - authorization 33
      - configuration
        - synchronization 34
        - updates synchronization 34
      - details 32
      - registration 33
      - software updates synchronization 34
- Extensibility
  - Microsoft implementations 43
  - overview 28
- External dependencies 16

## **F**

- Failure scenarios
  - data stores corrupted 29
  - network failure 29
  - update content corrupted 29
- Functional requirements
  - applicability 15
  - black box diagram 12
  - overview (section 2.1 10, section 2.1.2 11)
  - purpose 10
  - standards 15
  - white box diagram 13
- Functional requirements - overview 10

## **G**

- Glossary 7

## **H**

Handling requirements 29

## **I**

Implementations - Microsoft 43

Implementer - security considerations 30

Informative references 9

Initial

- deployment synchronization to replica DSS - details 34

- state 18

- update synchronization to update client - details 35

Initial state 18

Initialization procedures - coherency requirements 30

Install updates - computer user - overview 27

Introduction 5

## **M**

Manage computer groups - WSUS administrator - overview 20

Microsoft implementations 43

Monitor update installation - WSUS administrator - overview 22

## **N**

Non-timer events - coherency requirements 30

## **O**

Overview

- applicability 15

- black box diagram 12

- conceptual 5

- functional 11

- introduction 5

- purpose 10

- standards 15

- summary of protocols 16

- synopsis 10

- white box diagram 13

Overview (synopsis) 5

## **P**

Preconditions 18

Product behavior 43

## **R**

References 9

Reinitialization procedures - coherency requirements 30

Reporting data 7

Requirements

- applicability 15

- black box diagram 12

- coherency

  - initialization procedures 30

  - non-timer events 30

  - reinitialization procedures 30

  - timers 30

- error handling 29

- functional overview 11

- overview 10

- preconditions 18

- standards 15
- system purpose 10
- white box diagram 13

Rollup of reporting data to USS - details 39

## S

- Security considerations 30
- Server
  - downstream (DSS) 6
  - update 6
  - upstream (USS) 6
- Software updates 5
- Standards 15
- Start update scan - computer user - overview 26
- Summary diagram - overview 18
- Synchronize server - server management tool - overview 23
- System
  - dependencies
    - with other systems
      - external
        - configuration system 17
        - restartable HTTP download 17
      - within the system 16
    - failure scenarios
      - data stores corrupted 29
      - network failure 29
      - update content corrupted 29
    - requirements
      - purpose 10
    - use cases
      - actors 18
      - approve update - WSUS administrator 21
      - configure update
        - client - computer user 24
        - server - server management tool 19
      - install updates - computer user 27
      - manage computer groups - WSUS administrator 20
      - monitor update installation - WSUS administrator 22
      - start update scan - computer user 26
      - summary diagram 18
      - synchronize server - server management tool 23
  - System dependencies 16
    - within the system 16
  - System errors 29
  - System protocols 16
  - System requirements - overview 10
  - System use cases
    - actors 18
    - use case summary diagram 18

## T

- Table of protocols 16
- Timers - coherency requirements 30
- Tracking changes 44

## U

- Update
  - client 6
  - client is pointed to a new update server - details 40
  - server 6
  - software 5
  - synchronization to DSS

- authorization 33
- configuration
  - synchronization 34
  - updates synchronization 34
- details 32
- registration 33
- software updates synchronization 34
- Upstream server (USS) 6
- Use case summary diagram
  - overview 18
- Use cases
  - actors 18
  - approve update - WSUS administrator 21
  - configure update
    - client - computer user 24
    - server - server management tool 19
  - install updates - computer user 27
  - manage computer groups - WSUS administrator 20
  - monitor update installation - WSUS administrator 22
  - start update scan - computer user 26
  - summary diagram 18
  - synchronize server - server management tool 23
  - use case summary diagram 18

## **V**

- Versioning
  - Microsoft implementations 43
  - overview 28