Managing Mobile Devices Over Cellular Data Networks

Best Practices Document

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UNIQUE CHALLENGES OF MANAGING DEVICES OVER CELLULAR NETWORKS

Managing mobile devices over cellular networks poses some unique challenges due to the bandwidth limitations of typical cellular data networks as well as the coverage and connectivity available for cellular networks. It is important for an effective management solution to make the enhancements and adjustments needed to compensate for the extra challenges. Such enhancements are critical for cellular data networks but can also be helpful in managing devices connecting over dial-up or other low-bandwidth data networks.

Some of the problems that need to be taken into consideration for communication over cellular data networks are:

- **Availability / Disconnected state**: Mobile devices that are geographically dispersed may not be connected all the time unlike devices connecting to LAN / Wireless LAN networks within the four walls of a site, warehouse, distribution center, etc. The devices could be in a 'disconnected' state due to roaming out of the cellular coverage area or it might not be feasible to have the devices stay connected for extended time periods due to the high cost of cellular data usage in some regions. A successful management solution needs to adapt for the minimal connected durations by offline / batch processing, queuing and opportunistic communication.

- **Intermittent Connectivity:** Even when the devices are connected, the connectivity may not always be optimal, resulting in frequent interruptions during a session or transfer. Mobile devices in the field are seldom stationary and are often used in rapidly moving vehicles, which may lead to the data connection being interrupted as the device moves from one place to another. A management solution needs to utilize check-points and session persistence to successfully communicate in these conditions.

- **Latency / Bandwidth limitations:** While the speeds of the cellular networks are improving, the majority of devices worldwide still connect to GPRS / CDMA connections where the throughput is often limited with bandwidths typically less than 40-50kbps. A solution communicating over the cellular network needs to be bandwidth-efficient and should utilize optimization techniques including caching and compression.

- **Efficient Network Selection:** Frequently, the cellular data network is not the only option as devices may return to a central location after normal work hours and might have access to a high-speed connection like Wi-Fi, Ethernet cradles, etc. A management solution needs to be able to optimize network selection, limiting heavy data transfer to the faster networks for better user experience and savings.

- **Alternate connectivity:** In the event a remote device cannot connect to the cellular data network, physically accessing the device for troubleshooting or securing data on the device may not be an option for a device roaming several hundred miles away from the centralized helpdesk. A solution needs to provide alternate transport to the device through other modes of communication.

SOLUTIONS AND ENHANCEMENTS AVAILABLE IN SOTI MOBICONTROL

SOTI MobiControl's architecture was designed primarily for mobile device management and security over low-bandwidth connections like dial-up, GPRS, etc. Several enhancements are built into the communication protocols, server-side and client-side architecture and management console to minimize bandwidth consumption, eliminate unnecessary network chatter and efficiently utilize the limited bandwidth, battery and memory resources when communicating with devices over slower data networks.

These enhancements have allowed users of SOTI MobiControl to successfully manage devices over data networks as slow as the IDEN ("push-to-talk") with average speeds less than 14.4kbps (compared to GPRS at 40-50kbps)!

Opportunistic Communication over Multiple Data Networks

The SOTI MobiControl device client is capable of connecting over multiple data networks including USB connections utilizing Microsoft ActiveSync / Windows Mobile Device Center (WMDC), Ethernet / LAN, Wi-Fi / 802.11 and all cellular data networks (e.g. GPRS, CDMA, 1X, EDGE, 3G, EVDO, IDEN, UMTS, HSDPA, etc).

The device client is able to traverse firewalls allowing devices behind firewalls or on private networks to be monitored by remote administrators. Since the connection is initiated by the device, any device on any cellular data network can be monitored without incurring the added expense and overhead of arranging Virtual Private Network (VPN) connectivity, public IP addresses or private APNs from cellular carrier / data service providers.

This flexibility makes it possible to connect to devices over a mix of different data networks, choosing the best available network for the best end user experience and the maximum cost savings for cellular data usage.

Data Compression to Minimize Bandwidth Consumption

All communication between the SOTI MobiControl device client and the MobiControl server is compressed. Any applications or updates deployed over-the-air to the devices are compressed first using SOTI's proprietary compression solution to reduce the data usage over the cellular network and to accelerate transfer. MobiControl's Package Deployment engine can aggressively compress files down to as low as 20% of their original size (80% compression ratio), depending on the file type, thus optimizing communication over high-latency data networks.

Check-points for Resuming a Data Transfer Session

To successfully deliver updates and files to the mobile devices despite interruptions in connectivity and disconnections from the cellular data network, SOTI MobiControl utilizes check-points to send blocks of data / files to the mobile devices. If a data connection is interrupted, the file transfer / package delivery continues from the point of interruption when the data connection becomes available again, instead of restarting the download. Continuing the session from the point of interruption allows efficient utilization of bandwidth and ensures that even large files can be compressed and transferred successfully using the check-points, over intermittent cellular connections.

Caching Information to Reduce Data Transmission

When sending device inventory information to the server, the SOTI MobiControl device client compares the new information to the cached information snapshot on the device and transmits only the difference / incremental changes up to the MobiControl server. This reduces the information transmitted for maintaining up-to-date asset information, which is displayed in the information dashboards displayed in the MobiControl administrative console.

Alternate Connectivity Options and Automatic Failover

On the server side, when multiple SOTI MobiControl servers are running in parallel, the failover is handled automatically and in the event of a hardware failure of a server, the mobile devices automatically re-route to an alternate server or a different IP address. Server priority settings can be configured to control which server a particular group of devices will try to connect to first before seeking a connection to an alternate server.

On the device side, the breadth of communication options that SOTI MobiControl offers allows the devices to connect through alternate data networks if the primary network for communication is not available. For example, if due to lack of cellular data coverage or hardware / cellular radio problems, the mobile device cannot connect to the server over the cellular data network, the device can be connected through the USB to a local computer to allow for troubleshooting and investigation through the MobiControl Manager. Alternately, the device can also connect through a local Ethernet / Wi-Fi network to the MobiControl server on a different network.

This flexible architecture allows continuous monitoring of the mobile devices, regardless of the data network they are connected to.

Automatic Offline Mode / Batch Processing

To work around the intermittent and unpredictable connectivity over the cellular data networks, SOTI MobiControl supports automatic batch-processing and queuing of tasks and updates for offline devices that are not connected to the server at the time the update is deployed.

The pending updates are automatically installed on the devices when they connect to the server. Additionally, SOTI MobiControl supports device-side scheduling to allow administrators the capability to schedule after-hours maintenance tasks, backup scripts and file transfer activities.

Additionally, SOTI MobiControl servers support 'store-and-forward' transmission of updates and files to the mobile devices. For remote sites connecting through a slow data network, any PC workstation can serve as a regional MobiControl server that caches update files or packages locally and then distributes them to the mobile devices connecting locally. Instead of 1,000 devices at a remote site connecting individually to a centralized server to receive the update (resulting in a 1000 transmissions over-the-air), the centralized MobiControl server can transmit the update once to the regional server which caches it and distributes it to the mobile devices connecting locally. This saves valuable data bandwidth as the large file or package is transferred over the slow WAN / WWAN only once instead of 1,000 times. The store-and-forward capability is available for collecting and transferring files from remote mobile devices to a centralized server through an intermediary regional server.

Preferred Network Selection for Heavy Data Transfers

When deploying packages and updates to the mobile devices, the administrators can select the preferred network for the delivery to ensure minimal use of the cellular data bandwidth. Large files and updates can be transferred over high-speed networks utilizing batch-mode connectivity, when devices are connected to USB/Ethernet cradles or Wi-Fi connections. This allows maximizing the cost savings by minimizing cellular data usage.

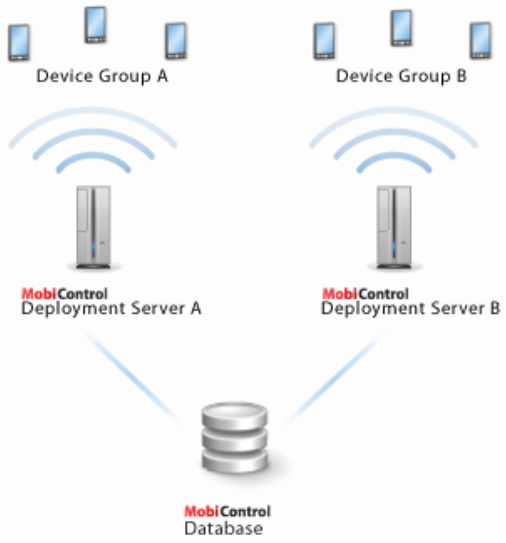
USING REGIONAL SERVERS FOR LOW BANDWIDTH CONNECTIVITY TO REMOTE SITES

Increasingly, customers are using SOTI MobiControl to manage devices in multiple regions and countries from one centralized helpdesk. In some instances, the devices operating in a different country may not have reliable cellular data connectivity or the bandwidth limitations might make it difficult to send large updates from one central location to remote devices.

SOTI MobiControl supports multiple network topologies to provide flexibility to the administrators and allow remote devices to be updated with new applications and updates even in remote locations that have less than optimal network connections.

Figure 1.1

Topology A: Centralized Server



Topology B: Multiple Regional Servers

Typically when an update needs to be sent to the devices, the MobiControl Server retrieves the appropriate package from the MobiControl database and transmits it to the mobile devices over-the-air according to their update schedules (as shown in *Topology A* above).

For devices that are connecting from remote locations (e.g. warehouses, distribution centers, retail locations, etc.) with slow network connections, multiple regional servers can be easily added to the system (as shown in *Topology B* above). The MobiControl Deployment server can be installed on any PC / workstation running Windows 2000/XP or higher and a dedicated server with server-grade OS is not required. Tiered servers can be implemented by configuring server priority rules for different groups of devices allowing devices in Group A to communicate with Server A (which has a higher priority) and seek for other lower-priority servers only if Server A is not available.

In *Topology B*, instead of a large file / package being pushed out from a central server over a low-bandwidth WAN link for each device, the data is transmitted to the regional server which caches it locally and distributes it to the local devices at that site / region connecting over high-speed LAN/WLAN connections. The regional server can distribute the file or package even when it is not connected to the central database due to bandwidth / connection limitations. This reduces significantly the transmissions over the slower wide-area network links and allows updating remote devices using faster local networks.

USER CONFIGURABLE BANDWIDTH TUNING OPTIONS IN SOTI MOBICONTROL

Overview of the device-server communication

The SOTI MobiControl device client on the device (i.e. the **device agent**) initiates a connection to the MobiControl Deployment Server when a data network is available. When the connection request is processed by the server, a TCP/IP connection is established and the device is recognized as an '**online**' device by the server. The server then periodically sends a brief '**test message**' (also known as the 'heart-beat' message) to the device to keep the connection alive. The device responds to the test message to indicate it is still online. If the server does not receive a response before the time-out occurs, the connection is closed and the device status changes to '**offline**'.

Server Test Message Interval

The frequency at which the server sends out the test message, to check for the device's connectivity status, is configurable by the administrator by changing the settings for the '**Test Message Interval**' for the appropriate server. Increasing the test message interval reduces the frequency of communication between the devices and the server, thus avoiding unnecessary data traffic at the server and minimizing over-the-air communication between the server and the devices.

The settings for the server can be accessed from the "Deployment Server Properties" menu under the *Deployment Servers* tab in the MobiControl Manager.

Connection Retry Interval

When the mobile device detects it is offline, it tries to reconnect to the server. The frequency at which the device attempts a reconnection is determined by the '**Connection Retry Interval**', which is configurable. By reducing the frequency at which the device tries to reconnect after a disconnection, the communication from the device to the server is minimized. The battery consumption is also improved due to decreased use of the communication radios on the device.

The Connection Retry Interval can be adjusted by changing the "Advanced Settings" from the "Configure Device(s)" menu under the *Devices* tab in the MobiControl Manager.

Device Update Schedule

While online, the mobile device periodically sends its updated inventory information to the server and checks for new packages and updates from the server. This interval is determined by the '**Device Update Schedule**'. Typically, new packages are not frequently deployed to the devices after the initial rollout phase, so a short interval for the Update Schedule is usually not necessary. The schedule should be set based on the administrator's requirements for the frequency of updating the device inventory information in the management console. The devices can be configured to refresh the information on initial connection to the server. This information can be refreshed 'on-demand' by the administrator as well when the device is online by selecting the "Refresh device status" option for a device.

The Update Schedule can be modified from the "Configure Device(s)" menu under the *Devices* tab in the MobiControl Manager. Multiple Update Schedules can be configured for the same group of devices.

File Sync Schedule

If the File Synchronization features in SOTI MobiControl are being used to transfer / synchronize files between the server and the devices, an optional '**File Sync Schedule**' determines how often the device and server communicate to check for new files. The schedule should be specified based on how frequently the administrator needs the server and devices to check for new files. Configuring a longer interval for the File Sync schedule minimizes the communication between the server and the devices, reducing cellular data usage.

The File Sync Schedule can be edited for each File Sync Rule configured under the *Rules* tab in the MobiControl Manager. Multiple File Sync rules can be configured for the same group of devices.

Configurable Connection Windows and Schedules

To provide maximum flexibility for matching the varying requirements of different environments, SOTI MobiControl provides different connection modes and multiple windows of time for communication between mobile devices and the server. In addition to the opportunistic connection mode in which the SOTI MobiControl agent persistently connects to the server when a data network is available, scheduled and manual connection modes are also available to allow administrators to minimize the device's communication with the server. The communication can be limited to certain time intervals or 'windows' of connectivity, outside of which the MobiControl agent does not attempt to connect to the server allowing minimizing of over-the-air bandwidth consumption. In the manual connection mode, the device agent connects to the server 'on-demand' when initiated by the end user of the device for support or updates.

The Connection Modes can be adjusted by changing the "Advanced Settings" from the "Configure Device(s)" menu under the *Devices* tab in the MobiControl Manager.

Remote Control Optimization

SOTI MobiControl's Remote Control technology is specially designed for low-bandwidth networks and uses proprietary algorithms and techniques to achieve the best remote control capability and user experience in the industry, over any type of network. In addition to the architectural enhancements built into the proprietary design of the Remote Control technology, SOTI MobiControl also provides user-configurable customizations to ensure usability and optimal performance of the remote control features when managing devices over cellular networks. These customizations include utilizing higher compression and lower color resolution to minimize the amount of information that is exchanged between the server and the devices for remote control purposes.

To customize the Remote Control for enhanced performance over cellular networks, a new **'Remote Control Connection Profile'** has to be created. The profile can be created from the *Remote Control* tab under the menu path "Tools > Options" in the MobiControl Manager.

RECOMMENDATIONS / BEST PRACTICES

The recommendations given below are intended to serve as guidance and a starting point for administrators configuring SOTI MobiControl and concerned with optimizing the solution for cellular data networks. While the focus is on cellular networks, these recommendations can be helpful for any administrator(s) interested in optimizing the server-client communications over low-bandwidth, high-latency networks. It is recommended that the specific values be used as a reference only and the various settings configured based on the individual requirements of each mobile deployment and the specific environment.

Fault Tolerance and Availability

To ensure high availability of the system and uninterrupted management of the mobile devices, the following steps can be taken:

- **Multiple IP addresses / fully qualified domain names (FQDNs)** should be configured under "Server Address for Device Communication" from the "Deployment Server Properties" menu under the *Deployment Server* tab in the MobiControl Manager. This allows for automatic fail-over as the devices can reach the Deployment Server at an alternate IP address or FQDN if for some reason, the server is not available at the primary IP address / FQDN.

- **Incoming SMS / Text Messaging** should be enabled for the mobile devices through the cellular carrier / mobile operator, when possible. When enabled, it provides a last-resort device rescue option to communicate with a device that is not connected to the data network due to lack of coverage or malicious use, and execute a MobiControl command on that device. A MobiControl command can perform a variety of actions from erasing or encrypting files, initiating a data connection to the device or delivering an instantaneous 'wipe' to the device.

- **Parallel Servers** running in tandem are supported by SOTI MobiControl to ensure continuous management of devices even in the event of a server being unavailable due to server maintenance or a hardware failure. When maximizing availability and redundancy in the event of a hardware failure is a concern, additional servers can be added to a deployment at any time. For more information on adding additional deployment servers, please refer to the Product Help documentation.

Remote Control Optimization

To compensate for the high latency on slower networks (e.g. GPRS network), a new Remote Control Connection profile should be created. Recommended settings for the new Remote Control profile are given below.

Remote Control Profile Settings	Recommended Minimum Values / Intervals
Connection Type	TCP/IP Server
Broken Connection Sensitivity	Low
Connect Timeout	Minimum 45 seconds. Recommended 90 seconds to avoid a timeout of the Remote Control connection request over slow networks.
Color Reduction	4-Color Grayscale.

Recommended Communication Settings and Schedules

The recommended values for the settings discussed in the section for User Configurable Bandwidth Tuning Options are given below.

Schedule / Interval	Recommended Minimum Values
Server Test Message Interval	Minimum 180 seconds. Recommended 300 seconds or higher depending on the environment. (The size of a test message is 32 bytes and the device responds with a transmission of 32 bytes as well).
Connection Retry Interval	Minimum 300 seconds. Recommended 600 seconds or higher depending on the environment.
Device Update Schedule	Minimum once every 2 hours. Recommended once every 4 hours or more depending on update requirements. The option to "Update when device connects" can be enabled to ensure the device receives new updates on connecting to the server.
File Sync Schedule	Minimum once every 2 hours. Recommended once every 12 hours or more depending on file transmission / sync requirements.
Connection Mode	A scheduled connection mode with a minimum connection window of 30 minutes each day is recommended. Additional connection windows can be scheduled depending on the requirements.
Preferred Network Selection	To minimize cellular data consumption, the option to deliver a package / update through non-cellular data networks only should be enabled when creating a Deployment Rule to deploy a package.

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