

Digi SureLink™ “Always-On” Connection

White Paper

Abstract

The purpose of this paper is to demonstrate how Digi technology in wireless/cellular connectivity can optimize reliability and uptime for maximum performance across often unpredictable networks. By using Digi SureLink, users of the Digi Connect™ WAN and Digi Connect™ Remote Gateway will be able to better control their connections for on-demand communications.

Overview

The nature of wireless connections (cellular/PCS) relative to wired connections is that they operate in a more intermittent environment. This intermittence is due to a number of factors, including RF signal loss caused by fading, interference and moving obstructions. Additional connection loss is due to the wireless carrier's practice of terminating inactive user/data sessions. For example, carrier networks may terminate data sessions if no data is sent/received for 120 minutes; this time interval varies by the specific carrier. Typically, the wireless device is not notified when a connection is terminated due to data inactivity. Connections may also drop periodically during maintenance windows, often in early morning hours on weekends.

For every wireless communication scenario there is a host (enterprise) and a remote device component. Many wireless applications require host initiated connections (mobile terminated) which can occur at unspecific times or frequencies and typically require a quick response from the wireless remote device. An example of this would be a remote monitoring application on a smoke stack being polled by a host application to check emissions. In order to accommodate this, the wireless device must be reachable at any time and requires an "always-on" connection. For cellular/PCS deployments this means that the wireless device is registered and authenticated on the wireless network at all times. Wireless devices can only detect a subset of the possible connection loss conditions, more specifically, those related to a reverse link RF loss or those related to receiving a network "termination" message. The undetected connection loss can only be mitigated by a wireless device pro-active approach. The pro-active approach involves sending Over-The-Air (OTA) link integrity monitoring packets and re-establishing the link when a loss is detected.

The "Always-On" requirement has business impact in that connection integrity must be tested periodically to ensure persistency, and this testing involves sending packets OTA. Since all OTA packets are chargeable to the end customer, "Always-On" related packets should be kept to a minimum. However, due to the intermittent nature of wireless connections, lost connections can occur at any time and must be detected as quickly as possible to provide an optimal persistent connection. Clearly, the maximum downtime of a wireless connection then becomes the interval between the "tests" of the network (for idle application data connections). It's not just about reconnection – it's also about data recovery. Or, at least, no data loss.

Digi's cellular/PCS products, including the Digi Connect WAN and Digi Connect Remote Gateway, provide a flexible solution for "Always-On" connection insurance. Included in this solution are a Digi Connectware™ Manager co-operative solution and a stand-alone "Inactivity Timer" solution. These solutions are described in the following sections; the deployment of either solution depends on the specific system application requirements.

Digi Connectware Manager - Digi SureLink

The Digi Connectware Manager software is available as part of the Digi Connectware Suite; it provides enterprise class remote site management and administration for Digi Connect™ products. Digi Connectware Manager can be installed by a customer or hosted by a Digi ASP partner, and can be accessed securely from anywhere across an IP network, including the Internet.

The Digi Connectware Manager supports a feature called Keep-Alive Messaging. This feature is used to:

- Maintain the integrity of the connection between the device and the Digi Connectware Manager during prolonged periods of inactivity in communications between the two, and
- Help the Digi Connectware Manager and the device recognize when the connection between them has been severed.

This is accomplished using the periodic exchange of keep-alive messages between the Digi Connectware Manager and the device. Keep-Alive Messaging is supported for both TCP and HTTP connections.

Keep-Alive Messaging works as follows:

During the establishment of a connection between a device and the Digi Connectware Manager, the device sends certain parameters (that have been programmed into its device during configuration) to the Digi Connectware Manager to activate the Keep-Alive Messaging feature for this connection. These parameters are:

Rx Interval - This interval specifies the maximum time that will elapse between messages sent by the device. This means that when the interval elapses (starting from the previous message sent from the device to the Digi Connectware Manager – be it a normal message or a keep-alive message) the device will send a keep-alive message to the Digi Connectware Manager. The interval timer is reset each time a message is sent to the Digi Connectware Manager. If there are sufficiently frequent payload messages sent from the device to the Digi Connectware Manager, the device may never need to send a keep-alive message. Its value in seconds is reported as "Conn Rx" in the Digi Connectware Manager's Detailed Device Report and as "Receive Timeout Interval" in the Device Connection Information report.

Tx Interval - This interval specifies the maximum time that will elapse between messages sent by the Digi Connectware Manager. This means that when the interval elapses, the Digi Connectware Manager will send a keep-alive message to the device. In a TCP connection, this interval starts once the previous message (be it a normal message or a keep-alive message) is sent to the device. In an HTTP connection, a message can be sent from the Digi Connectware Manager only upon receiving a Tx request from the device. Thus, when using HTTP this interval starts only from the instant the Digi Connectware Manager receives the Tx request from the device. Its value in seconds is reported as “Conn Tx” in the Digi Connectware Manager's Detailed Device Report and as “Send Timeout Interval” in Device Connection Information report.

Wait - This parameter specifies the number of times the Rx (or Tx) interval must expire before the Digi Connectware Manager (or device) will consider the connection between the Digi Connectware Manager and the device to be lost. For instance, assume the Rx Interval is set to 30 seconds and Wait is set to 2. Then, if the Digi Connectware Manager does not receive a message from the device for 60 seconds it will consider the connection to be lost, and perform the housekeeping actions to close the connection. In addition, an event log message of severity=INFO is generated. This log message will indicate either “HTTP connection terminated due to lack of keep-alive messages,” or “TCP connection terminated due to lack of keep-alive messages.” The value of Wait is reported as “Conn Wait” in the Digi Connectware Manager's Detailed Device Report and as “Receive Interval Wait Times” in the Device Connection Information report. The Digi Connectware Manager uses the values of the parameters passed to it by the device, i.e., the Digi Connectware Manager does not modify these values. Consequently, there is no configuration of the Digi Connectware Manager required in order to use the Keep-Alive Messaging feature. A number of considerations affect the selection of the proper values of the keep-alive message settings:

- Sending and receiving keep-alive messages causes a small amount of overhead both in the network and in the Digi Connectware Manager; therefore, they should not be more frequent than necessary. Also, the overhead of handling HTTP messages is higher than the overhead of TCP messages.
- The keep-alive message settings determine how fast the Digi Connectware Manager and the device will recognize that the connection between them has been lost. The Digi Connectware Manager will recognize the connection has been lost after Wait * Rx seconds. The wireless device will recognize that the connection has been lost after Wait * Tx seconds. In some applications the requirements for how fast the Digi Connectware Manager and the device need to recognize the lost connection may be different, leading to different values for Rx and Tx.
- Firewalls and proxies often close the connections after a period of inactivity. If the device connects to the Digi Connectware Manager via a firewall or a proxy it may be necessary to specify Rx and Tx smaller than these timeouts.

The device will correspondingly close the connection when its keep-alive message timer expires, and if configured to do so, will re-establish the connection to the Digi Connectware Manager.

Inactivity Timer - Digi SureLink

The Inactivity Timer is a Digi Connect WAN based feature that does not rely on a specific network side platform. The Inactivity Timer monitors received activity on the wireless connection. If data is not received within the specified “Inactivity Timeout” interval, the device resets the wireless connection and re-establishes a new one. This “reset” does not send any data across the wireless connection, so there is no usage incurred. The “Inactivity Timeout” is specified in seconds on the “Mobile Configuration” tab of the Digi Connect WAN (or Digi Connect Remote Gateway) web-based user interface.

Optionally, the device can be configured to send a “ping” to a specified IP address when the Inactivity Timer expires. For this option, if the device receives a response from the “ping”, it will not reset and re-establish the network connection; assuming the connection is still active and not requiring maintenance. Up to four IP “ping” addresses can be specified. If more than one is specified, the device will attempt to “ping” each address on the list if there is no reply from the current IP address on the list. The first reply terminates the sequence and resets the Inactivity Timer value without resetting the connection. Indeed, any response from the network when a “ping” is sent resets the Inactivity Timer.

Additional Persistence Assurance Monitoring

The Digi Connect WAN device management application constantly monitors the modem RF link integrity. If an RF loss is detected, the Digi Connect WAN management application resets and re-establishes the connection. For the rare extended RF loss condition or carrier network outage, the management software will continue to retry link establishment until the outage is corrected and a connection can be successfully established.

The Digi Connect WAN device also contains a “Watchdog” timer. The “Watchdog” timer is reset by the management application on a periodic basis. If the “Watchdog” timer expires, a hardware initiated reset occurs in the Digi Connect WAN device. This reset causes a device reboot and re-establishment of the network connection.

Conclusion

Many wireless applications require an “Always-On” connection strategy for network initiated connections (mobile terminated). Digi’s SureLink offering provides robust and flexible persistent connection options that can be used either in conjunction with the Digi Connectware Manager or in a device “stand-alone” configuration.

The method selected to assure persistent connections is customer deployment specific. The “stand-alone” Inactivity Timer provides a solution for deployments that do not include a Digi Connectware Manager platform; this solution, however, cannot be deployed in networks that block “pings.”

The Digi Connectware Manager provides a more powerful and efficient mechanism for always-on connections, which is especially useful in networks that do not forward “pings.” The Digi Connectware Manager also logs and reports “lost” connection status, which may be viewed from the Management Console. A future release of Digi Connectware Manager will include an enhanced alarm/filtering feature for detecting device connection loss. This feature generates/sends alarms when device connection loss exceeds a specified time interval or when the number of connection loss events exceeds a specified threshold for a specific time interval. This notification feature, in addition to the many other management/administrative functions offered by the Digi Connectware Manager, makes it an optimal solution for remote device management and operations.

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