Quick Note 044

Estimating Cellular Data Overhead When Using TransPort™ Enterprise Routers and Digi Remote Manager^{SM} 2.0

Contents

1   DOCUMENT VERSION

Version Number	Status
1.0	Initial release – 2014-Feb-3

2 ABSTRACT

Determining the network traffic cost for using Remote Manager on Digi TransPort products depends on several adjustable parameters. Given Remote Manager and TransPort product default settings, this paper will show the network traffic usage to be approximately 4MB/month/device. The paper will explain key traffic components and offer guidance on how to reduce this to less than 1MB/month/device.

Additional reductions are possible, but come through sacrificing key Remote Manager Features.

3 INTRODUCTION

Calculating Remote Manager Network Traffic usage is dependent on several factors. Some factors, like TransPort Device Type (TransPort WR11 versus WR44v2) or whether the DSL option is included, will have a deterministic effect on usage. However, many other factors, like the number of bytes passed through the router or data compressibility make it difficult to arrive at a precise number. The purpose of this paper is to provide a rough estimate and expectation for Digi Remote Manager costs. Data Usage was measured on several devices, but not measured along a broad fleet of devices.   The intent is to provide an estimate (+/- 10%) for the feature and guidance on how to tune and optimize your deployment.[1]

4 DATA USAGE COMPONENTS

4.1 General

Remote Manager Network traffic can be broken into two major categories: the cost for regularly scheduled traffic; and the cost for unscheduled or irregular events. An example of a regularly scheduled traffic would be the transmission of system temperature data points.

An example of an unscheduled event would be if an operator manually used Digi Remote Manager to read a file from one of their devices. This paper will ignore the cost of unscheduled events. However, the cost of several example events will be presented below.

Regularly scheduled traffic can be broken into the following categories:

1. Remote Management Connection Overhead: secure, persistent connection overhead costs
2. Device Health – Remote Manager data points
3. Compliance and Security costs – the cost of doing profile management

4.2 Remote Manager Connection Overhead

Digi Remote Manager connections use secure SSL over TCP/IP to transfer Device Health and profile management data to and from Digi Remote Manager. Besides this data, there is a cost for creating this SSL connection and a cost to maintaining this connection to Digi Remote Manager.

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[1] All the data presented in this paper used a TransPort WR21 (WR21-L52B-DE1)

When the Remote Manager connection is started, there is security information, as well as cloud protocol exchanged.   The cost of this transaction is:

$$C_{initial} = 4,778 \text{ bytes} \qquad [1]$$

After the Remote Management connection is created, the Device Health and profile management data can be exchanged anywhere from hourly to daily. Besides this essential data, there is an ongoing Keep-Alive cost to maintaining this connection. A single Keep-Alive exchange is 342 bytes of network traffic.

The general expression for Keep-Alive traffic per month is:

$$C_{KA} = (342 \text{ bytes/KA} * 2,592,000 \text{ sec/month}) / R_{KA} \qquad [2]$$

where R_{KA} is the rate of Keep-Alives. The Keep-Alive interval is driven by the cellular carrier's network requirements. The worst case interval for R_{KA} is 290 sec (< 5 minutes), which results in:

$$C_{KA290} = (342 \text{ bytes/KA} * 2,592,000 \text{ sec/month}) / 290$$

$$= 3,056,772 \text{ bytes/month} \qquad [3]$$

To illustrate, for Carriers that require traffic only once each hour, an R_{KA} of 3500 sec results in:

$$C_{KA3500} = (342 \text{ bytes/KA} * 2,592,000 \text{ sec/month}) / 3500$$

$$= 253,275 \text{ bytes/month} \qquad [4]$$

For an R_{KA} of 290 seconds, the total cost of Remote Management Overhead can be computed from [1] and [3]:

$$C_{RMO290} = C_{KA290} + C_{initial}$$

$$= 3,056,772 + 4778$$

$$= 3,061,550 \text{ bytes/month} \qquad [5]$$

4.3   Device Health

When devices go faulty or unexpected environmental events occur, monitoring a device's state is essential to avoiding a hazard or outage. For instance, monitoring a device's internal temperature can give early indications of a failing component or a facility HVAC failure. Device Health sends critical device health data samples to Digi Remote Manager which provides an opportunity to evaluate and monitor the health of your entire fleet.

Device Health information is broken into three categories: Mobile, Ethernet, and System. The default Mobile data includes information on the SIM card, device temperature, signal strength and quality, as well as bytes transferred and the Carrier Network information. The Ethernet data includes Transmit and Receive data, overruns, dropped packets, and link status. The System metrics include CPU utilization, Dynamic memory usage and availability, and routing buffer usage and availability. Additional data can be included as well.

Device Health data is a two stage operation: collecting the data and then reporting the data to Digi Remote Manager. For instance, a TransPort device can sample data once per hour and then report this data once per hour as well. Alternatively, it can sample once per hour and then report 4 samples once every 4 hours.

The TransPort device defaults to a 1 hour sampling and reporting rate, and thus, reporting the three Device Health categories, the cost is:

$$C_{DH-1-1} = 799{,}200 \text{ bytes/month} \tag{6}$$

It's worth noting the cost of Device Health is optimized for a 1 hour sampling rate and a 2 hour reporting rate:

$$C_{DH-1-2} = 486{,}000 \text{ bytes/month} \tag{7}$$

As you increase the number of samples per report, a diminished return occurs due to the data payload exceeding a single network frame. For instance, a 1 hour sampling rate and a 6 hour reporting rate is:

$$C_{DH-1-6} = 411{,}600 \text{ bytes/month} \tag{8}$$

And a 1 hour sampling period with a 12 hour reporting rate is:

$$C_{DH-1-12} = 373{,}320 \text{ bytes/month} \tag{9}$$

The examples above illustrate the TransPort's default 1 hour sampling period, which can be modified. Nevertheless, regardless of the sampling period, network traffic is optimized when the device bundles two samples per report. Further tuning is discussed below.

4.4   Compliance and Security

The Compliance and Security feature (sometimes referred to as "profile manager") is used to scan a fleet of TransPort devices and verify each profile is configured identically. Some parameters like specific IP address, Cellular Phone Number or System Location are excluded, however most settings can be monitored for deviations.

The device profile is broken into three categories: Configuration, File System, and Firmware. The default Configuration includes over 8000 parameters scanned; there are 13 files scanned; and the Firmware revision is scanned for consistency across the entire fleet. Once a Master Profile is defined, all devices, including the master, are scanned regularly and corrected for inconsistencies. For example, if a file is erroneously changed on one device, this will be detected and repaired during the next scan.

The interval each device is scanned has a major impact on Traffic usage. Profiles can be setup to scan hourly, daily, weekly, or monthly. The default scan interval is daily.

The cost of scanning an unmodified device once is:

$$C_{PROFILE\ MANAGER} = 7{,}490 \text{ bytes} \tag{10}$$

The cost of scanning an unmodified device, once per day over an entire month is:

$$C_{\text{PROFILE MANAGER-1}} = 224{,}700 \text{ bytes/month} \qquad [11]$$

Alternatively, the cost of scanning an unmodified device, once per hour over an entire month is:

$$C_{\text{PROFILE MANAGER-24}} = 5{,}392{,}800 \text{ bytes/month} \qquad [12]$$

And it's clear, comparing [11] and [12], the cost of scanning can quickly increase.

One further item worthy of mentioning, the cost of creating a profile will be an additional 91180 bytes. However, this operation could be performed on your local Ethernet.

5   DATA USAGE SUMMARY

With all three regularly scheduled Remote Management categories (Remote Management Connection Overhead, Device Health, profile management) defined, the total monthly Remote Management traffic estimate can be estimated by combining [5], [6] and [11]:

$$
\begin{aligned}
C_{\text{RM}} \quad &= C_{\text{RMO290}} + C_{\text{ES-1-1}} + C_{\text{PROFILE MANAGER-1}} \\[6pt]
&= (3{,}061{,}550 + 799{,}200 + 224{,}700) \\[6pt]
&= 4{,}085{,}450 \text{ bytes/month} \qquad [13]
\end{aligned}
$$

This assumes the default 290 second Keep-Alive Rate [3], the 1 hour Device Health sampling and reporting rates [6], and the once per day PROFILE MANAGER scanning rate [11]. This also does not include and PROFILE MANAGER modifications for altered configuration, files, or Firmware upgrades.

However, with minimal tuning, like using a Keep-Alive interval of 3500 seconds [4] instead of 290 seconds and reporting Device Health every two hours instead of one [7] reduces the cost:

$$
\begin{aligned}
C_{\text{RMtuned}} &= C_{\text{KA3500}} + C_{\text{ES-1-2}} + C_{\text{PROFILE MANAGER-1}} \\[6pt]
&= (253{,}275 + 486{,}000 + 224{,}700) \\[6pt]
&= 963{,}975 \text{ bytes/month} \qquad [14]
\end{aligned}
$$

6   ADVANCED CONSIDERATIONS

6.1   General

The profiling data presented above utilizes default settings or default settings with minimal modifications. The default behavior ensures connectivity, but is by no means optimizing cellular network usage. For instance, the default Keep Alive, which is set to 290 seconds, was selected to operate and maintain the Remote Manager connection regardless of application or carrier.

Needless to say, this parameter is the first thing that should be tuned for a particular application; other tuning examples are discussed below.

6.2   Tuning Device Health Data Points

All Remote Manager Data Point examples above used a 1 hour sample period; 24 samples per day. The Network traffic reduction shown in [6], [7], [8], and [9] was achieved solely by decreasing the Remote Manager Reporting period. The critical fact to understand from that section is: data usage is optimized when two samples are bundled in one report!

Applications vary and so does the strategy for gathering device data points. What should be emphasized is there is no requirement to take 24 samples in a day. Some applications could get by with a 12, 4, or 1 sample each day, and this would have a great impact on overall monthly usage.

If your application uses a sample rate n, but maintains the optimized two samples per report, the general expression for monthly traffic usage is shown:

$$C_{ES-n-2} = C_{ES-1-2}/n \text{ bytes/month} \qquad [15]$$

For instance, an application requiring four samples per day, which is a rate of one sample every 6 hours, reporting two samples per report is:

$$C_{ES-6-2} = 486,000 / 6$$

$$= 81,000 \text{ bytes/month} \qquad [16]$$

Alternatively, if your application requires one sample per report, the general expression changes to:

$$C_{ES-n-1} = C_{ES-1-1}/n \text{ bytes/month} \qquad [17]$$

Using the prior example of one sample every 6 hours, but reporting one sample per report:

$$C_{ES-6-1} = 799,200 / 6$$

$$= 133,200 \text{ bytes/month} \qquad [18]$$

6.3   Device Health Latency Data

One additional feature, not directly related to Remote Manager, is the ability to generate a periodic "ping" or "heartbeat" packet, which is used to monitor network latency or network round trip time. When configured, this metric is available for reporting through the 3G or 4G latency data point.

Although a ping packet and response are small, having this exchange repeated every 30 seconds (120 per hour) will have a great impact on the overall network usage. The cost of sending (and receiving) pings every 30 seconds each month is shown:

$$C_{ping-30} = 120 \text{ bytes} * 120 \text{ /hour} * 720 \text{ hours/month}$$

$$= 10,368,000 \text{ bytes/month} \qquad\qquad [19]$$

which is greater than two times the entire cost of the Remote Management [13], using all defaulted settings! For completeness, ping costs for once every 5 minutes (300 seconds) and 1 hour (3600 seconds) are also shown:

$$C_{ping-300} = 120 \text{ bytes} * 12 \text{ /hour} * 720 \text{ hours/month}$$

$$= 1,036,800 \text{ bytes/month} \qquad\qquad [20]$$

$$C_{ping-3600}= 120 \text{ bytes} * 1 \text{ /hour} * 720 \text{ hours/month}$$

$$= 86,400 \text{ bytes/month} \qquad\qquad [21]$$

Despite the high costs of monitoring latency, it is a key metric for evaluating the quality of a cellular connection. Needless to say, the feature must be used carefully. A more granular resolution (every 30 seconds) will catch momentary outages, but the cost is high [19]. Furthermore, applications that can tolerate outages might use a broader resolution (e.g., once per hour) to capture a general feel for the network coverage at each location. Lastly, this could be fine-tuned for those few devices in a fleet that demonstrate connectivity issues.

6.4   Unscheduled Event Costs

Out of Band Remote Management events occur when an operator or web services application interacts with a particular device. For example, when an operator uses Device Manager to modify a setting, load new firmware, or view the state of the device, traffic between your device and Digi Remote Manager is generated.

The following table lists the cost of common Out of Band Management operations:

Operation	Network Traffic (bytes)	Comments
Firmware Download	8,777,817	The cost for downloading WR21-5281.zip (7,180,288 bytes).
File Download	122,306	This is the cost for getting the sbios file (262,144 bytes) from a WR21. Note the reduction in size is due to compression.
Query Setting and Query State	7,634	The cost of a refresh operation.
Query Setting	5,686	This is the identical operation a PROFILE MANAGER Configuration scan. It's also a standard web services SCI call.
Query State	1,948	This is a standard web services SCI call.
File List	1,078	This is the cost of refreshing the Device Manager File Management tab.

7 GLOSSARY

Bytes   8 "bits" of data (e.g. 10101010)

KB   Kilobytes: 1,000 bytes

MB   Megabytes: 1,000 KB

Compliance Manager   A capability within Digi Remote Manager that allows users to create unique configuration (or "profiles") for a device or group of devices, scan periodically, and enforce uniformity.

Device Health   A capability within Digi Remote Manager that allows users to define performance thresholds for devices or groups of devices and alarm, report and troubleshoot to improve network performance.

Firmware Subscriptions   A capability within Digi Remote Manager that allows users to deliver the latest firmware to remote Digi devices.

C_{DH-1-1} Device Health Cost with 1 hour sampling and 1 hour reporting rates

C_{DH-1-2} Device Health Cost with 1 hour sampling and 2 hour reporting rates

C_{DH-1-6} Device Health Cost with 1 hour sampling and 6 hour reporting rates

$C_{DH-1-12}$ Device Health Cost with 1 hour sampling and 12 hour reporting rates

$C_{initial}$ Initial Remote Manager Connection cost

C_{KA} General Expression for Keep-Alive Cost

C_{KA290} Keep-Alive Cost using a Keep-Alive Rate (R_{KA}) of 290 sec

C_{KA3500} Keep-Alive Cost using a Keep-Alive Rate (R_{KA}) of 3500 sec

C_{O290} Connection overhead Cost using a Keep-Alive rate (R_{KA}) of 290 sec

C_{RM} Total Remote Management costs using all defaults

$C_{RMtuned}$ Total Remote Management costs using C_{KA3500} and C_{ES-1-2}

C_{PM} Single Profile scan cost

C_{PM-1} Total monthly Profile Manager cost to scan once per day per device

C_{PM-24} Total monthly Profile Manager cost to scan once per hour per device

R_{KA} The rate for exchanging Remote Manager Keep-Alive messages

SSL   Secure Sockets Layer

TCP/IP   Transmission Control Protocol/Internet Protocol

8   FOR MORE INFORMATION

Digi continues to improve the network efficiency of Digi Remote Manager, and will update this document to provide relevant, timely information.

For pre-sales technical support or questions regarding Digi Remote Manager, please contact your Digi sales rep or sales engineer, or Digi sales partner.

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