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DISCLAIMER

Chipkin Automation Systems™ has limited its liability for damages incurred by the customer or its personnel in the contractual documents pursuant to which the product is provided to the customer. The information and specifications contained throughout this user manual are up to date at the time of publication. Chipkin Automation Systems has used, and continues to use, its best efforts to maintain this user manual to reflect the most current configuration of the product. Chipkin Automation Systems reserves the right to change the contents of this user manual at any time without notice and assumes no liability for its accuracy. In the preparation of this user manual, Chipkin Automation Systems has incorporated, and/or compiled service information and maintenance procedures sourced from manufacturers and vendors of parts and components used in the manufacturing of this product. Therefore, Chipkin Automation Systems shall not be liable for omissions or missing data. It is not the intension of this user manual to instruct service technicians in using common sense, basic skills and rules of service repair.

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DOCUMENT REVISION HISTORY

REVISION	DATE	AUTHOR	NOTE
0	2018-July-18	BDC	Created.

Table 1 - Document Revision History

1. PREFACE

1.1 WELCOME

As a new user of the Chipkin BACnet Report Tool, you have joined thousands of satisfied customers who use Chipkin's protocol gateways, data clients and integration services to meet their building and industrial automation requirements. Our configuration expertise in this field combined with free BACnet and other tools ensure your success; and our customer support via phone, email and remote desktop tools means that we're there when you need us. Thank you for choosing Chipkin's products.

1.2 CHIPKIN

Chipkin offers expert solutions for your building and industrial automation requirements. We develop, configure, install and support gateways (protocol converters), data loggers, and remote monitor and controlling applications. Founded in October 2000, Chipkin provides expert solutions for converting BACnet®, Modbus®, and Lonworks®—to name just a few—and enabling interfaces for HVAC, fire, siren, intercom, lighting, transportation and fuel systems. The high-quality products we offer (including those from other vendors) interface with Simplex™, Notifier™, McQuay™, GE™ and many others—so you can rest assured that Chipkin will select the most appropriate solution for your application.

1.3 CUSTOMER SUPPORT

Chipkin is a small responsive company, and we live or die by the quality of our service—and with offices in two time-zones—we can provide support when you need it. For information on sales, service, obtaining documentation or submitting a service request, please call us toll free at 1-866-383-1657. Thanks for choosing Chipkin's protocol gateways, data clients and integration services to meet your building and industrial automation requirements.



SALES AND CUSTOMER SUPPORT

TOLL FREE: 1-866-383-1657

FAX: 1-416-915-4024

EMAIL: salesgroup1@chipkin.com

GENERAL

TOLL FREE: 1-866-383-1657

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2. OVERVIEW

2.1 PRODUCT SUMMARY

The Chipkin BACnet Wireshark Report Tool is a tool to help debug problematic device installations on sites with BACnet networks. The tool decodes the captured BACnet messages from a Wireshark PCap log file into their XML representations and outputs a comprehensive report containing important information and statistics. The outputted report and xml files provide the user with an informed understanding of their network so that they can easily locate and debug problematic devices.

2.1.1 Report Content

- Global PDU count
- Packet-size statistics
- Hop count statistics
- Network information
 - Network addresses
 - Number of sent messages and received messages and their service type
 - BACnet networks
 - Device addresses
 - BACnet objects
 - BACnet object properties and a history of their values

2.2 INSTALLATION SUMMARY

Firstly, the user needs to download and install Wireshark (<https://www.wireshark.org>) if they have not already done so.

To acquire the Chipkin BACnet Wireshark Report tool, simply download the executable from <https://store.chipkin.com/products/cas-bacnet-wireshark-report-tool>.

3. CONNECTIONS

3.1 NETWORK DIAGRAM

This block diagram consists of four BACnet IP devices communicating via a hub. A computer running Wireshark captures the messages entering the hub and saves them in a PCap file. The Chipkin BACnet Wireshark Report Tool decodes and processes the PCap file and outputs a Report.txt file containing important information and statistics, as well as a *.xml file for every packet in the PCap file.

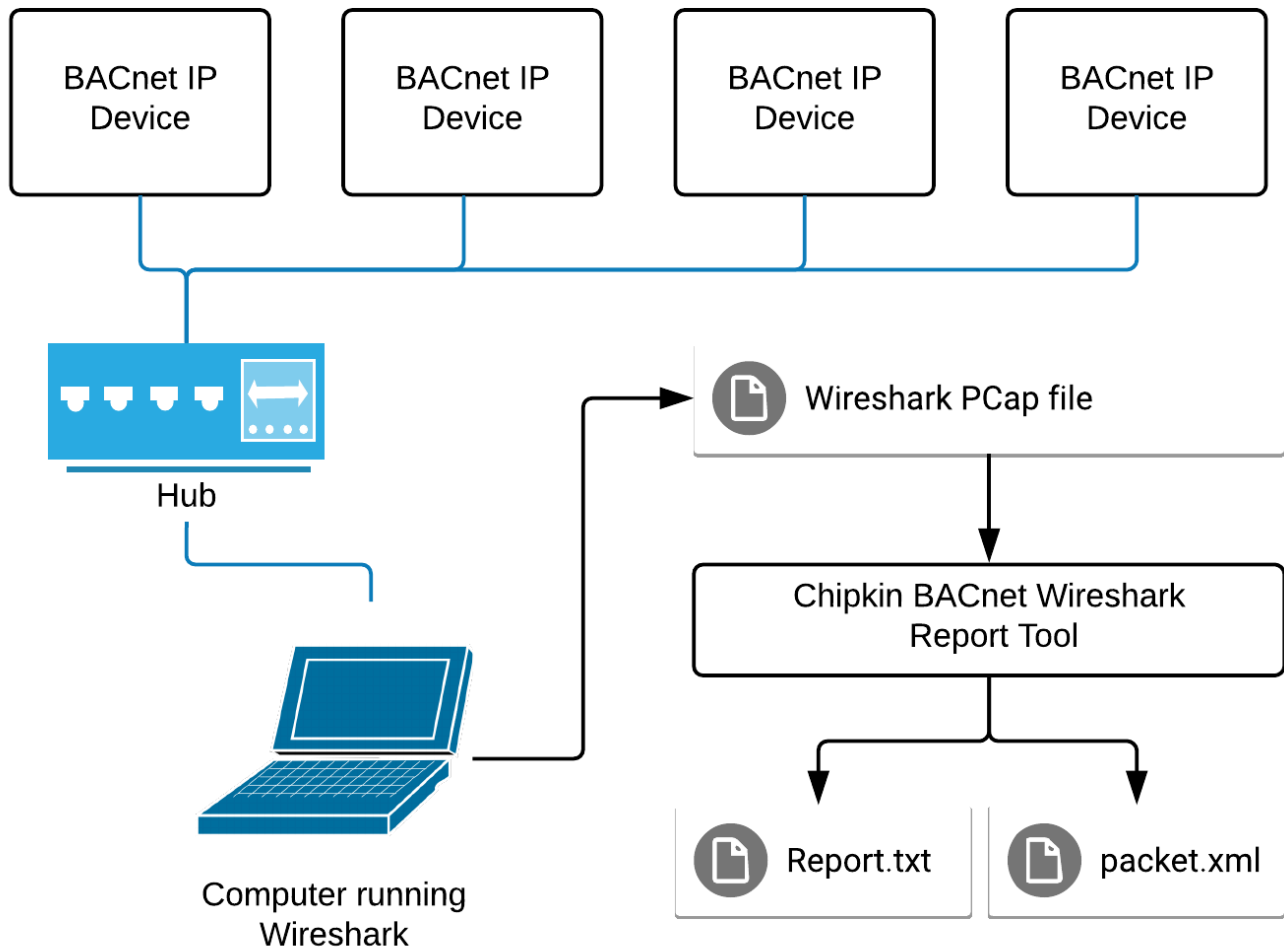
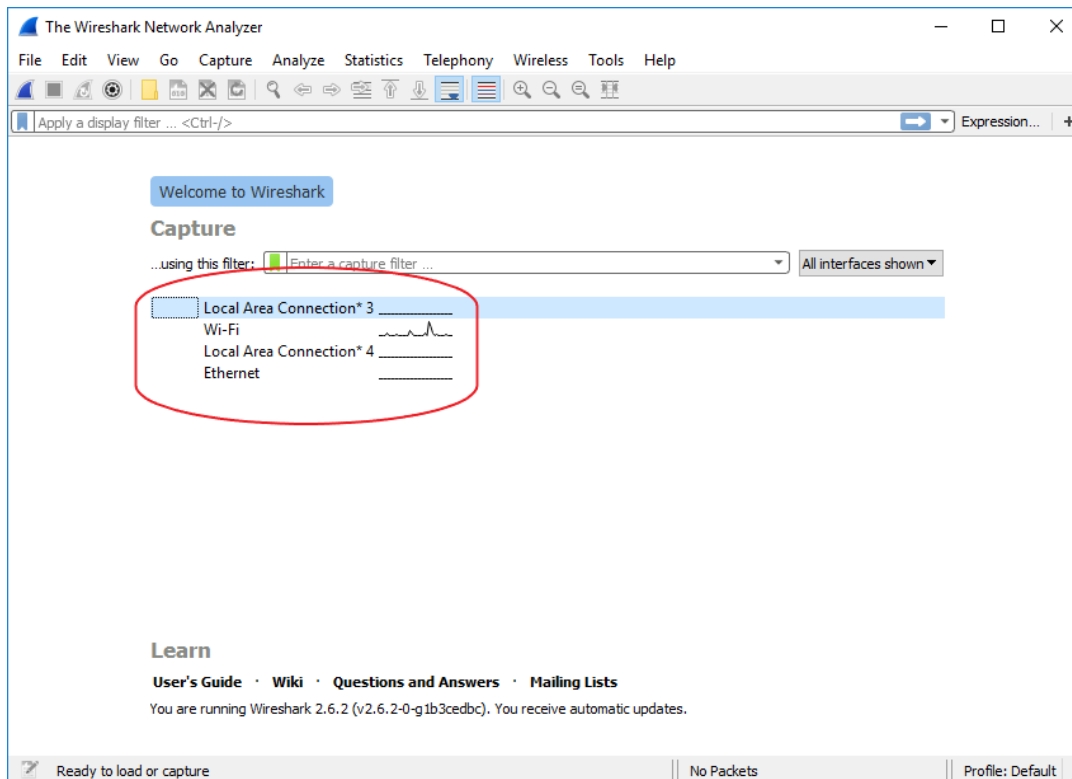



Figure 1 Network Diagram

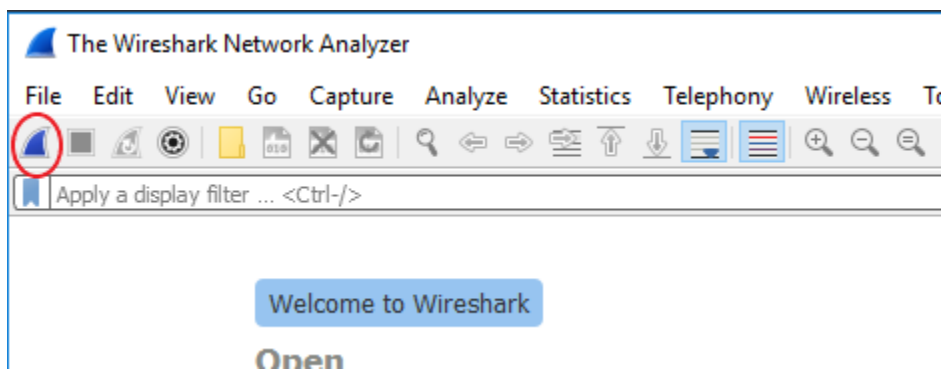
Figure 3.1-2. Network Connections Block Diagram

4. CREATING A WIRESHARK LOG

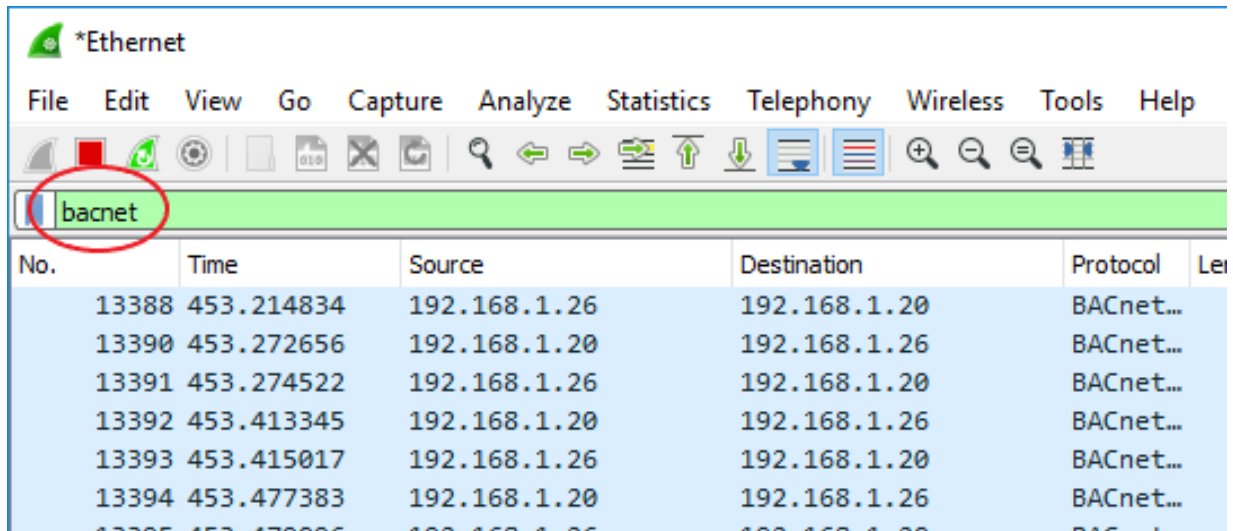
- 1) Download and install Wireshark if you have not already done so: <https://www.wireshark.org>.
- 2) Open Wireshark and click on the network you want to capture.




- 3) Click  to start capturing packets.



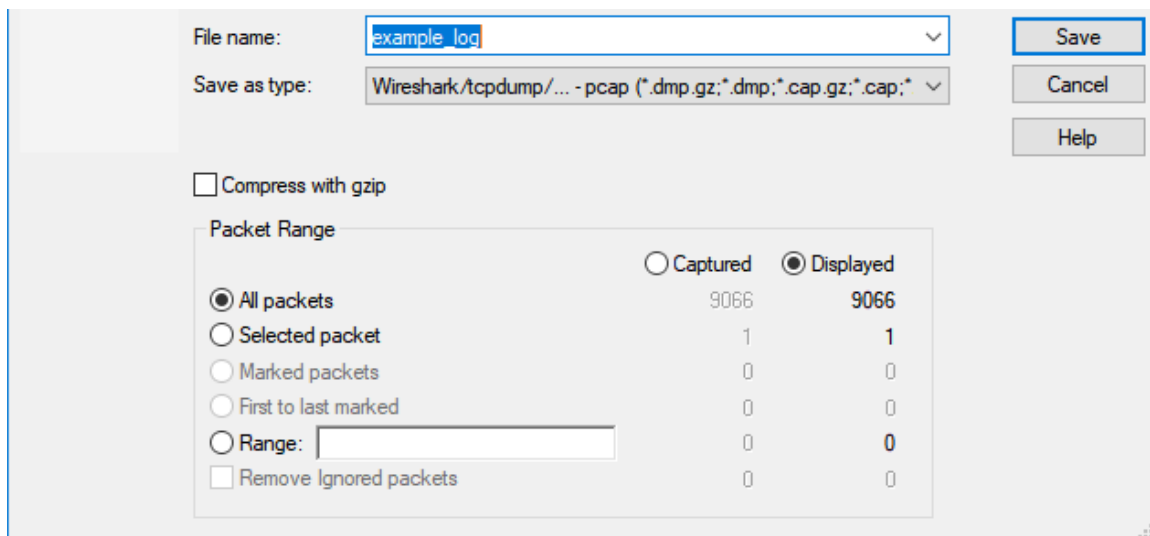
4) Enter **bacnet** as the display filter.



5) If you are debugging an issue, reproduce the problematic issue on the BACnet network.

6) Once you are confident you have all the messages you want captured, click  to stop capturing the communication.

7) Click **File->Export Specified Packets...**, change the log file format to ***.pcap**, ensure **Displayed** is selected, and save.



5. EXECUTION

5.1 COMMAND LINE SYNTAX

```
CASBACnetWiresharkReport [path to pcap file] [packet number]
```

5.2 COMMAND LINE ARGUMENTS

- Path to PCap File (optional) – The path to a single Wireshark log to be processed. *Default: All files in the executable's root folder.*
- Packet Number (optional) - The number of the packet in the specified Wireshark log to be processed (all other packets will be ignored). *Default: All packets in the Wireshark log.*

5.3 COMMAND LINE EXAMPLES

- 1) The following command decodes and processes every Wireshark log in the root folder of the CASBACnetWiresharkReport.exe program. The Report.txt file will contain a separate report section for each log and an XML representation of every packet in every log will be outputted:

```
CASBACnetWiresharkReport
```

- 2) The following command will output a report file that contains the BACnet information and statistics only concerning the fourth packet in wireshark_log.pcap (which is in the executable's root directory), as well as the XML representation of the fourth packet:

```
CASBACnetWiresharkReport wireshark_log.pcap 4
```

6. UNDERSTANDING THE OUTPUT

6.1 EXAMPLE REPORT

WIRESHARK BACNET REPORT TOOL v1.0.0

FYI: Packets received: 154

FYI: Packets successfully processed: 154

FYI: Packets unsuccessfully processed: 0

Global PDU Count

- Abort: 8
- Complex-Ack: 31
- Confirmed-REQ: 76
- Error: 20
- Simple-Ack: 7
- Unconfirmed-REQ: 12

Packet Statistics

Packet size stats:

Average packet size: 89 bytes

Largest packet size: 532 bytes (Pkt: 153)

Smallest packet size: 15 bytes (Pkt: 2)

Packets with size 1-60 bytes: 109 (70%)

Packets with size 61-100 bytes: 1 (0%)

Packets with size 101-300 bytes: 34 (22%)

Packets with size 301-1200 bytes: 10 (6%)

Packets with size 1201+ bytes: 0 (0%)

Hop count stats:

Lowest hop count: 255 bytes (Pkt: 1)

Packets with hop count 1-49: 0 (0%)

Packets with hop count 50-99: 0 (0%)

Packets with hop count 100-249: 0 (0%)

Packets with hop count 250-255: 76 (100%)

Networks Information

Network Address: 172.16.21.102

Sent.Messages: 22

Recv.Messages: 18

Sent.PDU.ConfirmedRequest: 22

Recv.PDU.ComplexAck: 10

Recv.PDU.Abort: 5

Recv.PDU.Error: 3

BACnet Network: 0 (Local network)

Device Address: 0 (Local device address)

Network Address: 172.16.21.101

Sent.Messages: 62

Recv.Messages: 61

Sent.PDU.UnconfirmedRequest: 7

Sent.PDU.ComplexAck: 20

Sent.PDU.SimpleAck: 7

Sent.PDU.Abort: 8

Sent.PDU.Error: 20

Recv.PDU.ConfirmedRequest: 61

BACnet Network: 389

Device Address: 0x05F17D

Object Identifier - device: 389501

Property - apduTimeout: 3000 (Pkt: 4)

Property - applicationSoftwareVersion: v1 (Pkt: 6)

Property - description: [Error: Error-class: property, Error-code: unknownProperty] (Pkt: 8)

Property - deviceAddressBinding: {No response}

Property - location: [Error: Error-class: property, Error-code: unknownProperty] (Pkt: 12)

Property - objectName: Chipkin Automation Systems Simulated Bacnet Device 1 (Pkt: 16)

Property - firmwareRevision: {No response}

Object Identifier - analogInput: 1

Property - objectIdentifier: analogInput, 1 (Pkt: 32)

Property - eventState: normal (0) (Pkt: 32)

Property - units: noUnits (95) (Pkt: 34)

Property - outOfService: false (Pkt: 34)

...

6.2 EXAMPLE XML

```

<!-- CAS BACnet Stack v3.2.1.0 -->
<BACnetPacket networkType='IP'>
  <BVLL function='originalUnicastNPDU' />
  <NPDU control='0x08' version='1'>
    <SourceNetwork>389</SourceNetwork>
    <SourceAddress length='3'>0x05F17D</SourceAddress>
  </NPDU>
  <ComplexACKPDU moreFollows='0' originalInvokeId='74' segmentedMessage='0' serviceChoice='readProperty'>
    <ReadPropertyACK>
      <ObjectIdentifier context='0' datatype='12' objectInstance='389501' objectType='8'>device, 389501
    </ObjectIdentifier>
    <PropertyIdentifier context='1' datatype='9' value='11'>apduTimeout</PropertyIdentifier>
    <PropertyValue context='3'>
      <UnsignedInteger datatype='2' value='3000'>3000</UnsignedInteger>
    </PropertyValue>
  </ReadPropertyACK>
</ComplexACKPDU>
</BACnetPacket>
    
```

6.3 SPECIAL BACNET OBJECT PROPERTY VALUES

6.3.1 {No response}

When a read request or write property request is sent, it specifies the object properties to be read/written. These properties are recorded by the BACnet Wireshark Report Tool; however, we don't know their actual values at this time. If no response is received that contains the current value(s) of a property, its value is reported as "{No response}".

e.g. *Property - description: {No response} (Pkt: #)*

6.3.2 {Empty}

A property's value will be recorded as {Empty} when the primitive element in the XML specifying the property's value does not have any text. The most common primitive element with no element text is a character string.

XML example:

```
<ReadResult>
  <PropertyIdentifier context='2' datatype='9' value='28'>description</PropertyIdentifier>
  <PropertyValue context='4'>
    <CharacterString datatype='7' encoding='0' length='0' />
  </PropertyValue>
</ReadResult>
```

Result in Report.txt: *Property - description: {Empty} (pkt: #)*

6.3.3 {Unknown}

The BACnet Stack may encounter an Application Protocol Data Unit (APDU) that it cannot handle. In this case, the primitive element specifying the value of the property in the XML will be <UnknownAPDU> and won't provide any information. As a result, the value for that property will be set to {Unknown}.

XML example:

```
<ReadResult>
  <PropertyIdentifier context='2' datatype='9'
value='60'>manipulatedVariableReference</PropertyIdentifier>
  <PropertyValue context='4'>
    <UnknownAPDU />
  </PropertyValue>
</ReadResult>
```

Result in Report.txt: *Property - manipulatedVariableReference: {Unknown} (pkt: #)*

6.3.4 Arrays of Values

A BACnet object may have a property with an array of values. In this case, the property's values are represented as [val1, val2, val3, ...] in the report.

XML example:

```
<ReadResult>
  <PropertyIdentifier context='2' datatype='9' value='110'>stateText</PropertyIdentifier>
  <PropertyValue context='4'>
    <CharacterString datatype='7' encoding='0' length='3'>Off</CharacterString>
    <CharacterString datatype='7' encoding='0' length='3'>Low</CharacterString>
    <CharacterString datatype='7' encoding='0' length='6'>Medium</CharacterString>
    <CharacterString datatype='7' encoding='0' length='4'>High</CharacterString>
    <CharacterString datatype='7' encoding='0' length='6'>Danger</CharacterString>
  </PropertyValue>
</ReadResult>
```

Result in Report.txt: *Property - stateText: [Off, Low, Medium, High, Danger] (Pkt: #)*

6.3.5 Enumeration Values

Some values are of an enumeration type (datatype 9). In this case, the string representation is displayed along with the number representation in brackets.

XML example (see that the "ObjectType" element has an attribute of "datatype='9'"):

```
<ReadResult>
  <PropertyIdentifier context='2' datatype='9' value='79'>objectType</PropertyIdentifier>
  <PropertyValue context='4'>
    <ObjectType datatype='9' value='23'>accumulator</ObjectType>
  </PropertyValue>
</ReadResult>
```

Result in Report.txt: *Property - objectType: accumulator (23) (Pkt: #)*

6.4 OTHER NOTABLE REPORT ATTRIBUTES

6.4.1 Multiple Updates to BACnet Property Values

When a property has its value changed over the course of a log, up to the last three values of the property, along with the number of the packet in which these values were found, will be shown in the report.

Example:

Property - localTime: 14:31:40.37 (Pkt: 26483), 14:31:30.36 (Pkt: 26446), 14:31:20.36 (Pkt: 26416) - (FYI: Only showing last 3 values)

6.4.2 Decoding vs Processing Packet Counts

You will see two sets of packet counts in the report:

Decoding counts example:

FYI: packet.count: 26510

FYI: packet.decode.error.count: 2191

FYI: packet.decode.skip_nonUDP.count: 45

FYI: packet.write.error.count: 0

Processing counts example:

FYI: Packets received: 24274

FYI: Packets successfully processed: 24266

FYI: Packets unsuccessfully processed: 8

Definitions:

- *packet.count* – Total number of packets in the Wireshark log
- *packet.decode.error.count* – Number of packets that the BACnet Stack could NOT decode
- *packet.decode.skip_nonUDP.count* – Number of Packets that have been skipped because they are not UDP messages
- *packet.write.error.count* – Number of times the BACnet Stack failed to write the XML formatted text to a *.xml file
- *Packets received* – Numbers of packets received for processing [*packet.count* - (*packet.decode.error.count* + *packet.decode.skip_nonUDP.count*)]
- *Packets successfully processed* – Number of packets whose information was successfully processed and entered in the report
- *Packets unsuccessfully processed*: Number of packets that could NOT be processed

7. DIAGNOSTICS AND SUPPORT

7.1 LONG EXECUTION TIME

Execution times will vary drastically between Wireshark logs since the length is dependent on both the number of messages and the amount of content in the messages. Most Wireshark logs will have many thousands or even hundreds of thousands of messages. On the low end, the user should expect the program to only take a few minutes, while a user with a log of 100 000 packets should expect to let the program run in the background for around 15-20 minutes.

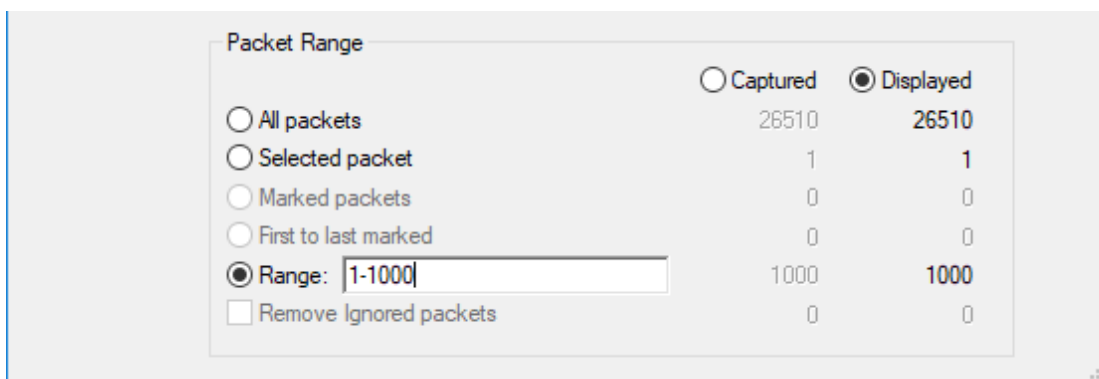
Execution time factors:

- Decoding and processing each packet is time consuming - adding packets to a Wireshark log will always add execution time.
- The BACnet Wireshark Report tool must store all the network information it processes from the Wireshark log before writing the information to the report file at the end. As a result, the execution speed will slow down as the tool progresses for large Wireshark logs.
- A Wireshark log capture of a complex network consisting of many devices communicating with each other will have a longer per-packet execution time since each message will likely contain new and/or large amounts of information to be recorded.
- Writing all the network information to the report file is expensive.

7.2 REDUCING EXECUTION TIME

Depending on the information you are looking for, you may be able to split the Wireshark log into multiple smaller logs. This will lower the overall execution time since the execution speed slows down as the tool progresses for large Wireshark logs.

To quickly create a Wireshark log that is a subset of another one, go to **File->Export Specified Packets...** and choose a packet range:



Note: The time to process multiple Wireshark logs in one program execution is the same as the accumulative time of re-executing the program for each one since the program automatically clears all previous data for each new log anyways.

7.3 "Could not decode packet as BACnet" ERRORS

This error occurs when the BACnet Stack cannot decode the message into XML which happens when the packet is not a BACnet message or the BACnet message service choice is not supported by the BACnet Stack.

7.4 REPORTING BUGS AND REQUESTING FEATURES

Chipkin always strives to provide the highest quality of products and services to customers. Please contact us (<https://store.chipkin.com/contact-us>) to report bugs or suggest features so that we can improve the BACnet Wireshark Report Tool for you.

BEST PRACTICES

The Chipkin BACnet Report Tool (CAS-1000-04) best practices:



Tip: We highly recommend filtering any non-BACnet IP messages out of Wireshark logs before they are passed to the BACnet Wireshark Report Tool. To do so, open the Wireshark logs and then follow steps 4 and 7 (skip 5/6) in the [\[Creating a Wireshark Log\]](#) section above.

APPENDIX A: SAFETY WARNINGS

This Appendix is left intentionally blank.

APPENDIX B: HARDWARE SPECIFICATIONS

This Appendix is left intentionally blank.

APPENDIX C: LIMITED WARRANTY

LIMITED WARRANTY

Chipkin Automation Systems provides a 30-Day Return Window (see Return of Non-Defective Products below) and the following limited warranty. This limited warranty extends only to the original purchaser.

Please note that any warranty services or questions must be accompanied by the order number from the transaction through which the warranted product was purchased. **The order number serves as your warranty number and must be retained.** Chipkin Automation Systems will offer no warranty service without this number.

Chipkin Automation Systems warrants this product and its parts against defects in materials or workmanship for *three years labor and one year parts* from the original ship date. During this period, Chipkin Automation Systems will repair or replace defective parts with new or reconditioned parts at Chipkin Automations Systems option, without charge to you. Shipping fees incurred from returns for under-warranty service in the first 30-days will be paid by Chipkin Automation Systems. All shipping fees both to and from Chipkin Automation Systems following this 30-day period must be paid by the customer. All returns, both during and following the 30-day period, must be affected via the Procedures for Obtaining Warranty Service described below.

All original parts (parts installed by Chipkin Automation Systems at the original system build) replaced by Chipkin Automation Systems or its authorized service center, become the property of Chipkin Automation Systems. Any after-market additions or modifications will not be warranted. The gateway system owner is responsible for the payment, at current rates, for any service or repair outside the scope of this limited warranty.

Chipkin Automation Systems makes no other warranty, either express or implied, including but not limited to implied warranties of merchantability, fitness for a particular purpose, or conformity to any representation or description, with respect to this computer other than as set forth below. Chipkin Automation Systems makes no warranty or representation, either express or implied, with respect to any other manufacturer's product or documentation, its quality, performance, merchantability, fitness for a particular purpose, or conformity to any representation or description.

Except as provided below, Chipkin Automation Systems is not liable for any loss, cost, expense, inconvenience or damage that may result from use or inability to use the gateway. Under no circumstances shall Chipkin Automation Systems be liable for any loss, cost, expense, inconvenience or damage exceeding the purchase price of the gateway.

The warranty and remedies set forth below are exclusive and in lieu of all others, oral or written, expressed or implied. No reseller, agent or employee is authorized to make any modification, extension or addition to this warranty.

WARRANTY CONDITIONS

The above Limited Warranty is subject to the following conditions:

1. This warranty extends only to products distributed and/or sold by Chipkin Automation Systems. It is effective only if the products are purchased and operated in Canada or the USA. (Within the USA including US 48 States, Alaska and Hawaii.)
2. This warranty covers only normal use of the gateway. Chipkin Automation Systems shall not be liable under this warranty if any damage or defect results from (i) misuse, abuse, neglect, improper shipping or installation; (ii) disasters such as fire, flood, lightning or improper electric current; or (iii) service or alteration by anyone other than an authorized Chipkin Automation Systems' representative; (iv) damages incurred through irresponsible use, including those resulting from viruses or spyware, overclocking, or other non-recommended practices.
3. You must retain your bill of sale or other proof of purchase to receive warranty service.
4. No warranty extension will be granted for any replacement part(s) furnished to the purchaser in fulfillment of this warranty.
5. Chipkin Automation Systems and its Authorized Service Center accepts no responsibility for any software programs, data or information stored on any media or any parts of any products returned for repair to Chipkin Automation Systems.
6. All pre-installed software programs are licensed to customers under non-Chipkin Automation Systems software vendor's term and conditions provided with the packages.
7. This warranty does not cover any third party software or virus related problems.
8. Chipkin Automation Systems makes no warranty either expressed or implied regarding third-party (non-Chipkin Automation System) software.
9. Thirty-day Return Window does not include opened software, parts, special order merchandise and shipping and handling fees.

RETURN OF NON-DEFECTIVE PRODUCTS

A non-defective product may be returned to Chipkin Automation Systems within thirty (30) days of the invoice date for a refund of the original purchase price with the following amendments/fees:

1. Chipkin Automation Systems will refund neither the original shipping cost nor the shipping and handling fees incurred from the products return. If the original purchase was made under a "Free Shipping" promotion then a standard \$40 fee will be deducted from any return in counter to that offer.

2. No refund will be granted for software which has been opened, used, or tampered with in any way which jeopardized Chipkin Automation Systems ability to remarket or resell the product. Chipkin Automation Systems maintains full discretion in decisions regarding a products fitness for return.
3. Any non-defective returns are subject to a 15% restocking fee, which percentage is taken from the final purchase price less any shipping or handling charges.
4. Quantity purchases of five systems or more are not eligible for return.

To return a defective product, please contact our Customer Service Department for a Return Merchandise Authorization (RMA) number and follow the Return of Products Instructions below. The RMA is valid for 10 days from date of issuance. **Returns will not be accepted without an RMA.** Manufacturer restrictions do apply. Any item missing the UPC on the original packaging may not be returned.

PROCEDURES FOR OBTAINING WARRANTY SERVICE

RMA (Returning Merchandise Authorization) Policy:

If repairs are required, the customer must obtain an RMA number and provide proof of purchase. RMA and services are rendered by Chipkin Automation Systems only. Any shipping costs after 30 days (starting from the original date of purchase) on any item returned for repair is the customers' responsibility. All returned parts must have an

RMA number written clearly on the outside of the package along with a letter detailing the problems and a copy of the original proof of purchase. No COD packages will be accepted. No package will be accepted without an RMA number written on the outside of the package. RMA numbers are only valid for 30 days from the date of issue.

Should you have any problems with your gateway, please follow these procedures to obtain the service:

1. If you have purchased our on-site warranty, please find your warranty# (the order number from the transaction through which the warranted product was originally purchased) and contact Chipkin Automation Systems Customer Service by phone at 1-866-383-1657 (Toll free) or 1-647-557-3330.
2. If the gateway must be repaired, an RMA number (Return Merchandise Authorization Number) will be issued for shipment to our repair department. Please follow the instructions given by Chipkin Automation Systems technical support staff to ship your gateway. Chipkin Automation Systems will not accept any shipments without an RMA number.
3. Pack the gateway in its original box or a well-protected box, as outlined in the Return Shipping Instructions. Chipkin Automation Systems will not be responsible for shipping damage/loss of any product outside the original 30-day Chipkin Automation Systems-paid

service period. It is very important that you write the RMA number clearly on the outside of the package. Ship the gateway with a copy of your bill of sale or other proof of purchase, your name, address, phone number, description of the problem(s), and the RMA number you have obtained to:

Chipkin Automation Systems RMA# _____
3381 Cambie St., #211
Vancouver, B.C. Canada, V5Z 4R3

4. Upon receiving the gateway, Chipkin Automation Systems will repair or replace your gateway (at Chipkin Automation Systems discretion) and will ship it back to you within 2 weeks (dependent on parts availability) via UPS.
5. Cross-exchange (Parts only): You will need to provide a valid credit card number as a deposit guarantee when the RMA number is issued. Once approval has been obtained on your credit card, the part(s) will be shipped UPS. You will need to ship defective part(s) back to Chipkin Automation Systems within 15 days to avoid charges to your credit card. If such charges are incurred, the shipped part(s) will be billed at the then current price.
6. Chipkin Automation Systems will pay for shipping to and from the customer only within the first thirty days following the original product ship date. Following this 30-day period all shipping fees both for under warranty and post warranty repairs are the sole responsibility of the customer. The customer also assumes full liability for losses or damages resulting from shipping as well as all responsibility to pursue remuneration for such issues with their selected carrier.

AFTER ONE-YEAR WARRANTY – POST WARRANTY REPAIR

For post warranty repair, the procedure is the same as outlined above for RMA and shipping. However, you are responsible for shipping charges both ways, current labor (\$75 per hour if not under warranty), and the current price of part(s) used in repair.

GLOSSARY

- **APDU** - Application Protocol Data Unit.
- **BACnet** – The communication protocol for Building Automation and Control (BAC) networks.
- **Log** – A Wireshark log saved in the *.pcap file format.
- **PCap (Packet Capture)** – Data files containing the packet data of a network.
- **PDU** – Protocol Data Unit.
- **NPDU** – Network Layer Protocol Data Unit.
- **Report.txt** – The text file containing all BACnet Stack information, error messages that occurred while decoding or processing the messages, global session stats, and the report.
- **Report** – The section of Report.txt containing all the information and statistics about the Wireshark log gathered from analyzing the decoded packets from the BACnet stack. The section is indicated by the title “WIRESHARK BACNET REPORT TOOL v#.#.#”.
- **XML** – Extensible Markup Language.

THANK YOU

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