

Protocol and Integration: Compact & MSGPACK



Agenda

1. Where we came from (Cola A/B lmdscandata)
2. Compact (MSGPACK)
3. LiDAR
4. Wireshark plug-in

Why new formates?

- Amount of data increase → efficient data transmission
- New requirements for cyber security which may not be longer supported by CoLa




Overview

Choice of different data formats & drivers



Type	Info	Advantages	Limitations
LMDscandata	<ul style="list-style-type: none"> TCP/IP always complete scan CoLa A/B Same channel like config. 	<ul style="list-style-type: none"> Well known Includes seconde sensor data such as outpute state 	<ul style="list-style-type: none"> quite a lot of bandwidth Not cyber secure
COMPACT (data format)	<ul style="list-style-type: none"> available for UDP outputs segments (e.g. 30° is one segment) (LRS4000 TCP/IP complete scan) similar to other 3D LiDAR Data format approaches contains information like device Identification / Serial Number, time stamp and device status Requires <ul style="list-style-type: none"> ~5 MBit for picoScan (3 echoes) ~35 Mbit for multiScan (3 echoes) 	<ul style="list-style-type: none"> very efficient much smaller band with needed "memcpy" will do the job → super efficient and resource-saving a bit like CoLa B 	<ul style="list-style-type: none"> Data is not "self-describing" more "difficult" to parse (needs probably more integration time on customer side)
MSGPCK (data format)	<ul style="list-style-type: none"> available for UDP and TCP/IP(LRS4000) outputs segments (e.g. 30° is one segment) contains information like device Identification / Serial Number, time stamp and device status requires about <ul style="list-style-type: none"> ~10 MBit for picoScan (3 echoes) ~70 Mbit for multiScan (3 echoes) 	<ul style="list-style-type: none"> easy to integrate with existing "libraries" Easy to parse ROS drivers also uses this protocol Each field has a kind of "speaking name" or numbering 	<ul style="list-style-type: none"> quite a lot of bandwidth requires more computing power, especially for parsing

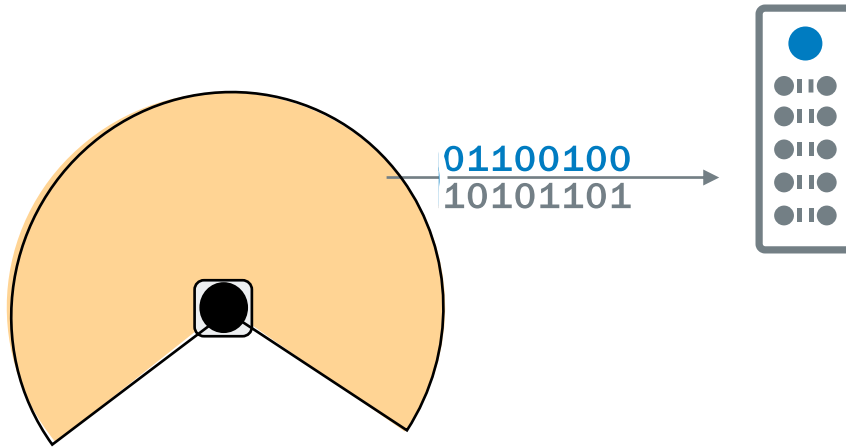
Who supports what?

	<u>Distance Data Compact</u>	<u>Distance Data MSGPACK</u>	IMU Data Compact	IMU Data MSGPACK	TCP support	UDP support
 picoScan	✓	✓	✓	✗	✗	✓
 multiScan	✓	✓	✓	✗	✗	✓
 LRS4000	✓	✗	✗	✗	✓	✗

› Q4 2024

LMDscandata

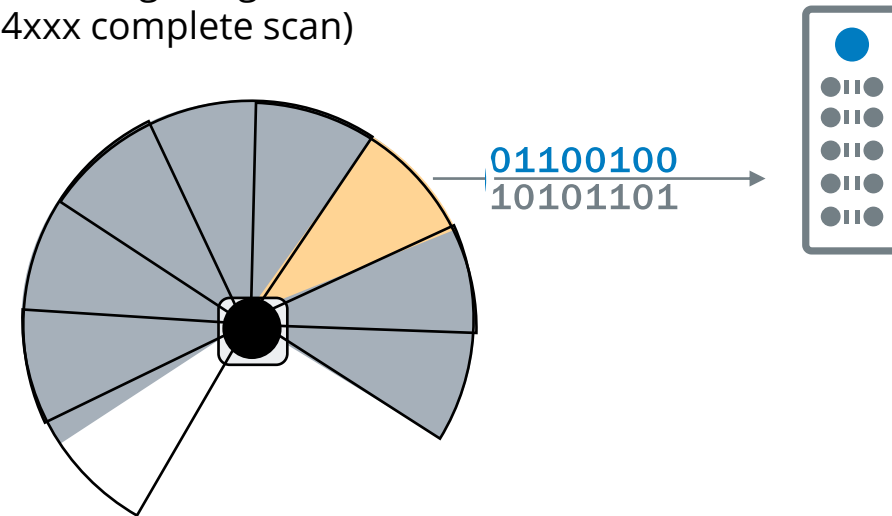
Transmit complete scan/frame



MSGPACK/Compact

Consist of several segment

Transmit single segments (LRS4xxx complete scan)

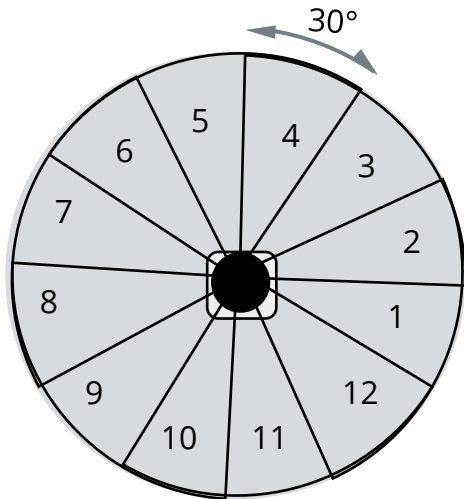


Transmission of complete scan causes a high latency at the beginning of a scan. MSG/Compact transmit each segment.

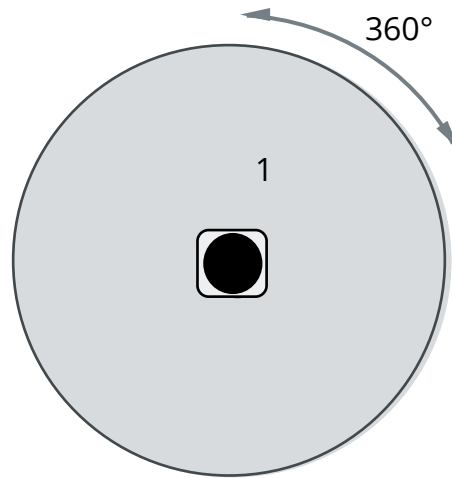


Dataformat

multiScan

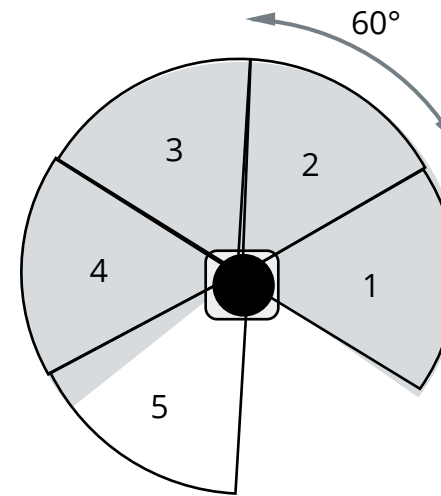


LRS4000

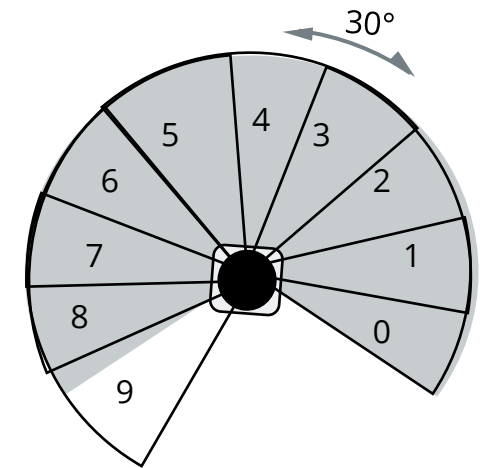


picoScan

60° segments ≥ 30 Hz



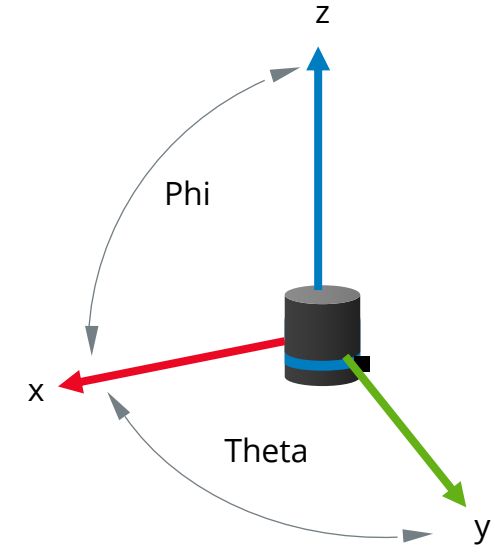
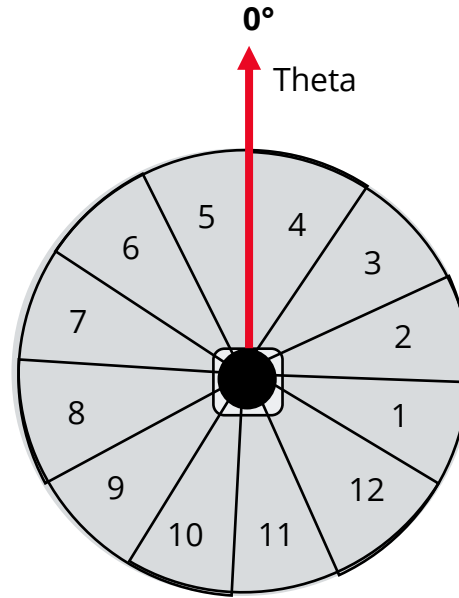
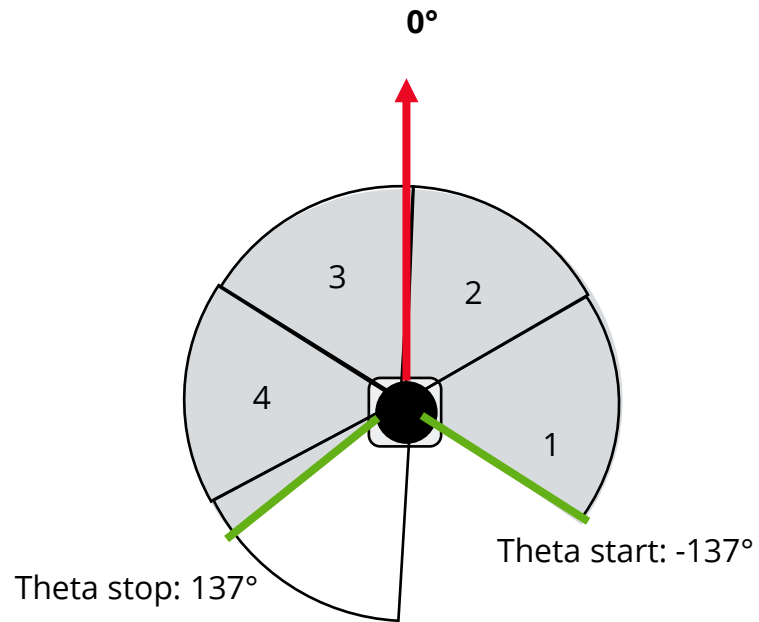
30° segments ≤ 25 Hz



multiScan segment size is always 30°. picoScan segment size depends on spinning frequency. Not every segment is completely filled with data.



Angle and orientation



Work with Compact

MeasurementData picoScan 1/2

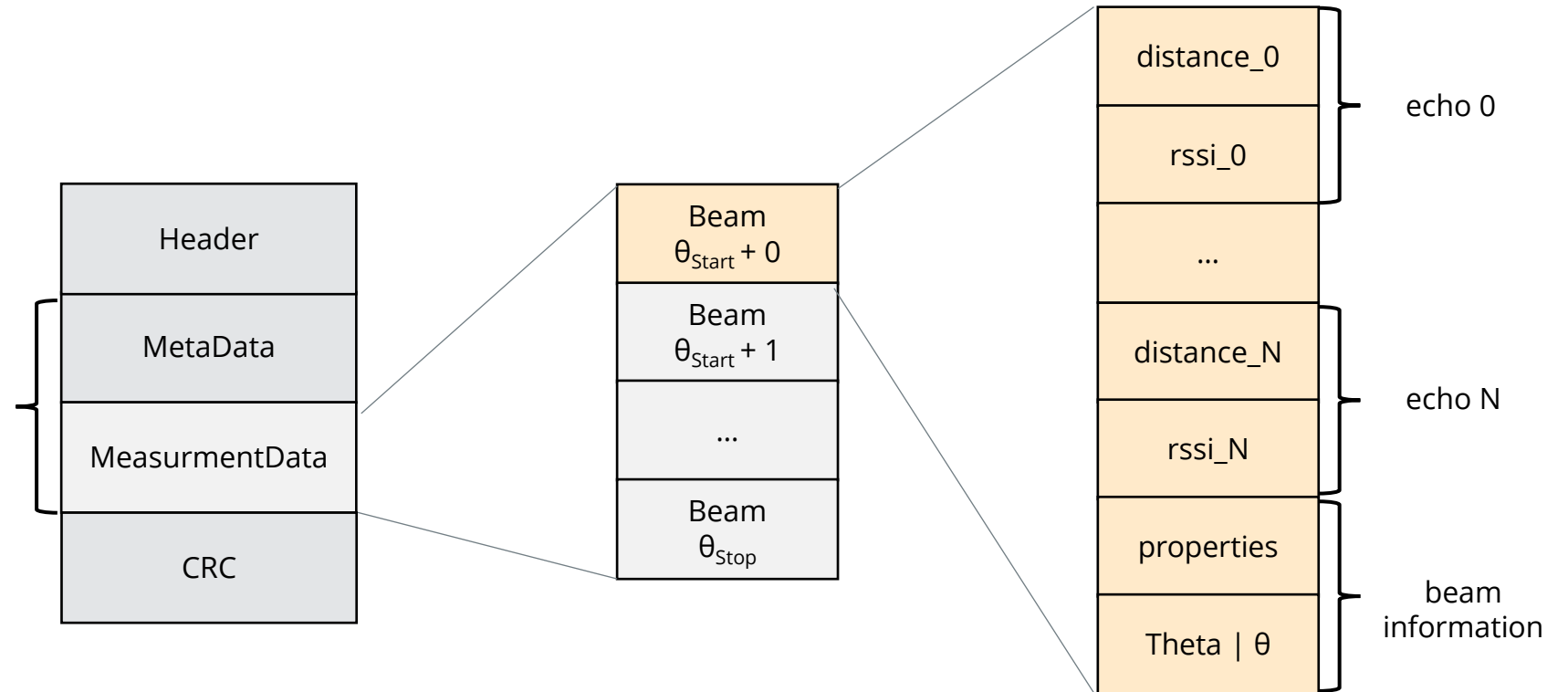
Scan Segment

Measurement Data

Beam

- picoScan has only a single Module on 0°

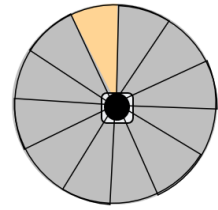
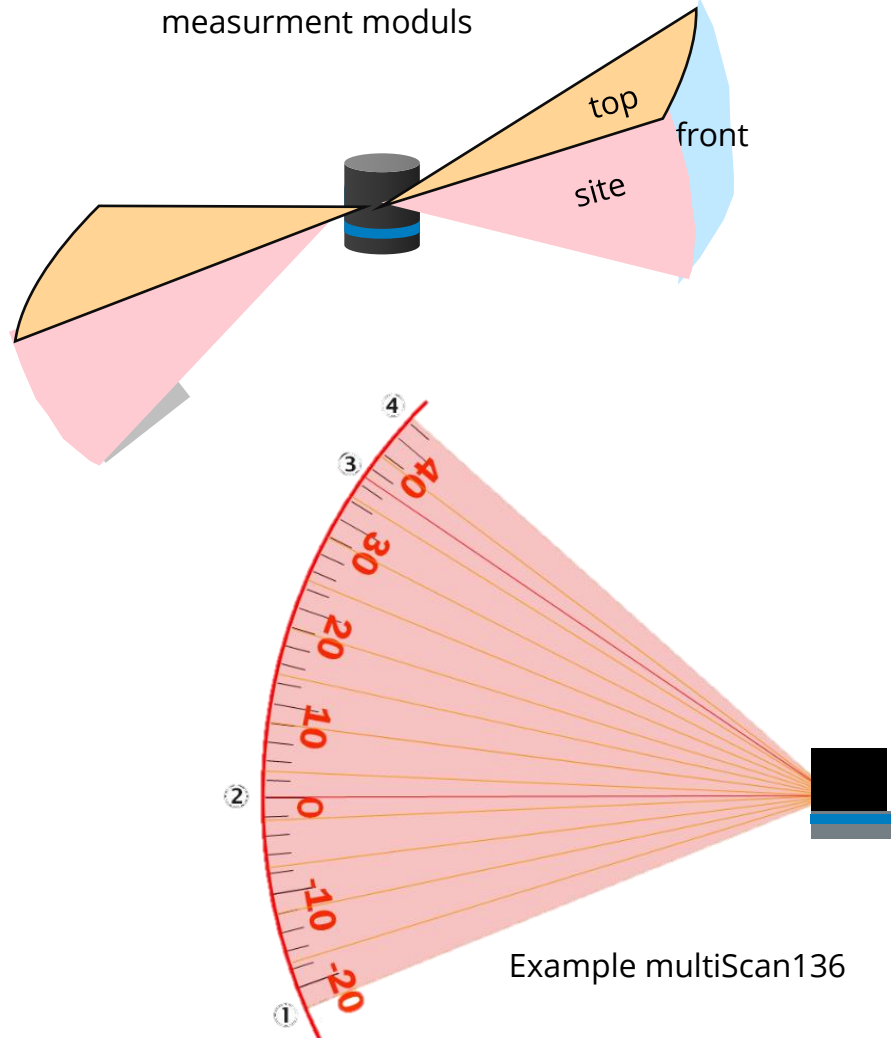
Module 0



multiScan136

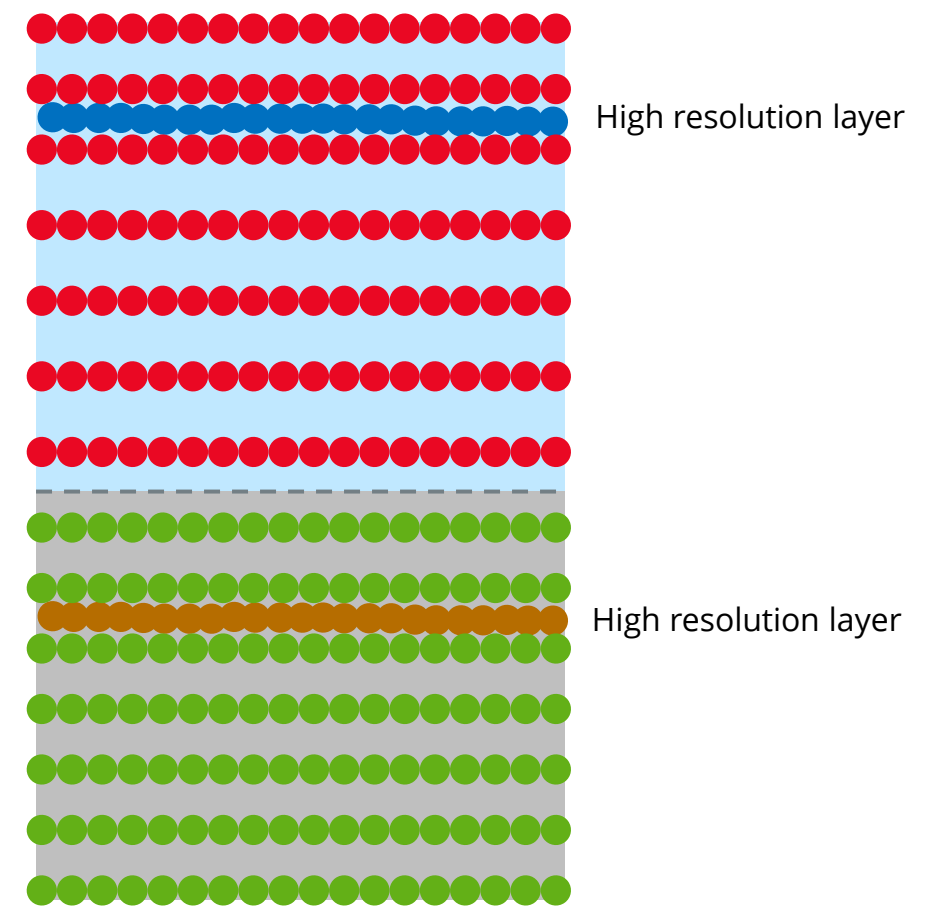
Multi layer LiDAR

Two hardware measurement moduls

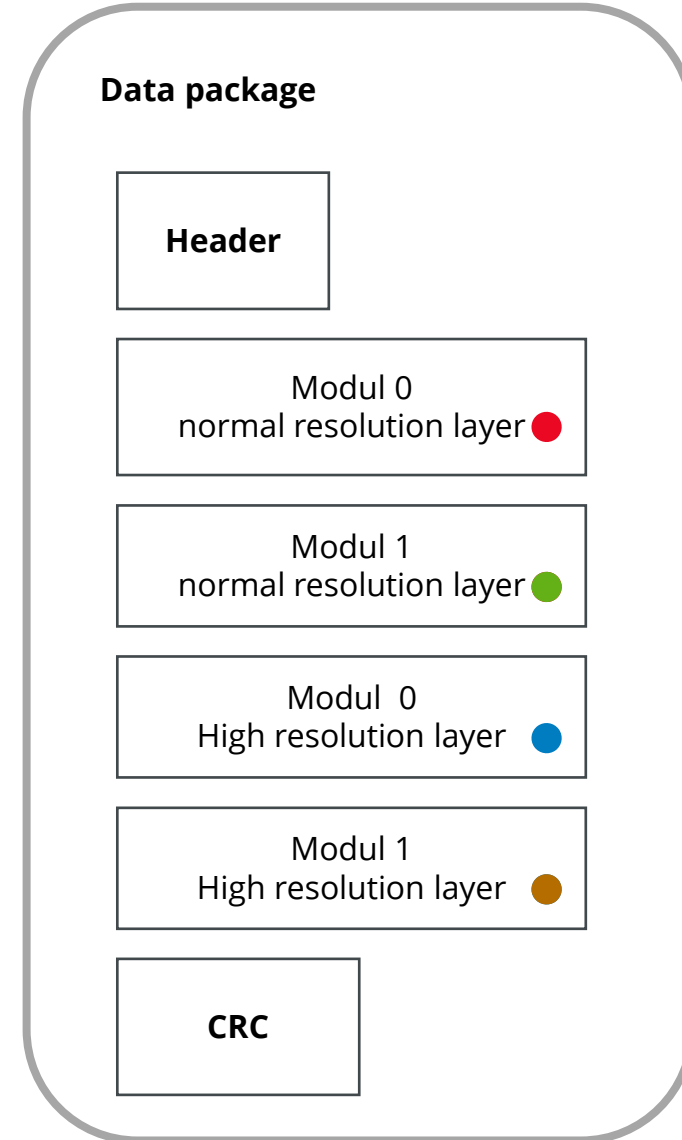


Top view

Front view

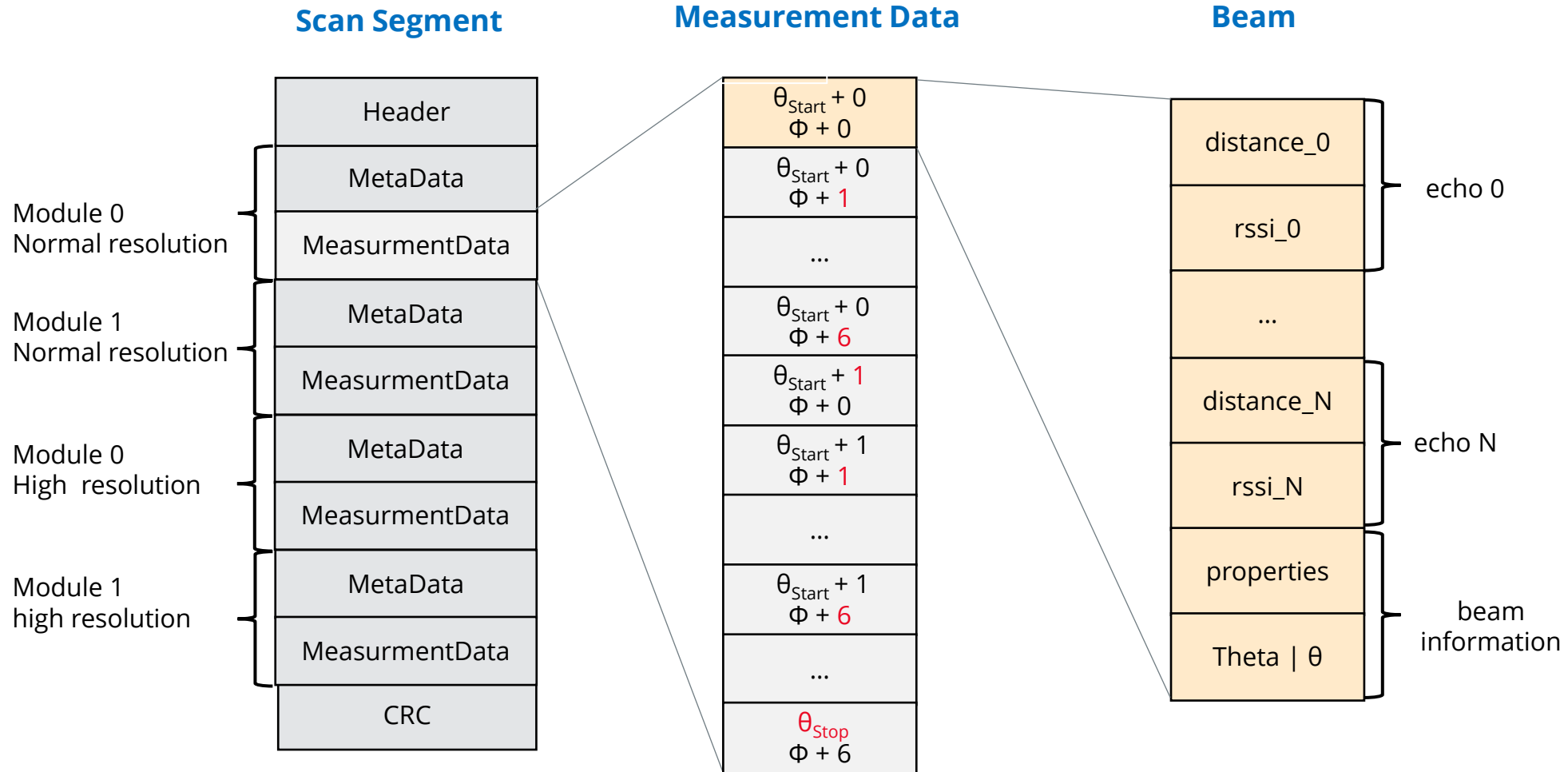


multiScan moduls



Work with Compact

MeasurementData multiScan 1/3



See chapter 5.1 & 5.3



Searching for the distance information

The image shows a person from behind, standing in a room with a large chalkboard. The chalkboard is covered in technical drawings, including a circular diagram with arrows, a line graph, and various mathematical notations. A thought bubble containing a glowing lightbulb icon is positioned above the person's head. The background of the entire slide is a hexagram data dump from a network capture, with columns of hexadecimal values and corresponding ASCII characters.



Compact & MSGPACK, Schwender, Kunkler, Waldkirch

Wireshark

Whats that?

- Powerful package analysis tool
- Analysis of ethernet, bluetooth, usb, wifi traffic
- Graphical representation of data
- Well known
- SICK provides a COMPACT plug-in for easy understanding/error search

The screenshot displays the Wireshark interface with a packet capture file named 'multiScan136_Compact_Training_David.pcapng'. The main pane shows a list of captured packets with columns for No., Time, Source, Destination, Protocol, Length, and Info. The selected packet (No. 414) is highlighted in green. Below the packet list, the packet details pane shows the structure of the selected packet, including Measurement Data Module 0 (Beams set 8) through Measurement Data Module 0 (Beams set 25). The packet bytes pane shows the raw data of the selected packet, including the frame (882 bytes) and reassembled IPv4 (14168 bytes). The status bar at the bottom indicates the size of the module (4 bytes), the number of packets (14622), and the profile (Default).

No.	Time	Source	Destination	Protocol	Length	Info
401	0.054347	192.168.0.1	192.168.0.100	TCP	1514	80 → 57557 [ACK] Seq=436541 Ack=1 Win=501 Len=
402	0.054421	192.168.0.100	192.168.0.1	TCP	54	57557 → 80 [ACK] Seq=1 Ack=438001 Win=4106 Len=
403	0.054977	192.168.0.1	192.168.0.100	TCP	1514	80 → 57557 [ACK] Seq=438001 Ack=1 Win=501 Len=
404	0.054977	192.168.0.1	192.168.0.100	TCP	1514	80 → 57557 [ACK] Seq=439461 Ack=1 Win=501 Len=
405	0.054977	192.168.0.1	192.168.0.100	TCP	1514	80 → 57557 [ACK] Seq=440921 Ack=1 Win=501 Len=
406	0.054977	192.168.0.1	192.168.0.100	TCP	1514	80 → 57557 [ACK] Seq=442381 Ack=1 Win=501 Len=
407	0.054977	192.168.0.1	192.168.0.100	TCP	1514	80 → 57557 [ACK] Seq=443841 Ack=1 Win=501 Len=
408	0.055605	192.168.0.1	192.168.0.100	TCP	1514	80 → 57557 [ACK] Seq=445301 Ack=1 Win=501 Len=
409	0.055605	192.168.0.1	192.168.0.100	TCP	1514	80 → 57557 [ACK] Seq=446761 Ack=1 Win=501 Len=
410	0.055605	192.168.0.1	192.168.0.100	TCP	1514	80 → 57557 [ACK] Seq=448221 Ack=1 Win=501 Len=
411	0.055605	192.168.0.1	192.168.0.100	TCP	239	80 → 57557 [PSH, ACK] Seq=449681 Ack=1 Win=501 Len=
412	0.055605	192.168.0.1	192.168.0.100	IPv4	1514	Fragmented IP protocol (proto=UDP 17, off=0, I
413	0.055605	192.168.0.1	192.168.0.100	IPv4	1514	Fragmented IP protocol (proto=UDP 17, off=1480
414	0.055783	192.168.0.100	192.168.0.1	TCP	54	57557 → 80 [ACK] Seq=1 Ack=449681 Win=4106 Len=
415	0.056238	192.168.0.1	192.168.0.100	IPv4	1514	Fragmented IP protocol (proto=UDP 17, off=2960
416	0.056238	192.168.0.1	192.168.0.100	IPv4	1514	Fragmented IP protocol (proto=UDP 17, off=4440
417	0.056238	192.168.0.1	192.168.0.100	IPv4	1514	Fragmented IP protocol (proto=UDP 17, off=5920
418	0.056238	192.168.0.1	192.168.0.100	IPv4	1514	Fragmented IP protocol (proto=UDP 17, off=7400

Wireshark Compact dissector



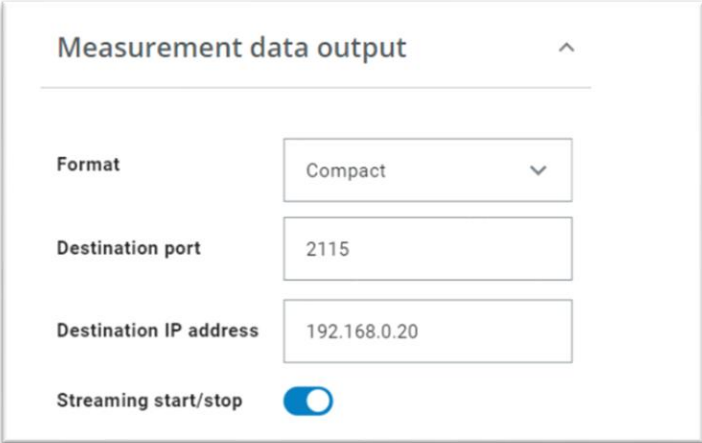
```
Frame 25: 882 bytes on wire (7056 bits), 882 bytes captured (7056 bits) on interface \Device\NPF_...
Ethernet II, Src: Sick_59:89:90 (00:06:77:59:89:90), Dst: Dell_84:c3:be (74:78:27:84:c3:be)
Internet Protocol Version 4, Src: 192.168.0.1, Dst: 192.168.0.100
User Datagram Protocol, Src Port: 51551, Dst Port: 2115
Compact Protocol
  Header
    Start Of Frame\t\t: 0x02020202
    Command Id\t\t\t: 1
    Telegram Counter\t\t: 1439
    Time Stamp Transmit\t\t: Jan 1, 1970 00:22:47.572635000 UTC
    Telegram Version\t\t: 4
    Size of Module 0\t\t: 3390 Bytes
  > Module 0
  > Module 1
  > Module 2
  > Module 3
  > CRC
0000 c9 5f 08 43 37 58 93 2a 02 02 02 02 01 00 00 00  .._C7X* .....
0010 9f 05 00 00 00 00 00 00 9b 80 83 51 00 00 00 00  .....Q...
0020 04 00 00 00 3e 0d 00 00 02 00 00 00 00 00 00 00  .....>.....
0030 64 6a 00 00 00 00 00 00 9a 6e 6f 01 07 00 00 00  dj.....no...
0040 1e 00 00 00 03 00 00 00 53 62 83 51 00 00 00 00  .....SbQ...
0050 53 62 83 51 00 00 00 00 53 62 83 51 00 00 00 00  SbQ....SbQ...
0060 53 62 83 51 00 00 00 00 53 62 83 51 00 00 00 00  SbQ....SbQ...
0070 53 62 83 51 00 00 00 00 53 62 83 51 00 00 00 00  SbQ....SbQ...
0080 07 72 83 51 00 00 00 00 07 72 83 51 00 00 00 00  rQ....rQ...
0090 07 72 83 51 00 00 00 00 07 72 83 51 00 00 00 00  rQ....rQ...
00a0 07 72 83 51 00 00 00 00 07 72 83 51 00 00 00 00  rQ....rQ...
00b0 07 72 83 51 00 00 00 00 2c dd cb 3e ec f3 9d 3e  rQ....,>...
00c0 79 a7 61 3e 1b 14 07 3e 1a 02 38 3d 66 af 25 bd  y>...>...8=f...
00d0 e2 61 00 be 77 87 0b c0 d4 d5 17 c0 84 ab 1b c0  a..w...
00e0 72 4f f4 bf 20 35 1b c0 18 13 17 c0 9c 8c 0b c0  r0...5...
00f0 8e 45 d6 bf 48 e2 ee bf a7 8d f6 bf 13 86 b3 bf  E..H...
0100 e0 a0 f5 bf d1 5c ed bf d9 4f d6 bf 00 00 80 3f  ....\...0...
0110 3e 0d 00 00 01 03 03 00 b2 00 7f 9f 00 00 00 00  >.....
0120 00 00 00 00 00 97 13 f9 00 ff ab 00 00 00 00 00  .....
0130 00 00 00 00 ac 0f 46 01 7f a4 00 00 00 00 00 00  .....F...
0140 00 00 00 73 0e 0f 01 ff 71 00 00 00 00 00 00 00  ...s...q...
0150 00 00 1e 19 00 00 00 00 00 00 00 00 00 00 00 00  .....
0160 00 99 0e 85 07 7f 9f 00 00 00 00 00 00 00 00 00  .....
0170 ea 0f 95 04 7f 9e 00 00 00 00 00 00 00 00 95  .....
0180 13 b4 00 7f a0 00 00 00 00 00 00 00 00 00 f2 13  .....
0190 fa 00 7f ac 00 00 00 00 00 00 00 00 00 00 07 10 48  .....
01a0 01 7f a2 00 00 00 00 00 00 00 00 00 ce 0e f8 00  .....
01b0 7f a4 00 00 00 00 00 00 00 00 00 79 19 b5 01 ff  .....y...
01c0 53 00 00 00 00 00 00 00 00 f4 0e ba 06 7f 94  S.....
01d0 00 00 00 00 00 00 00 00 00 45 10 b7 04 ff 9b 00  .....E...
01e0 00 00 00 00 00 00 00 00 f0 13 b1 00 7f 9f 00 00  .....
01f0 00 00 00 00 00 00 00 00 14 f1 00 7f a9 00 00 00  .....M...
0200 00 00 00 00 00 00 62 10 4b 01 ff a0 00 00 00 00  .....b.K...
0210 00 00 00 00 29 0f ea 00 7f a4 00 00 00 00 00 00  .....)....
0220 00 00 00 00 d4 19 ad 01 7f 22 00 00 00 00 00 00  .....".
0230 00 00 00 4f 0f 41 07 7f a0 00 00 00 00 00 00 00  ...O.A...
0240 00 00 a0 10 e3 04 7f a3 00 00 00 00 00 00 00 00  .....
0250 00 4b 14 b2 00 7f 0f 00 00 00 00 00 00 00 00  .....v.....
```

Split the package into the single information

Jump into wireshark

Sensor setup

1. Connect sensor to pc.
2. Open a browser and the IP address of the device.
3. Set up your device to output Compact format via UDP.
4. Change Destination IP address to the IP address of your pc.



Measurement data output

Format: Compact

Destination port: 2115

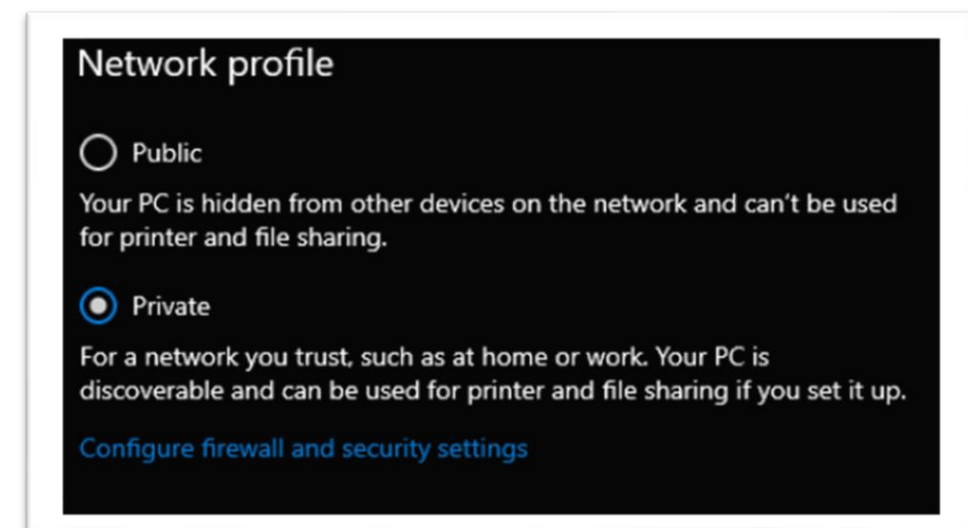
Destination IP address: 192.168.0.20

Streaming start/stop:

5. Make sure the ethernet settings of your PC are correct (network needs to be "private")

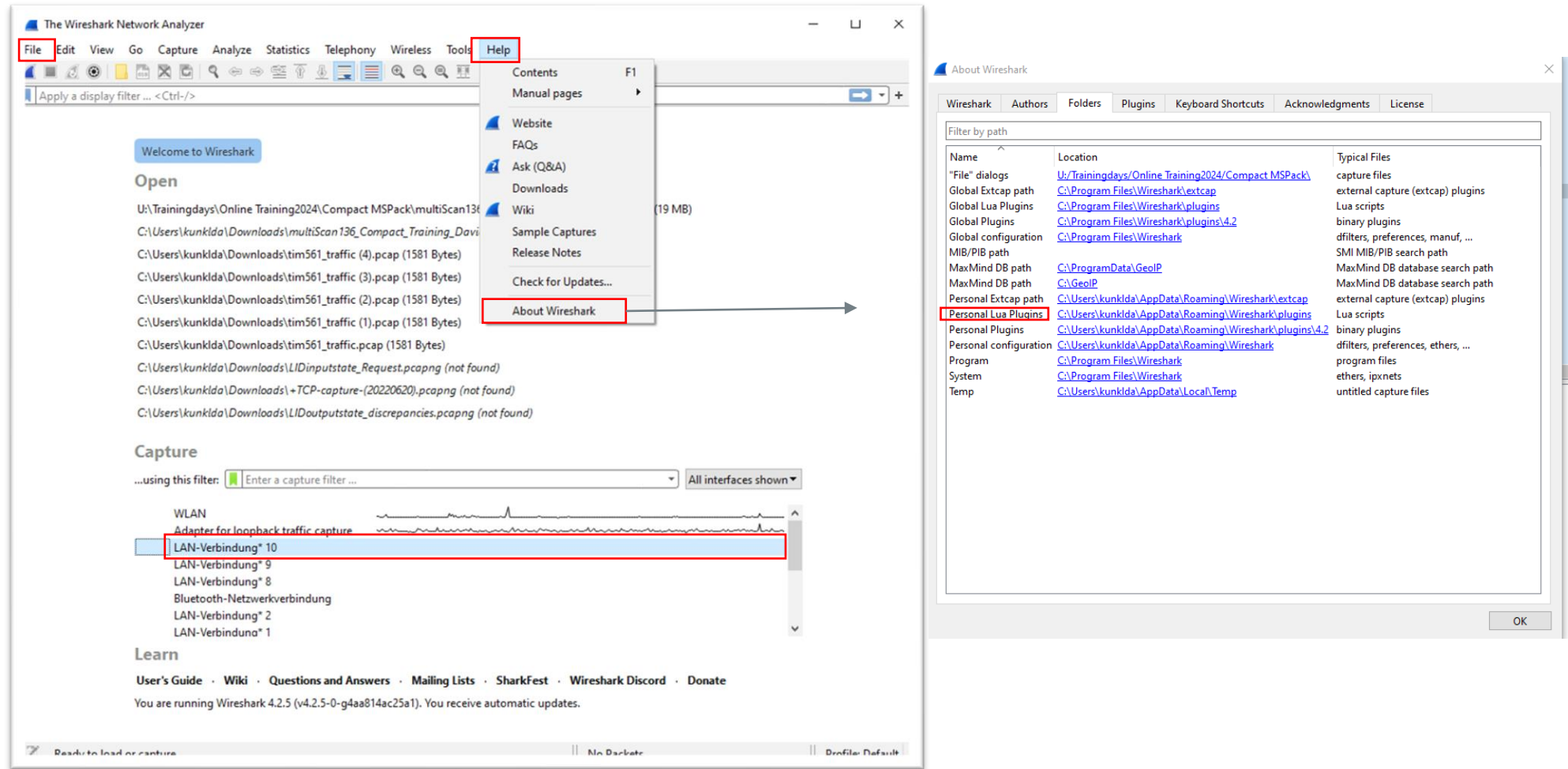
or with command line tool: 'get-NetConnectionProfile'

```
change ethernet connection  
'Set-NetConnectionProfile -InterfaceIndex 18 -  
NetworkCategory Private'
```



Some hints

Installing wireshark plug in

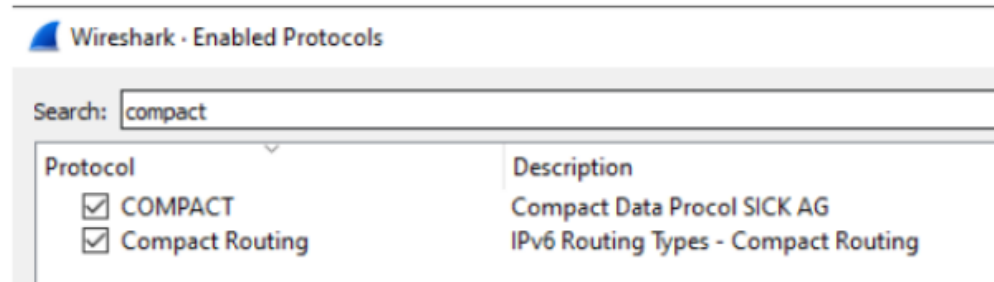
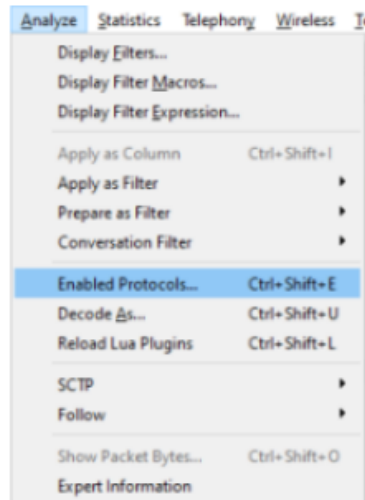


Enable plug in

- To disable the plugin use Analyze --> Enable Protocols --> uncheck

Enable/disable in GUI:

Analyze→Enabled Protocols...



Hands on

TASK 1

- › Installing wireshark <https://www.wireshark.org/download.html>
- › Installing the COMPACT wirshark plug-in <https://support.sick.com/sick-knowledgebase/article/?code=KA-08425>
- › With device: Open the device connection (just a couple of seconds)
 Without device: Open a .pcap file (see attachments)

Summary Compact

General

- Packed data with minimum overhead
- Easy to extract data from raw dumps
- Each Compact message **Header** and a **CRC**
- Depending on the device, a Segment may have more than one **Module**
- **MetaData** contain general information about the angle, time size and echos of the Segment
- **MeasurementData** contain the measured distance and RSSI value per echo plus properties and the theta value of the Beam