Vendor-Independent Testing Tools
Ease of Use, Performance, and Tools Integration

Fred Steinhauser

IEC 61850 Europe 2017

Overview

Tools Evolution – where we are today

Ease of Use

Performance

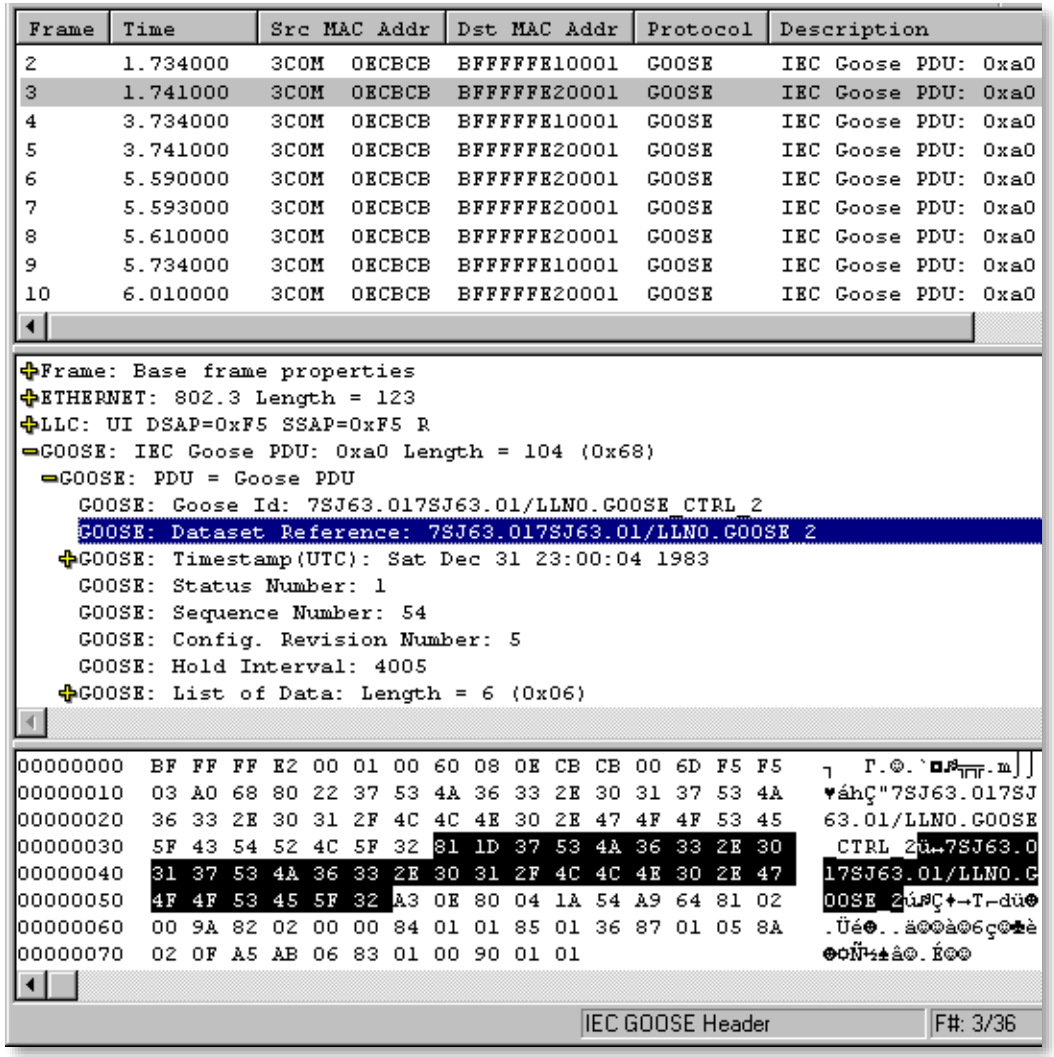
Tools Integration

GOOSE Hex Dumps

Protocol analyzers

Plug-ins

ca. 2002



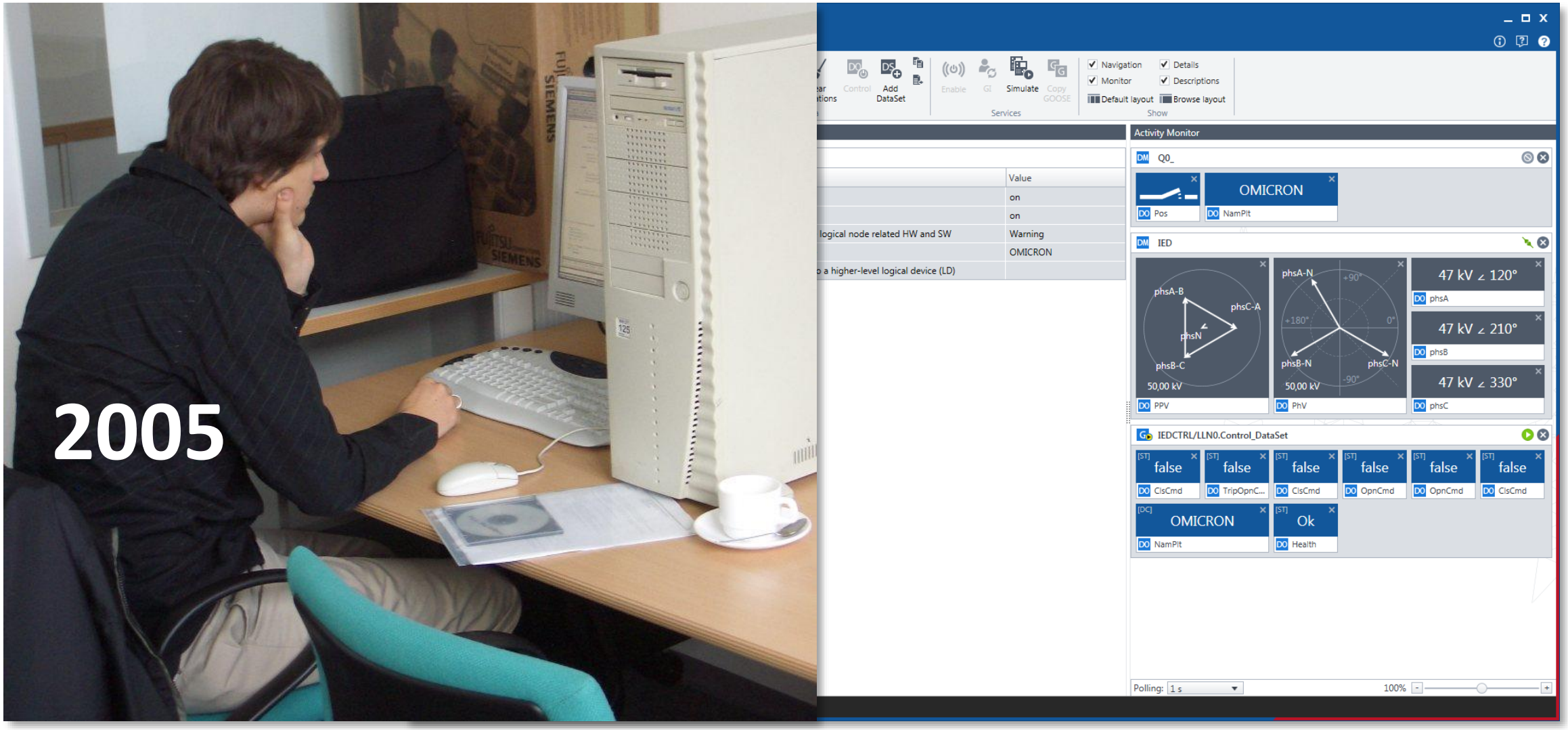
Frame	Time	Src MAC Addr	Dst MAC Addr	Protocol	Description
2	1.734000	3COM 0ECBCB	BFFFFFE10001	GOOSE	IEC Goose PDU: 0xa0
3	1.741000	3COM 0ECBCB	BFFFFFE20001	GOOSE	IEC Goose PDU: 0xa0
4	3.734000	3COM 0ECBCB	BFFFFFE10001	GOOSE	IEC Goose PDU: 0xa0
5	3.741000	3COM 0ECBCB	BFFFFFE20001	GOOSE	IEC Goose PDU: 0xa0
6	5.590000	3COM 0ECBCB	BFFFFFE20001	GOOSE	IEC Goose PDU: 0xa0
7	5.593000	3COM 0ECBCB	BFFFFFE20001	GOOSE	IEC Goose PDU: 0xa0
8	5.610000	3COM 0ECBCB	BFFFFFE20001	GOOSE	IEC Goose PDU: 0xa0
9	5.734000	3COM 0ECBCB	BFFFFFE10001	GOOSE	IEC Goose PDU: 0xa0
10	6.010000	3COM 0ECBCB	BFFFFFE20001	GOOSE	IEC Goose PDU: 0xa0

```
+Frame: Base frame properties
+ETHERNET: 802.3 Length = 123
+LLC: UI DSAP=0xF5 SSAP=0xF5 R
-GOOSE: IEC Goose PDU: 0xa0 Length = 104 (0x68)
 -GOOSE: PDU = Goose PDU
    GOOSE: Goose Id: 7SJ63.017SJ63.01/LLN0.GOOSE_CTRL_2
    GOOSE: Dataset Reference: 7SJ63.017SJ63.01/LLN0.GOOSE_2
  +GOOSE: Timestamp(UTC): Sat Dec 31 23:00:04 1983
    GOOSE: Status Number: 1
    GOOSE: Sequence Number: 54
    GOOSE: Config. Revision Number: 5
    GOOSE: Hold Interval: 4005
  +GOOSE: List of Data: Length = 6 (0x06)
```

```
00000000  BF FF FF E2 00 01 00 60 08 0E CB CB 00 6D F5 F5   ┐  Γ.☺.`◘♂╥╥.m⌡⌡
00000010  03 A0 68 80 22 37 53 4A 36 33 2E 30 31 37 53 4A   ♥áhÇ"7SJ63.017SJ
00000020  36 33 2E 30 31 2F 4C 4C 4E 30 2E 47 4F 4F 53 45   63.01/LLN0.GOOSE
00000030  5F 43 54 52 4C 5F 32 81 1D 37 53 4A 36 33 2E 30    CTRL_2ü↔7SJ63.0
00000040  31 37 53 4A 36 33 2E 30 31 2F 4C 4C 4E 30 2E 47   17SJ63.01/LLN0.G
00000050  4F 4F 53 45 5F 32 A3 0E 80 04 1A 54 A9 64 81 02   OOSE_2úº Ç♦→T⌐dü☻
00000060  00 9A 82 02 00 00 84 01 01 85 01 36 87 01 05 8A   .Üé☻..ä☺☺à☺6ç☺♣è
00000070  02 0F A5 AB 06 83 01 00 90 01 01                  ☻☼Ñ½▲â☺.É☺☺
```

IEC GOOSE Header | F#: 3/36

IEC 61850 Browser & Test Client

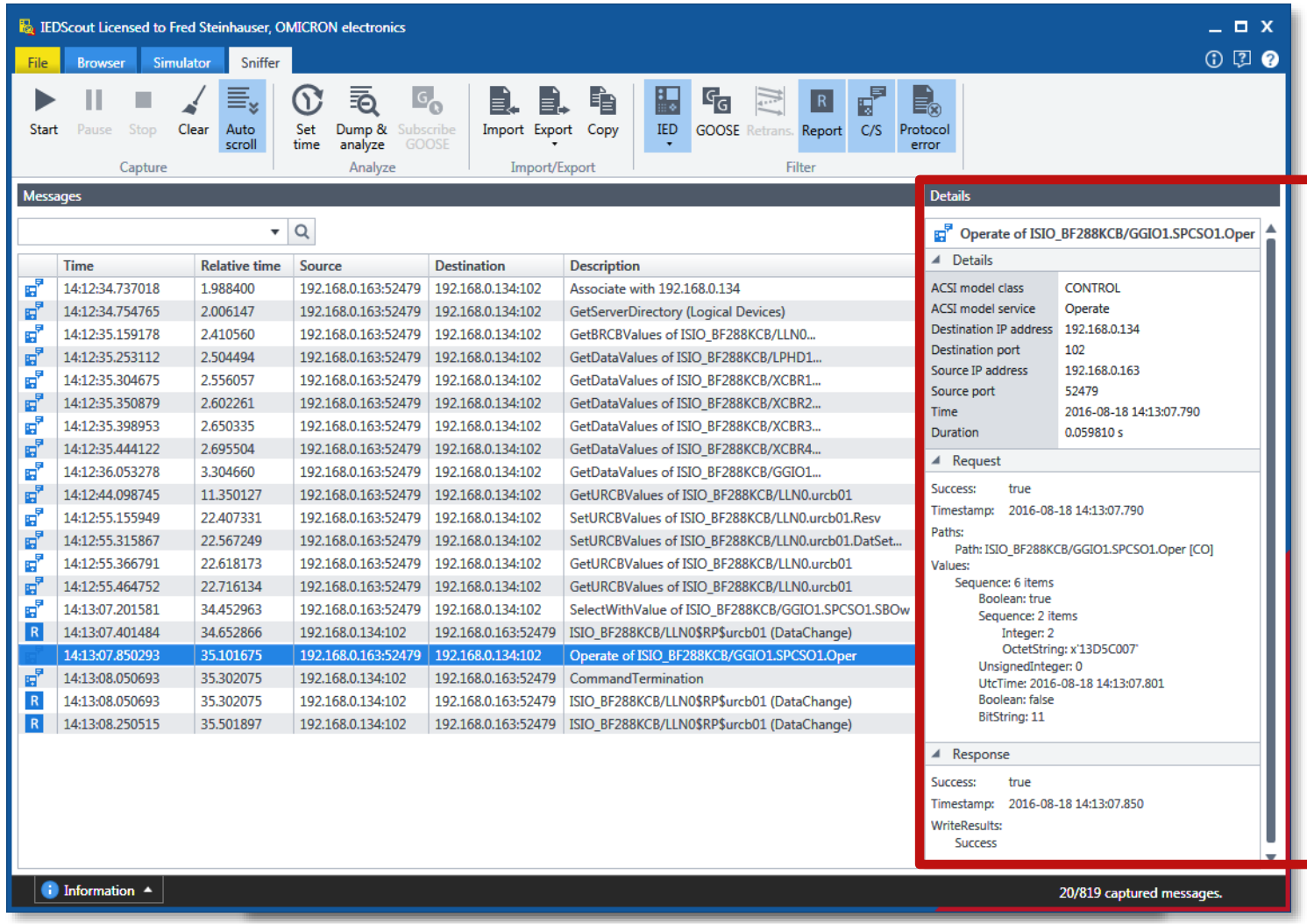


OMICRON

Generic Expert Tools vs. Application Oriented Tools

IEC 61850 Select-before-operate

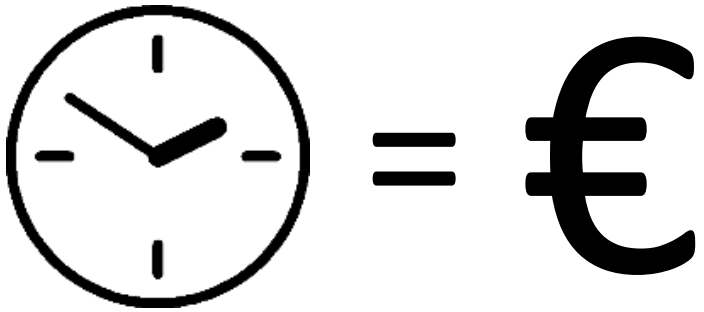
(SBOw)



Decoded IEC 61850 service related information

OMICRON

Ease of Use



Efficiency

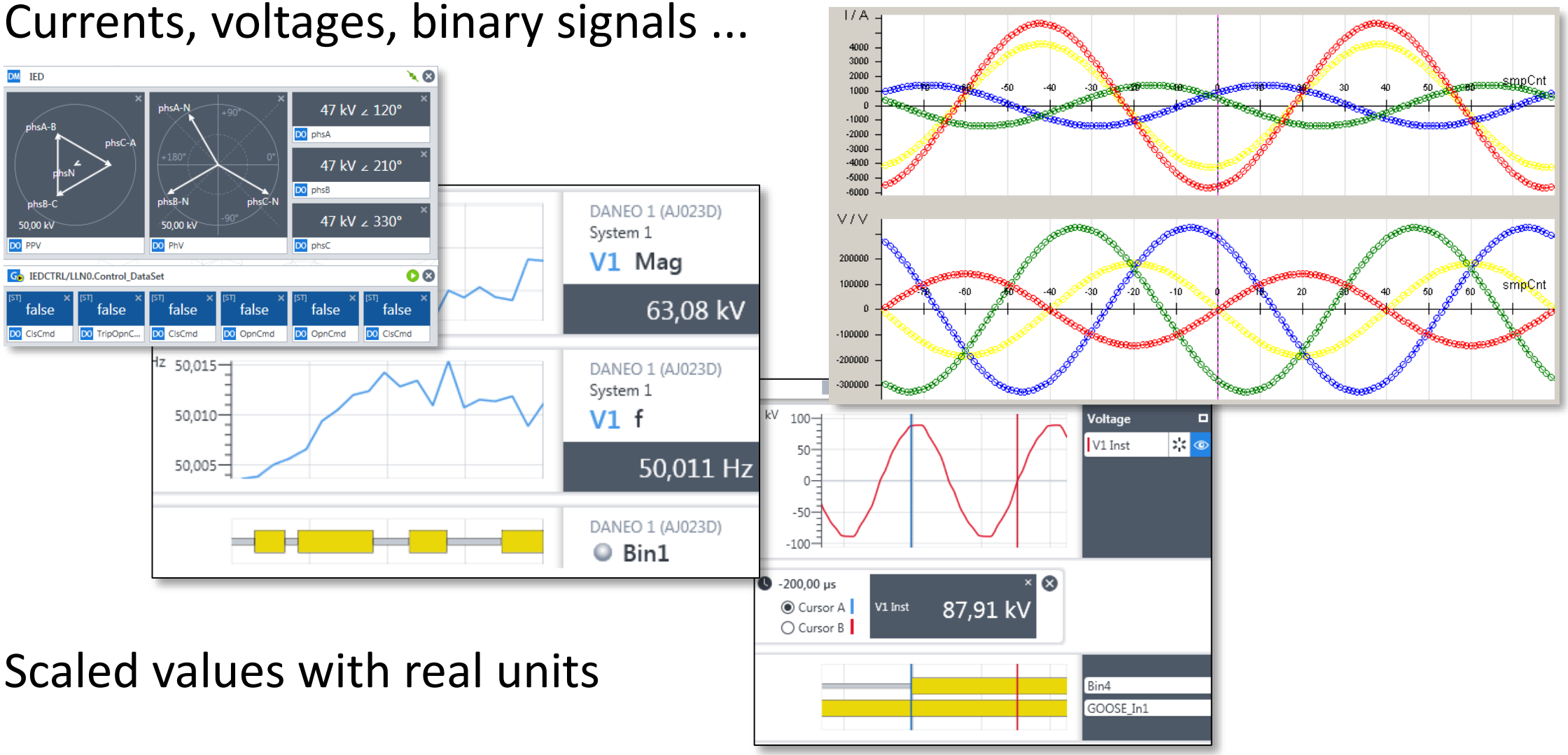
- Gentle learning curve
- Get your job done quickly

Obviousness

- See clearly what is going on
- Avoid errors
- Get it right the first time

Use Terms and Language of the User

Currents, voltages, binary signals ...



Scaled values with real units

OMICRON

Performance

Speed of execution

- Parsing of SCL files
- Simulating many IEDs
- Connecting to many IEDs

Measurement accuracy

- Timing measurements
- Process bus

Contributors in Timing Measurements

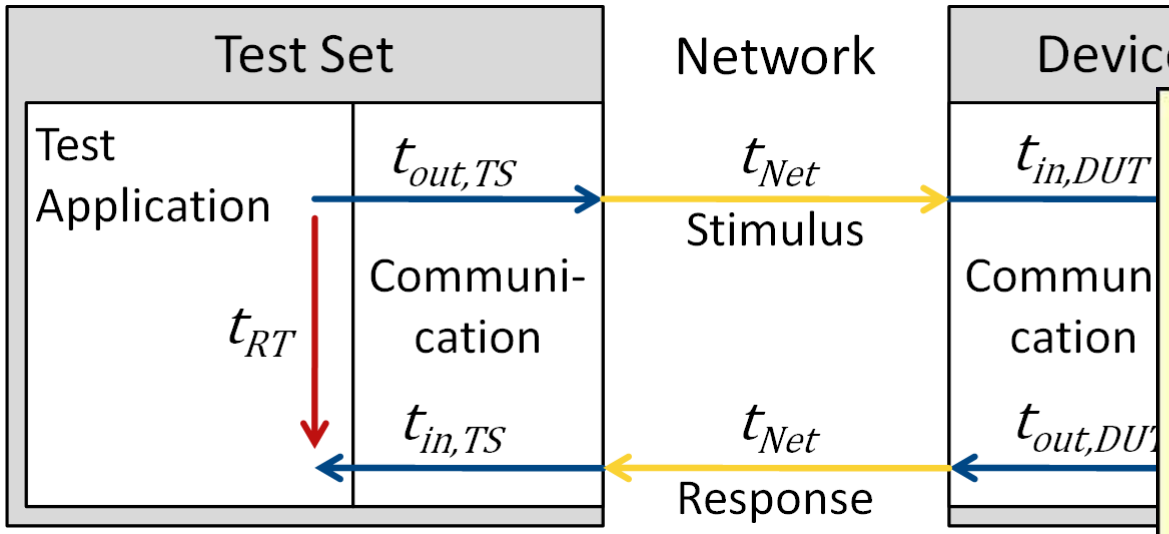
Influencing factors

- Time behavior of device under test
  - To be measured
- Time behavior of test equipment
  - Should be superior to be of minor influence
- Time behavior of test environment
  - Should be minimized

Error propagation

- Combines influencing factors

Classical GOOSE Ping-Pong Test



GOOSE Performance Calculation Summary

Average value $\bar{t}$ and standard deviation σ

Calculating DUT performance:

$$\bar{t}_{DUT} = \frac{\bar{t}_{RT}}{2} - \bar{t}_{TS}\,, \quad \sigma_{DUT} = \sqrt{\frac{\sigma_{RT}^2}{2} - \sigma_{TS}^2}$$

Calibrating the test set:

$$\bar{t}_{TS} = \frac{\bar{t}_{RT}}{4}\,, \quad \sigma_{TS} = \frac{\sigma_{RT}}{2}$$

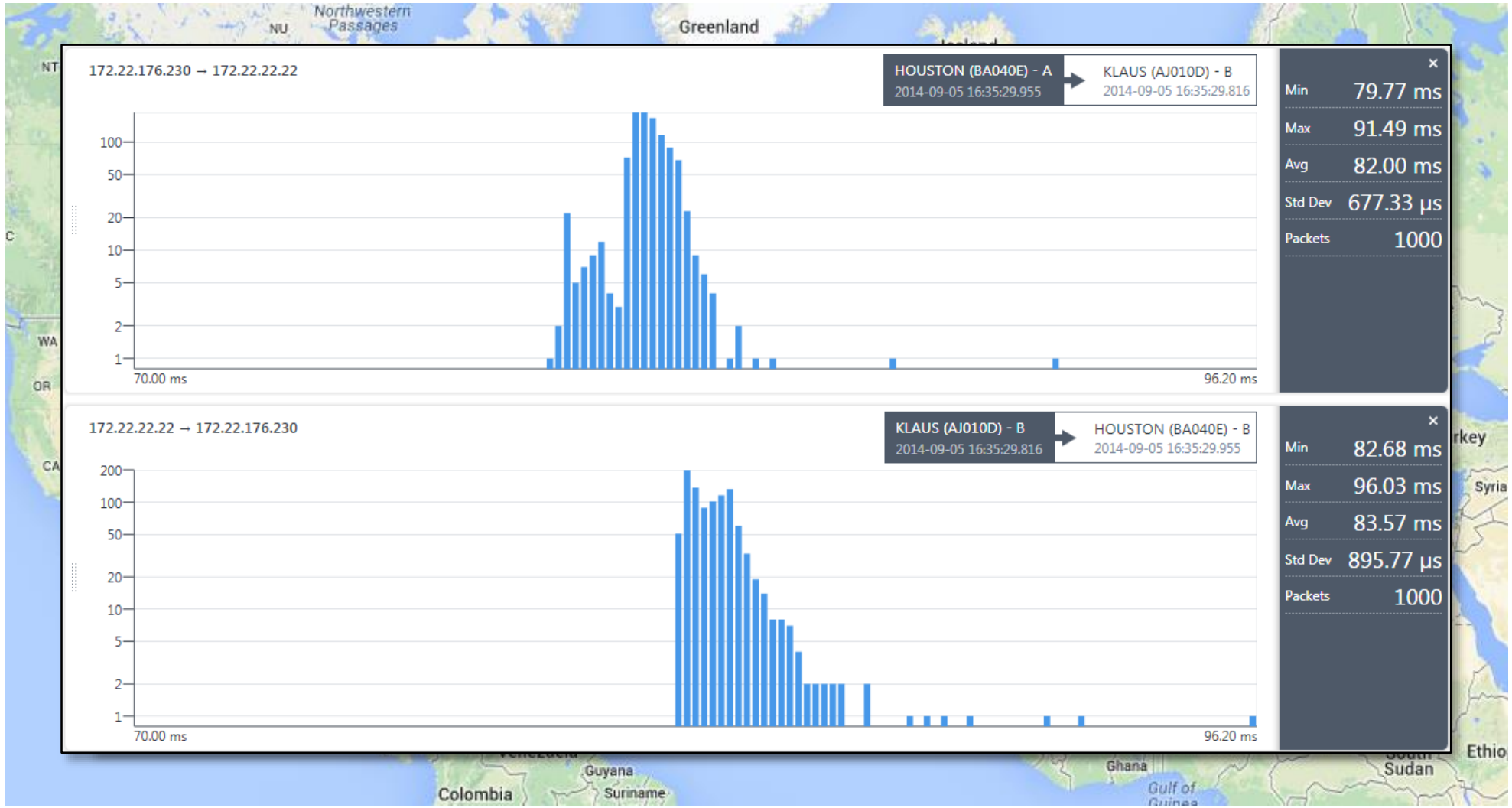
Confidence interval: $\left[\bar{t} - k \cdot \sigma\,,\ \bar{t} + k \cdot \sigma\right]$

$k \approx 4$ for 99.99% confidence

$k \approx 2.6$ for 99% confidence

Maximum rating: $\bar{t} + k \cdot \sigma$

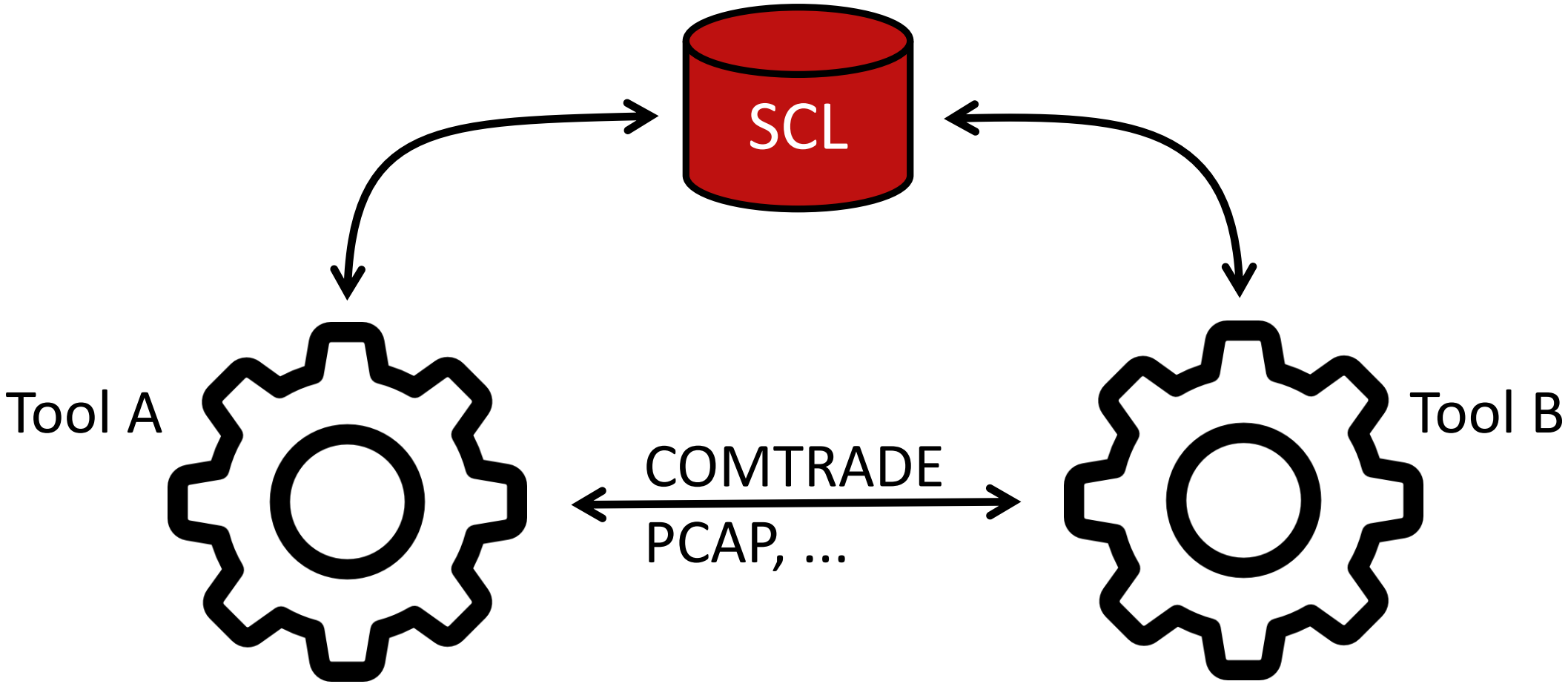
Wide Area Timing Measurements



Map data © 2014 Google. Draft Logic distance calculator © 2014 draftlogic.com

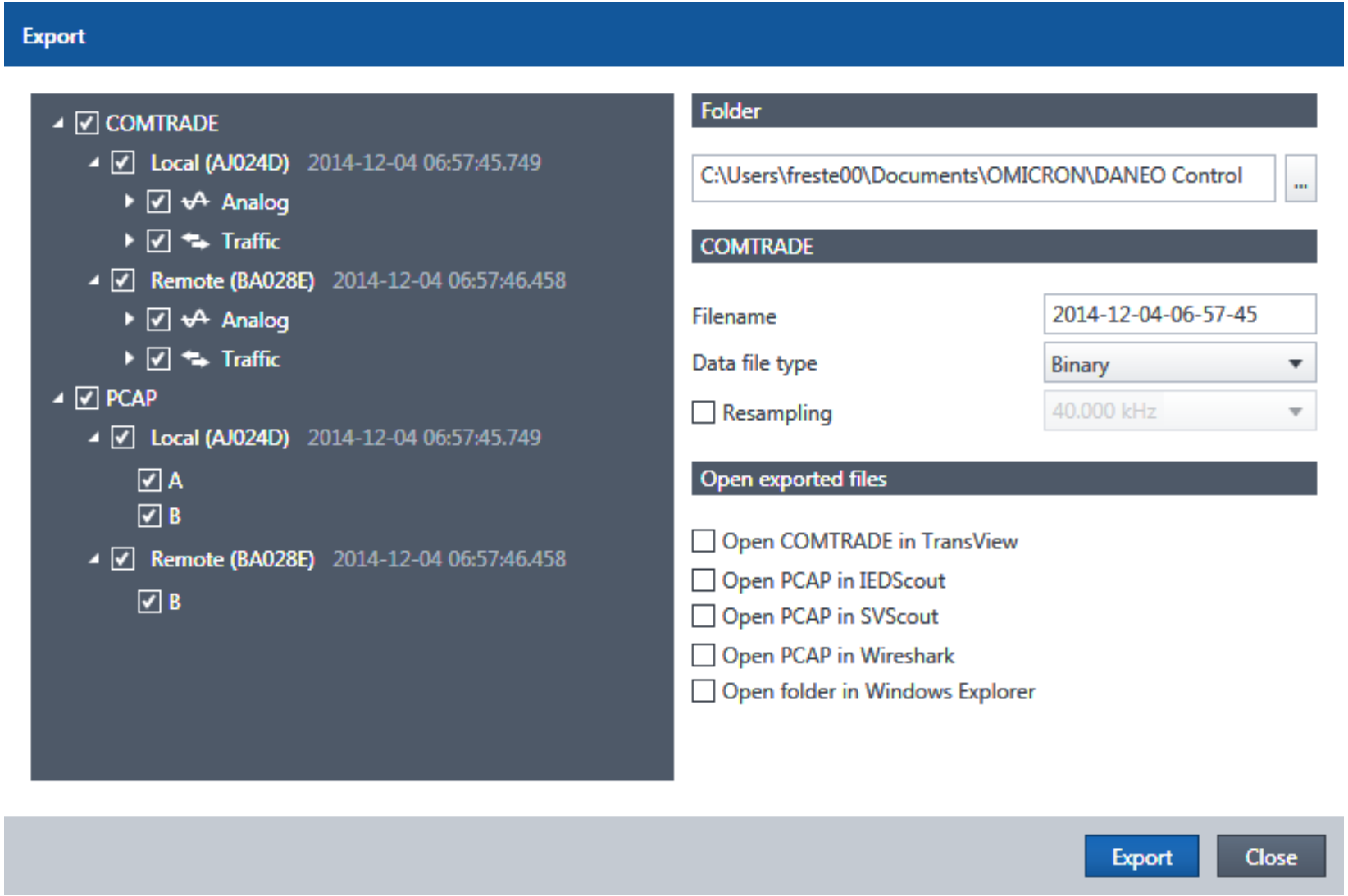
Guaranteed Performance through dedicated Hardware

Tools Integration with Open Interfaces



Icon designed by Gregor Cresnar from Flaticon

Tools Integration



Summary

Ease of Use is not just nice – it means efficiency

Performance is essential for test & measurement tools

Tools Integration provides additional value

Thank You for Your Attention !

fred.steinhauser@omicronenergy.com

www.linkedin.com/in/fredsteinhauser