



Vendor-Independent Testing Tools

Ease of Use, Performance, and Tools Integration

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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	BFFFFFFE10001	GOOSE	IEC Goose PDU: 0xa0
3	1.741000	3COM 0ECBCB	BFFFFFFE20001	GOOSE	IEC Goose PDU: 0xa0
4	3.734000	3COM 0ECBCB	BFFFFFFE10001	GOOSE	IEC Goose PDU: 0xa0
5	3.741000	3COM 0ECBCB	BFFFFFFE20001	GOOSE	IEC Goose PDU: 0xa0
6	5.590000	3COM 0ECBCB	BFFFFFFE20001	GOOSE	IEC Goose PDU: 0xa0
7	5.593000	3COM 0ECBCB	BFFFFFFE20001	GOOSE	IEC Goose PDU: 0xa0
8	5.610000	3COM 0ECBCB	BFFFFFFE20001	GOOSE	IEC Goose PDU: 0xa0
9	5.734000	3COM 0ECBCB	BFFFFFFE10001	GOOSE	IEC Goose PDU: 0xa0
10	6.010000	3COM 0ECBCB	BFFFFFFE20001	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/LLNO.GOOSE CTRL 2
GOOSE: Dataset Reference: 7SJ63.017SJ63.01/LLNO.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)

Offset	Hex	ASCII
00000000	BF FF FF E2 00 01 00 60 08 0E CB CB 00 6D F5 F5	1 P. @. `P. m
00000010	03 A0 68 80 22 37 53 4A 36 33 2E 30 31 37 53 4A	ahc"7SJ63.017SJ
00000020	36 33 2E 30 31 2F 4C 4C 4E 30 2E 47 4F 4F 53 45	63.01/LLNO.GOOSE
00000030	5F 43 54 52 4C 5F 32 81 1D 37 53 4A 36 33 2E 30	CTRL 2u-7SJ63.0
00000040	31 37 53 4A 36 33 2E 30 31 2F 4C 4C 4E 30 2E 47	17SJ63.01/LLNO.G
00000050	4F 4F 53 45 5F 32 A3 0E 80 04 1A 54 A9 64 81 02	OOSE 2LPC+-T-dü@
00000060	00 9A 82 02 00 00 84 01 01 85 01 36 87 01 05 8A	.Üé@. .a@à@6ç@è
00000070	02 0F A5 AB 06 83 01 00 90 01 01	@N+à@.É@

IEC GOOSE Header F#: 3/36

IEC 61850 Browser & Test Client



	Value	Warning
	on	
	on	
logical node related HW and SW		Warning
to a higher-level logical device (LD)		OMICRON

Activity Monitor

DM QO_

OMICRON

DO Pos DO NamPit

DM IED

phasA-B phsC-A phsN

phasB-C 50,00 kV

phasA-N +90° 47 kV ∠ 120°

+180° 0° DO phsA

phasB-N -90° 47 kV ∠ 210°

phasC-N DO phsB

DO PPV DO PhV DO phsC

IEDCTRL/LLN0.Control_DataSet

[ST] false [ST] false [ST] false [ST] false [ST] false [ST] false

DO ClsCmd DO TripOpnC... DO ClsCmd DO OpnCcmd DO OpnCcmd DO ClsCmd

OMICRON [ST] Ok

DO NamPit DO Health

Polling: 1 s 100%

Generic Expert Tools vs. Application Oriented Tools

IEC 61850 Select-before-operate

(SBOw)

The screenshot shows the IEDScout software interface. The main window displays a list of messages in a table. The selected message is 'Operate of ISIO_BF288KCB/GGIO1.SPCS01.Oper'. A detailed view of this message is shown in a side panel, highlighting the request and response details.

Time	Relative time	Source	Destination	Description
14:12:34.737018	1.988400	192.168.0.163:52479	192.168.0.134:102	Associate with 192.168.0.134
14:12:34.754765	2.006147	192.168.0.163:52479	192.168.0.134:102	GetServerDirectory (Logical Devices)
14:12:35.159178	2.410560	192.168.0.163:52479	192.168.0.134:102	GetBRCBValues of ISIO_BF288KCB/LLN0...
14:12:35.253112	2.504494	192.168.0.163:52479	192.168.0.134:102	GetDataValues of ISIO_BF288KCB/LPHD1...
14:12:35.304675	2.556057	192.168.0.163:52479	192.168.0.134:102	GetDataValues of ISIO_BF288KCB/XCBR1...
14:12:35.350879	2.602261	192.168.0.163:52479	192.168.0.134:102	GetDataValues of ISIO_BF288KCB/XCBR2...
14:12:35.398953	2.650335	192.168.0.163:52479	192.168.0.134:102	GetDataValues of ISIO_BF288KCB/XCBR3...
14:12:35.444122	2.695504	192.168.0.163:52479	192.168.0.134:102	GetDataValues of ISIO_BF288KCB/XCBR4...
14:12:36.053278	3.304660	192.168.0.163:52479	192.168.0.134:102	GetDataValues of ISIO_BF288KCB/GGIO1...
14:12:44.098745	11.350127	192.168.0.163:52479	192.168.0.134:102	GetURCBValues of ISIO_BF288KCB/LLN0.urb01
14:12:55.155949	22.407331	192.168.0.163:52479	192.168.0.134:102	SetURCBValues of ISIO_BF288KCB/LLN0.urb01.Resv
14:12:55.315867	22.567249	192.168.0.163:52479	192.168.0.134:102	SetURCBValues of ISIO_BF288KCB/LLN0.urb01.DatSet...
14:12:55.366791	22.618173	192.168.0.163:52479	192.168.0.134:102	GetURCBValues of ISIO_BF288KCB/LLN0.urb01
14:12:55.464752	22.716134	192.168.0.163:52479	192.168.0.134:102	GetURCBValues of ISIO_BF288KCB/LLN0.urb01
14:13:07.201581	34.452963	192.168.0.163:52479	192.168.0.134:102	SelectWithValue of ISIO_BF288KCB/GGIO1.SPCS01.SBOw
14:13:07.401484	34.652866	192.168.0.134:102	192.168.0.163:52479	ISIO_BF288KCB/LLN0\$RP\$urcb01 (DataChange)
14:13:07.850293	35.101675	192.168.0.163:52479	192.168.0.134:102	Operate of ISIO_BF288KCB/GGIO1.SPCS01.Oper
14:13:08.050693	35.302075	192.168.0.134:102	192.168.0.163:52479	CommandTermination
14:13:08.050693	35.302075	192.168.0.134:102	192.168.0.163:52479	ISIO_BF288KCB/LLN0\$RP\$urcb01 (DataChange)
14:13:08.250515	35.501897	192.168.0.134:102	192.168.0.163:52479	ISIO_BF288KCB/LLN0\$RP\$urcb01 (DataChange)

Details

Operate of ISIO_BF288KCB/GGIO1.SPCS01.Oper

Details

- ACSI model class: CONTROL
- ACSI model service: Operate
- Destination IP address: 192.168.0.134
- Destination port: 102
- Source IP address: 192.168.0.163
- Source port: 52479
- Time: 2016-08-18 14:13:07.790
- Duration: 0.059810 s

Request

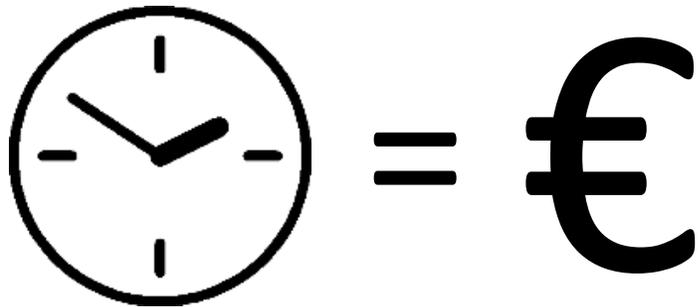
- Success: true
- Timestamp: 2016-08-18 14:13:07.790
- Paths:
 - Path: ISIO_BF288KCB/GGIO1.SPCS01.Oper [CO]
- Values:
 - Sequence: 6 items
 - Boolean: true
 - Sequence: 2 items
 - Integer: 2
 - OctetString: x'13D5C007'
 - UnsignedInteger: 0
 - UtcTime: 2016-08-18 14:13:07.801
 - Boolean: false
 - BitString: 11

Response

- Success: true
- Timestamp: 2016-08-18 14:13:07.850
- WriteResults:
 - Success

Decoded
IEC 61850
service
related
information

Ease of Use



Efficiency

- Gentle learning curve
- Get your job done quickly

Obviousness

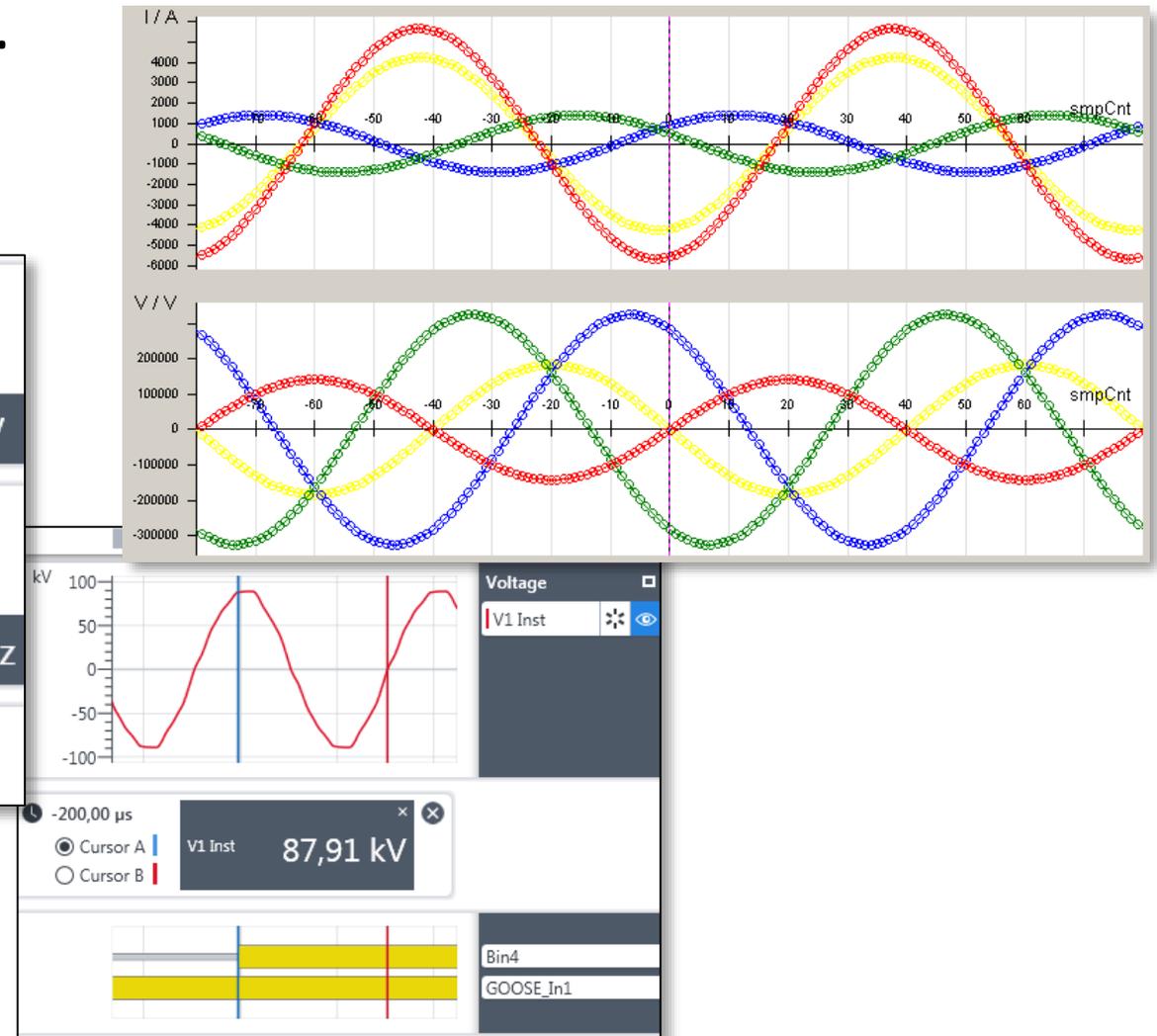
- See clearly what is going on
- Avoid errors
- Get it right the first time

Use Terms and Language of the User

Currents, voltages, binary signals ...



Scaled values with real units



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

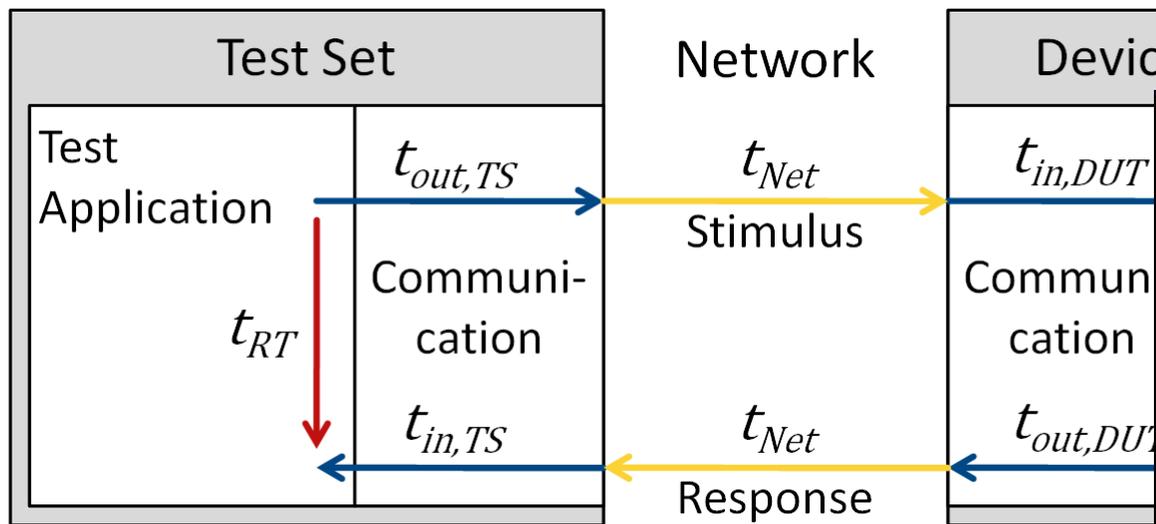
- Time behavior of device under test
 - To be measured
- Time behavior of test equipment
 - Should be superior to be of minor influence
- Time behavior of test environment
 - Should be minimized



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:

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

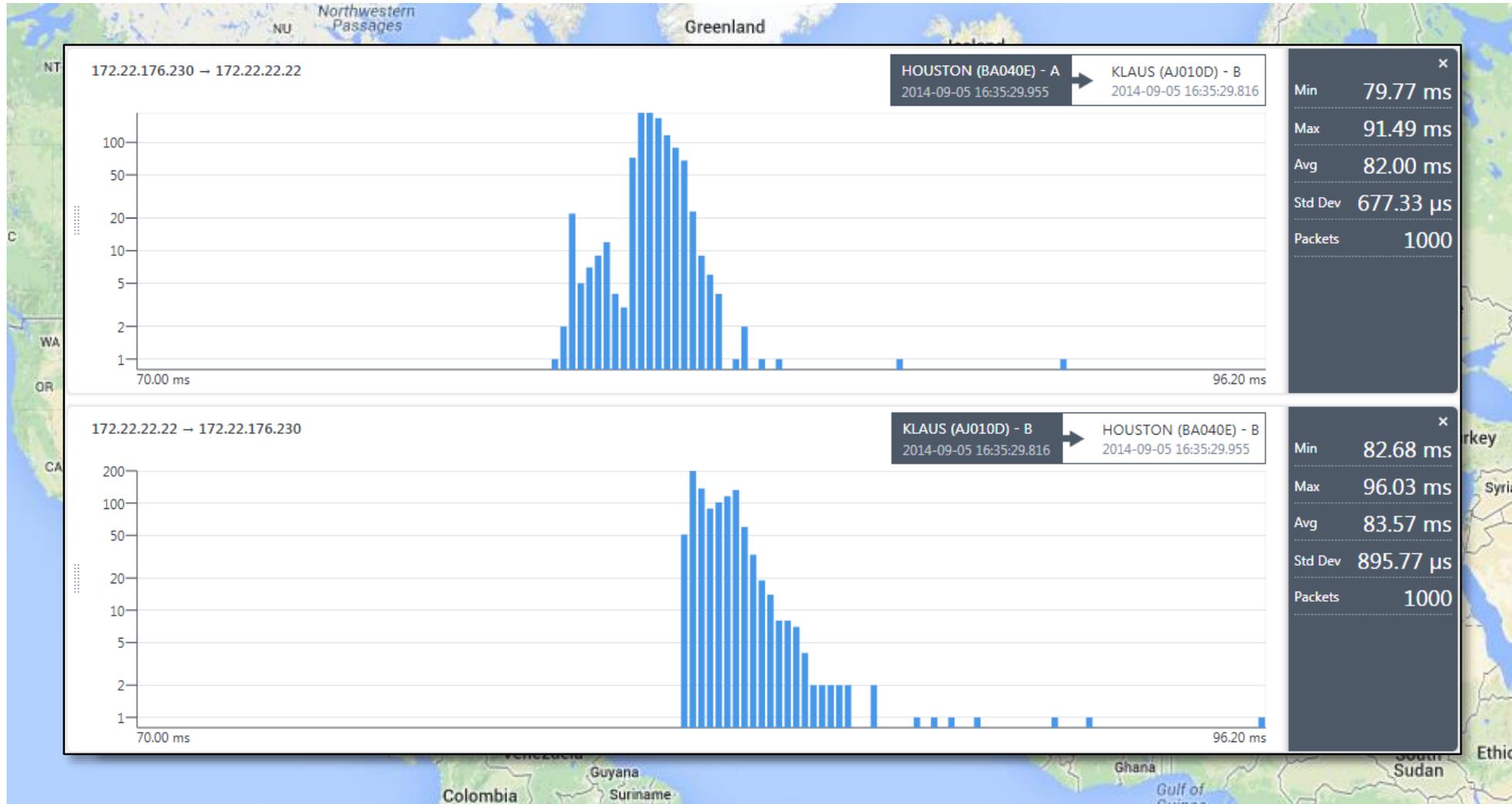
Confidence interval: $[\bar{t} - k \cdot \sigma, \bar{t} + k \cdot \sigma]$

$k \approx 4$ for 99.99% confidence

$k \approx 2.6$ for 99% confidence

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

Wide Area Timing Measurements

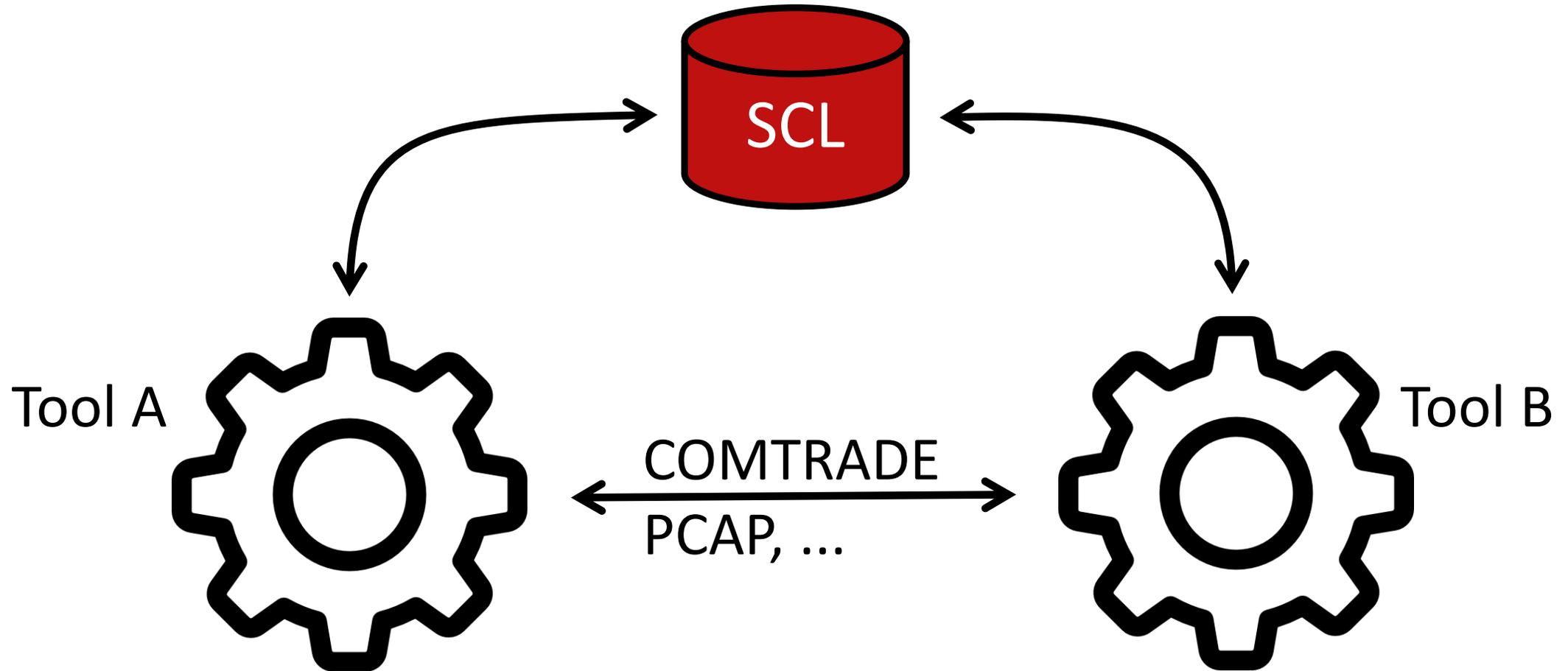


Map data © 2014 Google. Draft Logic distance calculator © 2014 draftlogic.com

Guaranteed Performance through dedicated Hardware



Tools Integration with Open Interfaces



Tools Integration

Export

- COMTRADE
 - Local (AJ024D) 2014-12-04 06:57:45.749
 - Analog
 - Traffic
 - Remote (BA028E) 2014-12-04 06:57:46.458
 - Analog
 - Traffic
- PCAP
 - Local (AJ024D) 2014-12-04 06:57:45.749
 - A
 - B
 - Remote (BA028E) 2014-12-04 06:57:46.458
 - B

Folder

C:\Users\frete00\Documents\OMICRON\DANEO Control

COMTRADE

Filename: 2014-12-04-06-57-45

Data file type: Binary

Resampling: 40.000 kHz

Open exported files

- Open COMTRADE in TransView
- Open PCAP in IEDScout
- Open PCAP in SVScout
- Open PCAP in Wireshark
- Open folder in Windows Explorer

Export **Close**

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 !

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