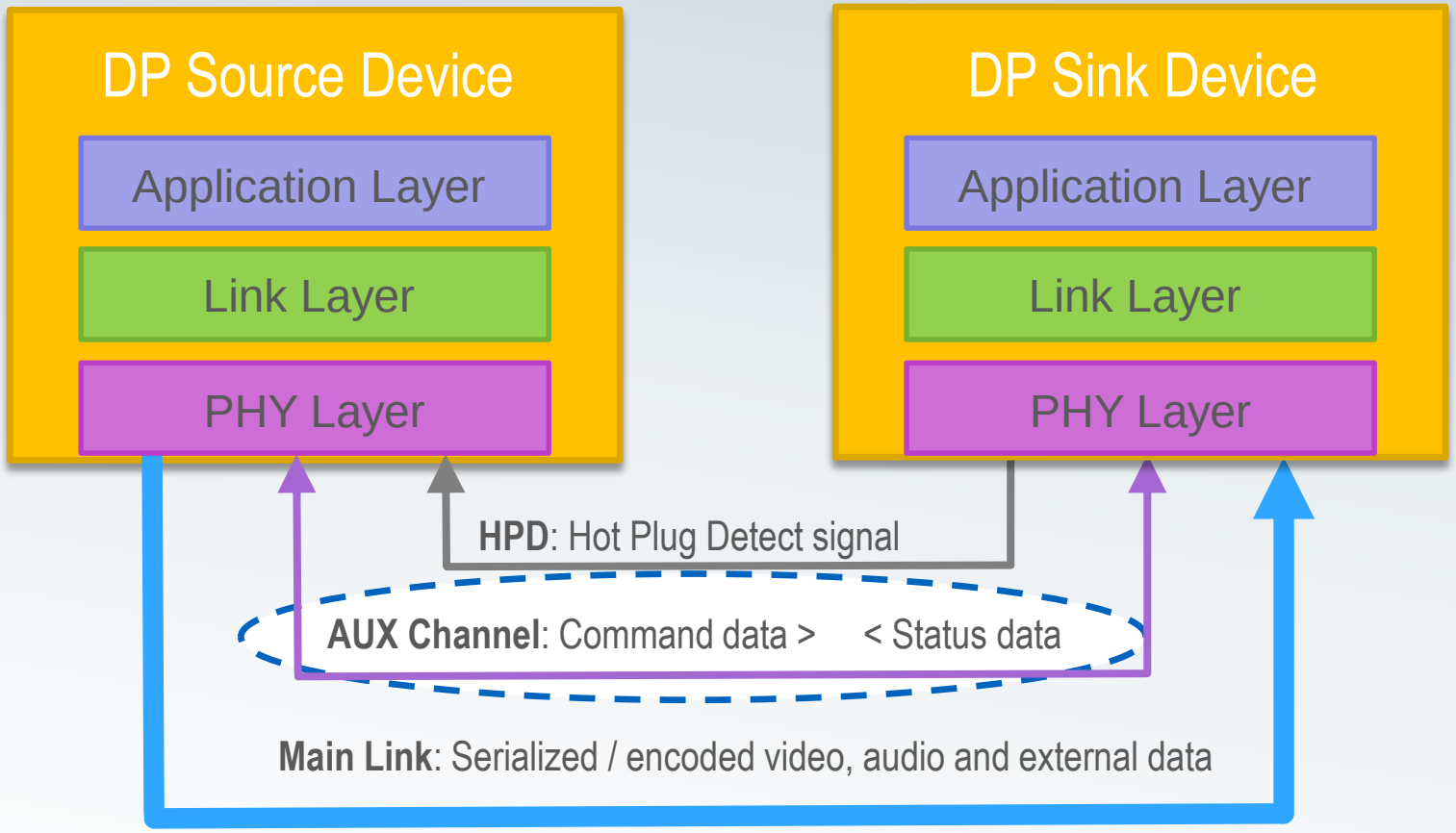
How to Monitor AUX Channel Communication of DisplayPort Interfaces

DisplayPort Interface



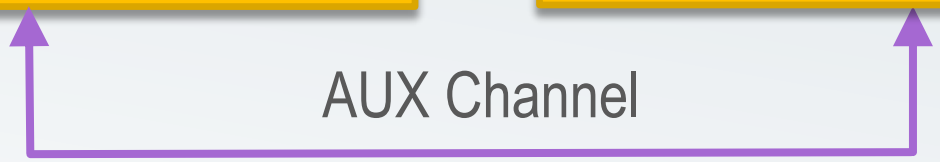
AUX Channel Topology

DP Source Device

- Master of the AUX Channel (called *AUX CH Requester*).
- Must initiate a *Request Transaction.*

DP Sink Device

- AUX Channel slave (*AUX CH Replier*).
- Responds with a *Reply Transaction.*



- Single differential pair.
- Half-duplex bidirectional operation.
- 1 Mbps using Manchester-II coding.

Use of AUX Channel

AUX Link Services

- Link Capability Read
- Link Configuration (training)
- Link Status Read

AUX Device Services

- EDID Read
- MCCS (Monitor Command and Control Set) support
- Sink Event Notification

Sideband Messaging

- Send & Receive Messages from Remote DP Nodes
- Report MST Status Changes and Errors

AUX Channel Protocol Example 1

Read from Sink DPCD

Source		Sink	
Req RD 1 byte from 0x00218	90 02 19 00	AUX ACK (1 byte)	00 00

Source: Read one byte of data from DPCD 0x00218

Sink: OK,

TEST_REQUEST (Test requested by the Sink device):
0x00218 := 0x00

- TEST_LINK_TRAINING = 0
- TEST_VIDEO_PATTERN = 0
- TEST_EDID_READ = 0
- PHY_TEST_PATTERN = 0
- FAUX_TEST_PATTERN = 0

Please refer to: DP v1.2a: 2.9.3.1 Address Mapping for Link Configuration/Management

AUX Channel Protocol Example 2

Write to Sink DPCD

Source		Sink	
Req WR 5 bytes to 0x00102	80 01 02 04 22 38 38 38 38	ACK	00

Source: Write 5 bytes of data to DPCD 0x00102
- TRAINING_PATTERN_SET (0x00102 := 0x22)
  - TRAINING_PATTERN_SET = 2 (Pattern 2)
  - RECOVERED_CLOCK_OUT_EN = 0
  - SCRAMBLING_DISABLE = 1
  - SYMBOL_ERROR_COUNT_SEL = 0 (Disparity and Illegal Symbol)
- TRAINING_LANE0_SET (Link Training Control, Lane 0)(0x00103 := 0x38)
  - VOLTAGE_SWING_SET = level 0
  - MAX_SWING_REACHED = 0
  - PRE_EMPHASIS_SET = level 3
  - MAX_PRE-EMPHASIS_REACHED = 1 etc. …

Sink: OK

Please refer to: DP v1.2a 2.9.3.1 Address Mapping for Link Configuration/Management

AUX Channel Protocol Example 3

Sideband Message - step 1 (Request)

Source		Sink	
Req WR 5 bytes to 0x01000	80 10 00 04 10 02 cb 01 d5	ACK	00

DOWN_REQ - REQ: LINK_ADDRESS
-- Sideband message header --
Link_Count_Total = 1
Link_Count_Remaining = 0
Broadcast_Message = 0
Path_Message = 0
MSG_Body_Length = 2
Start_Of_MT = 1
End_Of_MT = 1
Message_Sequence_No = 0

Please refer to: DP v1.2a 2.9.3.1 Address Mapping for Link Configuration/Management

AUX Channel Protocol Example 3

Sideband Message - step 2 (Enquire Reply)

Source		Sink	
Req RD 1 bytes from 0x02003	90 20 03 00	AUX_ACK - 1 bytes	00 10

DEVICE_SERVICE_IRQ_VECTOR_ESI0 [CLR] [1.2]
0x02003 := 0x10

(Reserved) REMOTE_CONTOL_COMMAND_PENDING = 0
AUTOMATED_TEST_REQUEST = 0
CP_IRQ = 0
MCCS_IRQ = 0
DOWN_REP_MSG_RDY = 1
UP_REQ_MSG_RDY = 0
SINK_SPECIFIC_IRQ = 0

Please refer to: DP v1.2a 2.9.3.1 Address Mapping for Link Configuration/Management

AUX Channel Protocol Example 3

Sideband Message - step 3 (Reply)

Source		Sink	
Req RD 16 bytes from 0x01410	90 14 10 0f	AUX_ACK - 16 bytes	00 22 93 1a 45 03 90 c0 4b 00 00 00 00 00 00 00 00

DOWN_REP - Message Transaction fragment
-- Sideband message header --
- Link_Count_Total = 1
- Link_Count_Remaining = 0
- Broadcast_Message = 0
- Path_Message = 0
- MSG_Body_Length = 21
- Start_Of_MT = 1
- End_Of_MT = 0
- Message_Sequence_No = 0

Etc. …

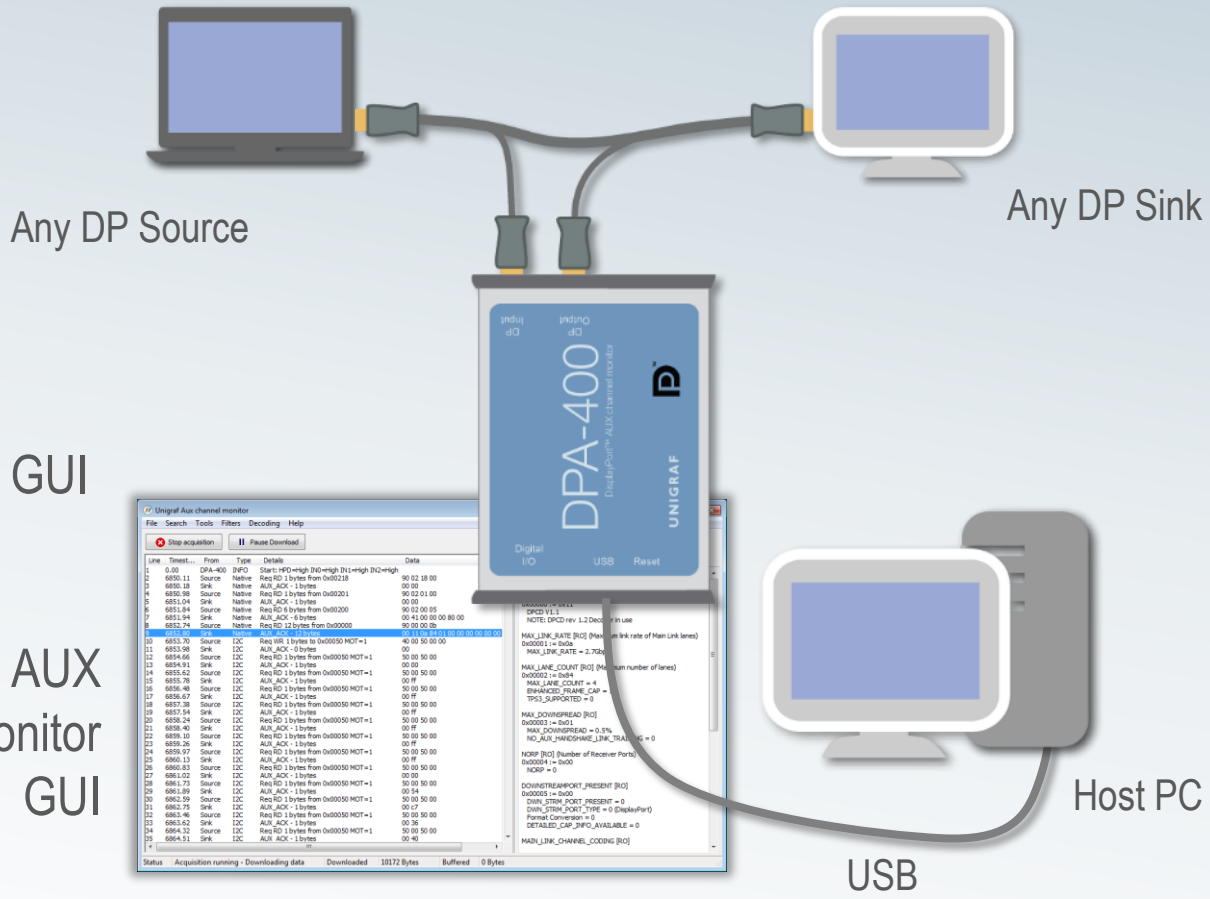
Please refer to: DP v1.2a 2.9.3.1 Address Mapping for Link Configuration/Management

UNIGRAF

AUX Monitor

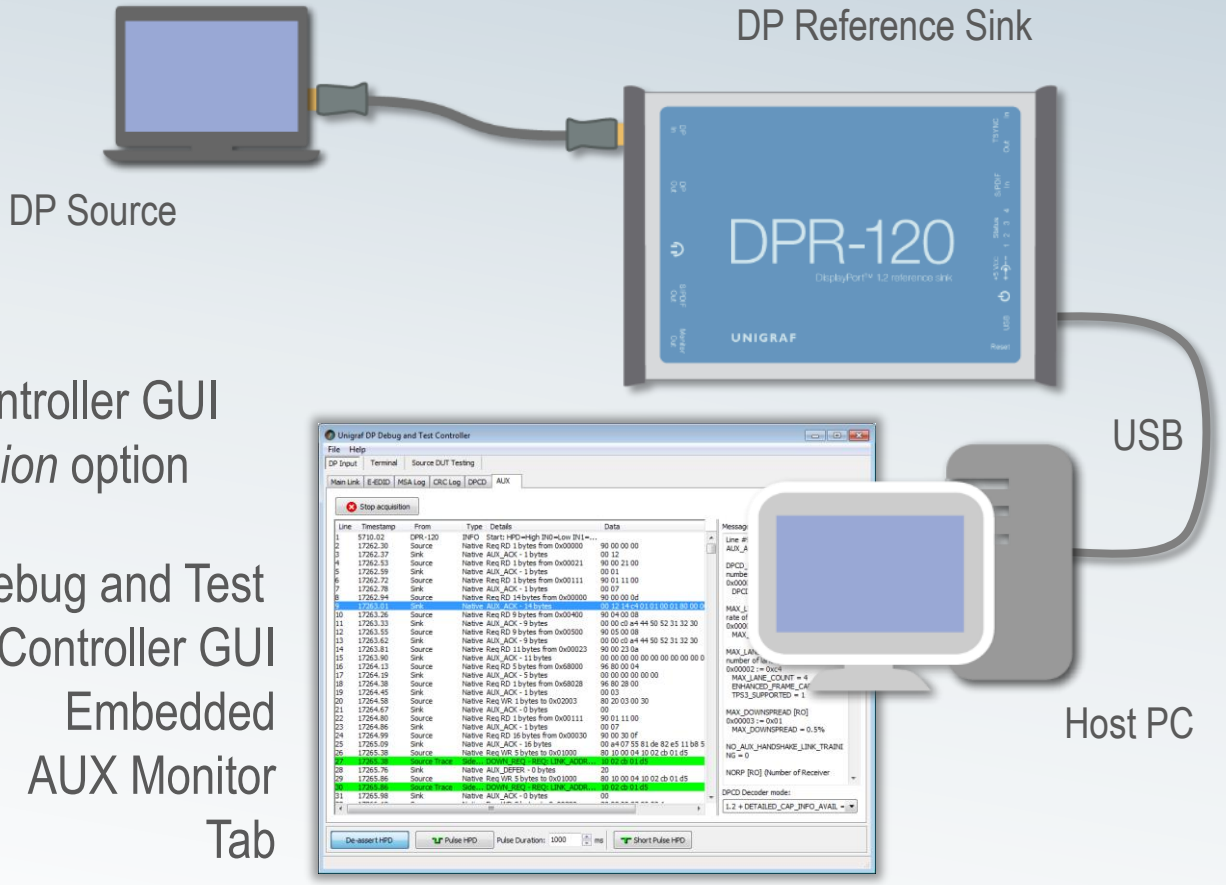
Equipment:

- DPA-400 1.2 unit
- Unigraf “Y” cable
- AUX Channel Monitor GUI



UNIGRAF

DPR-120 Embedded AUX Monitor



Equipment:

- DPR-120 unit
- Debug and Test Controller GUI
- *MST Debug Extension* option

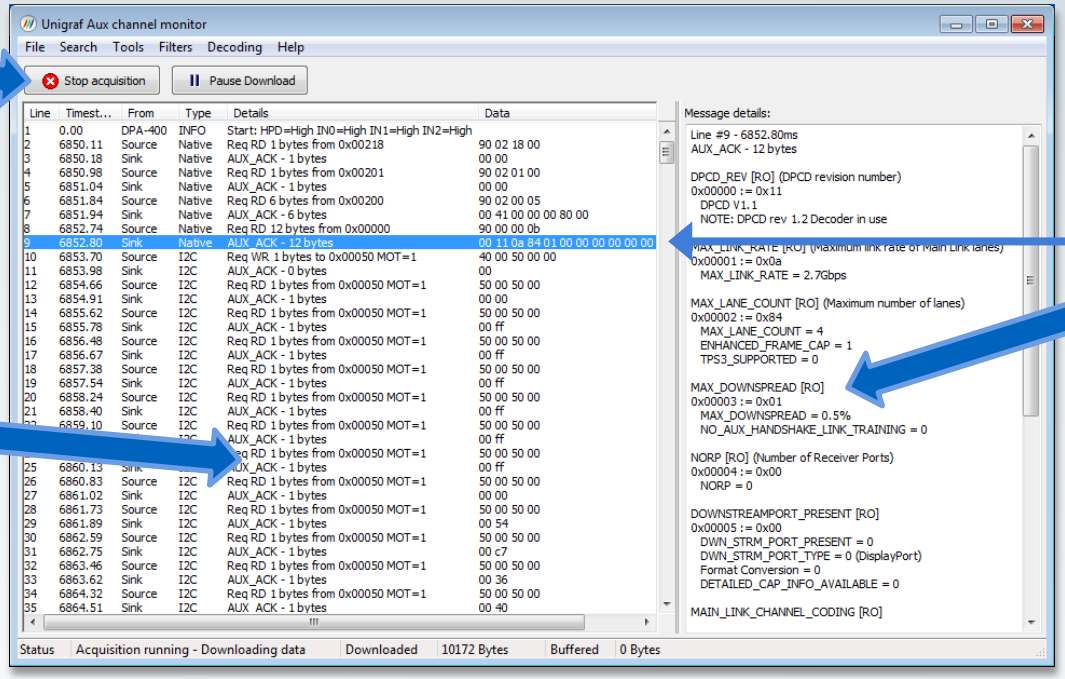
Debug and Test Controller GUI Embedded AUX Monitor Tab

UNIGRAF

Unigraf AUX Monitor GUI

Log controls

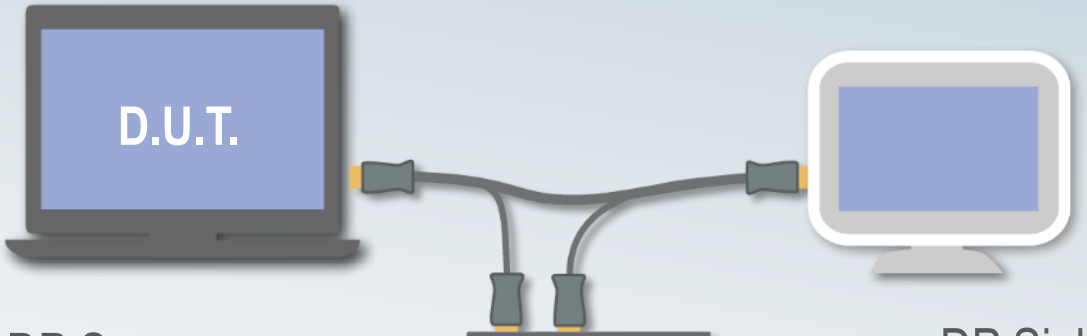
AUX Channel transaction log



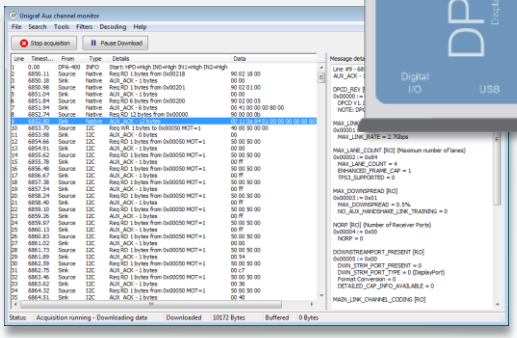
Parsed interpretation of one transaction

UNIGRAF

Case: Interoperability Testing

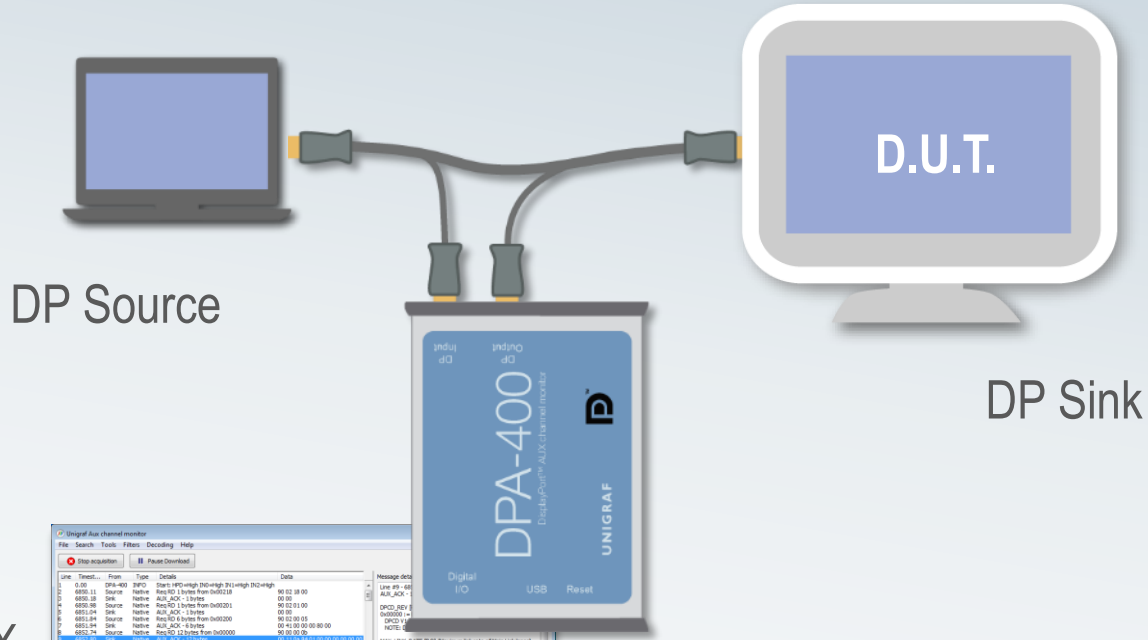


AUX Monitor GUI



UNIGRAF

Case: Interoperability Testing



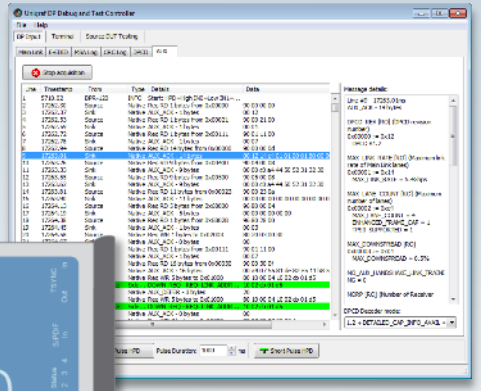
AUX Monitor GUI

UNIGRAF

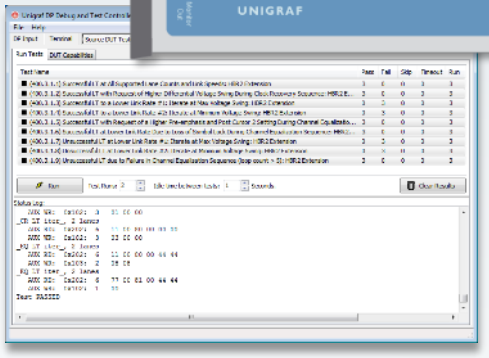
Case: Link Compliance Testing

DP Source

DP Reference Sink



Embedded
AUX Monitor Tab

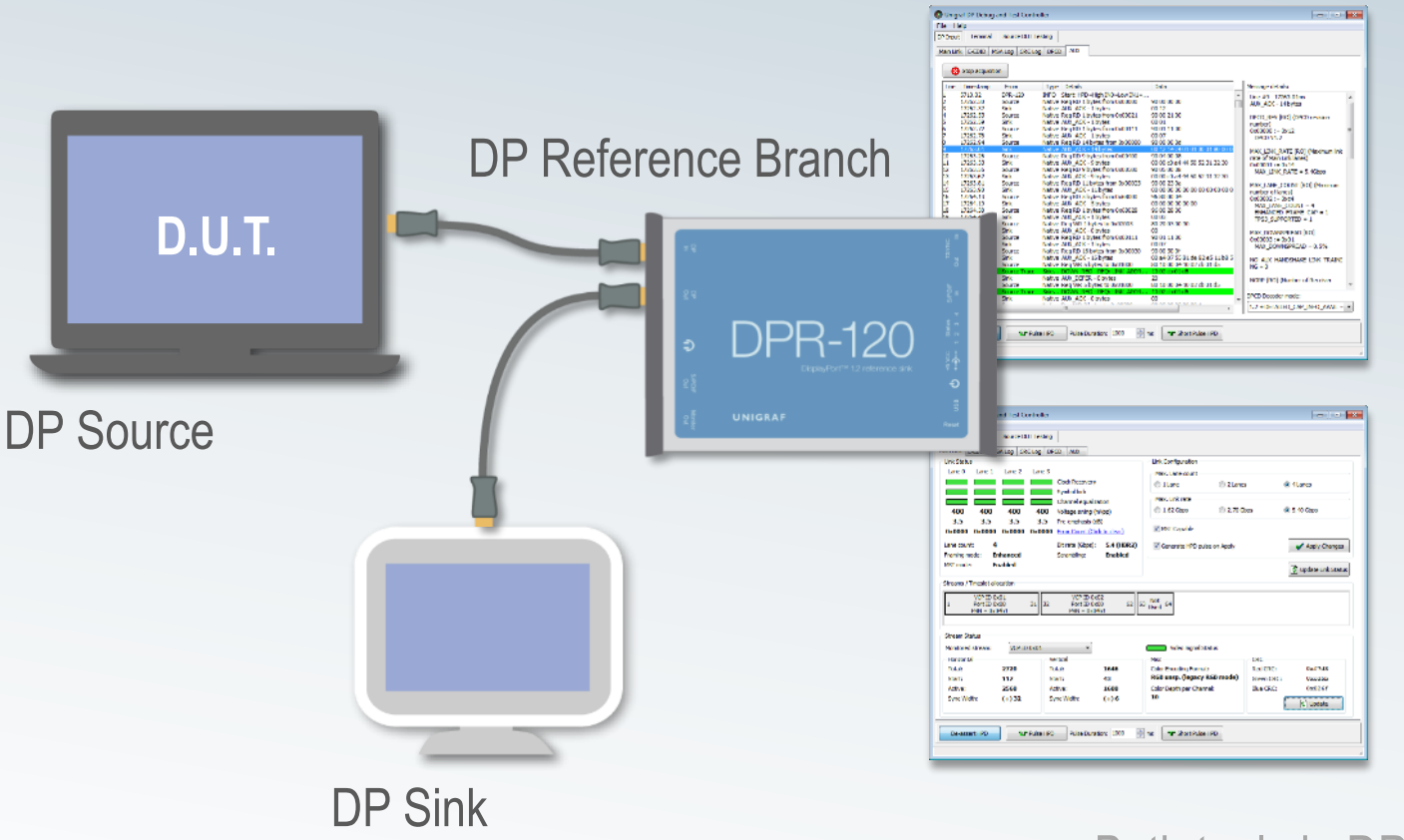


Compliance Testing Tab

Both tools in
DPR-120
Debug and Test
Controller GUI

UNIGRAF

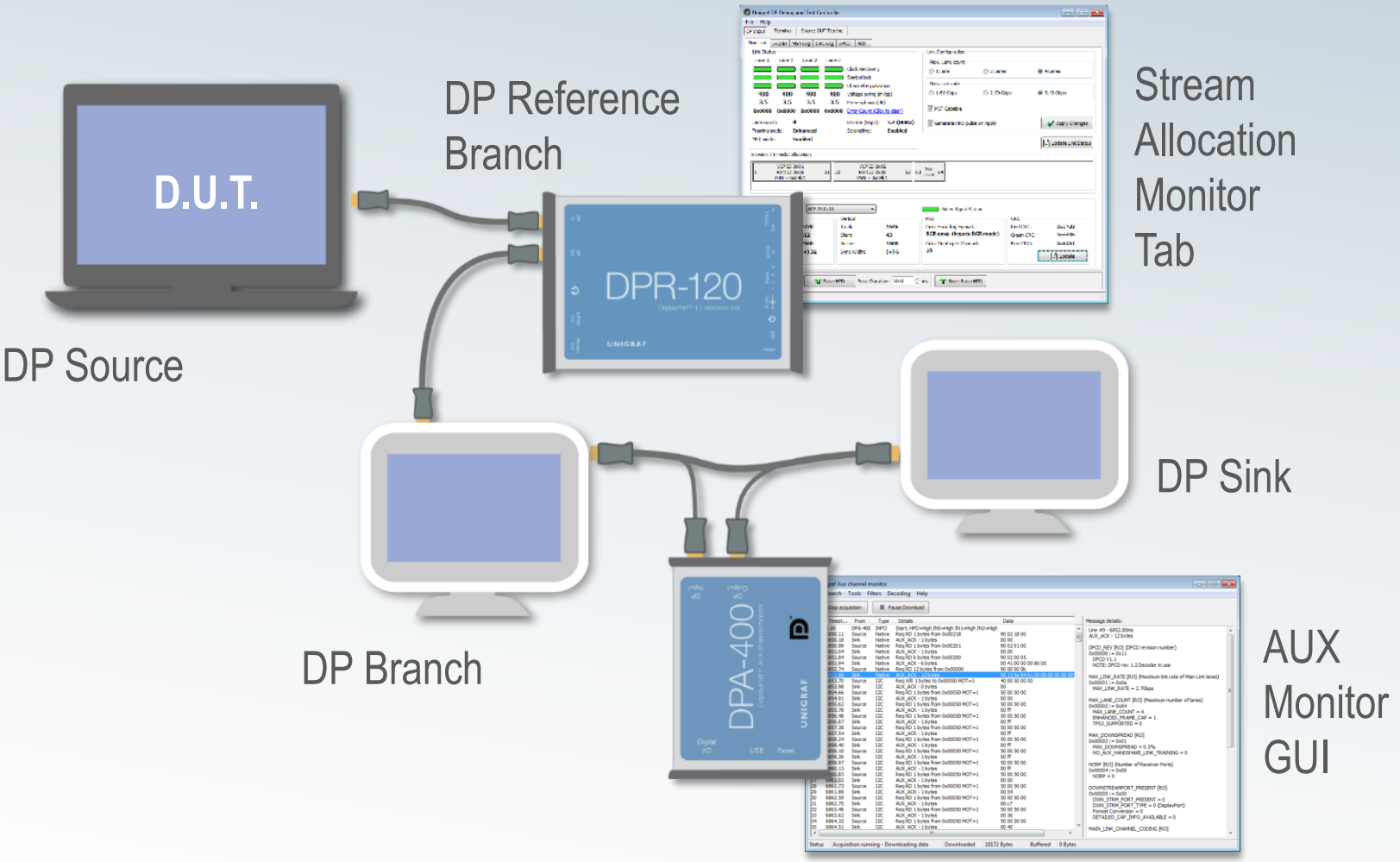
Case: MST Interoperability Testing



Both tools in DPR-120
Debug and Test Controller GUI

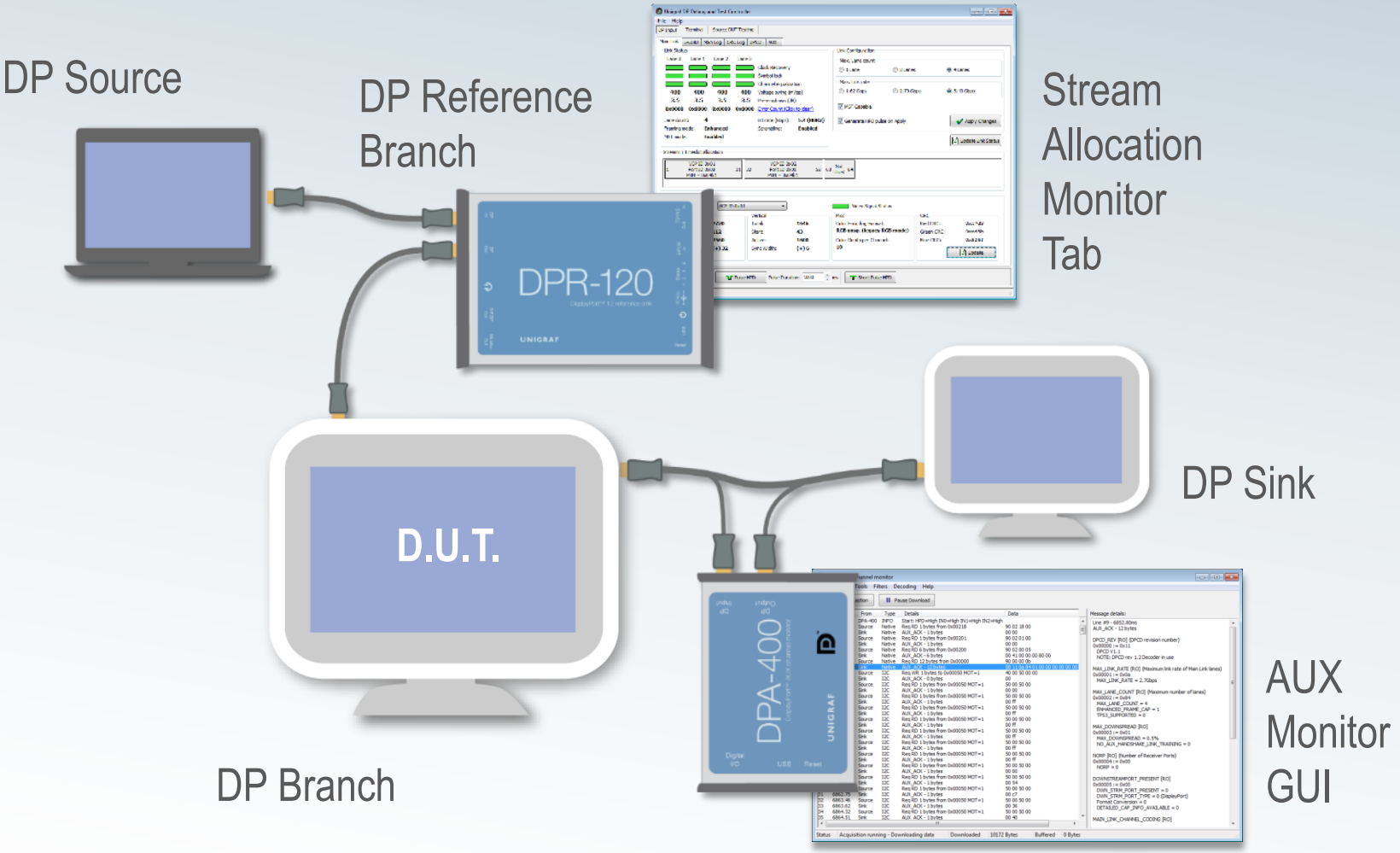
UNIGRAF

Case: MST Interoperability Testing



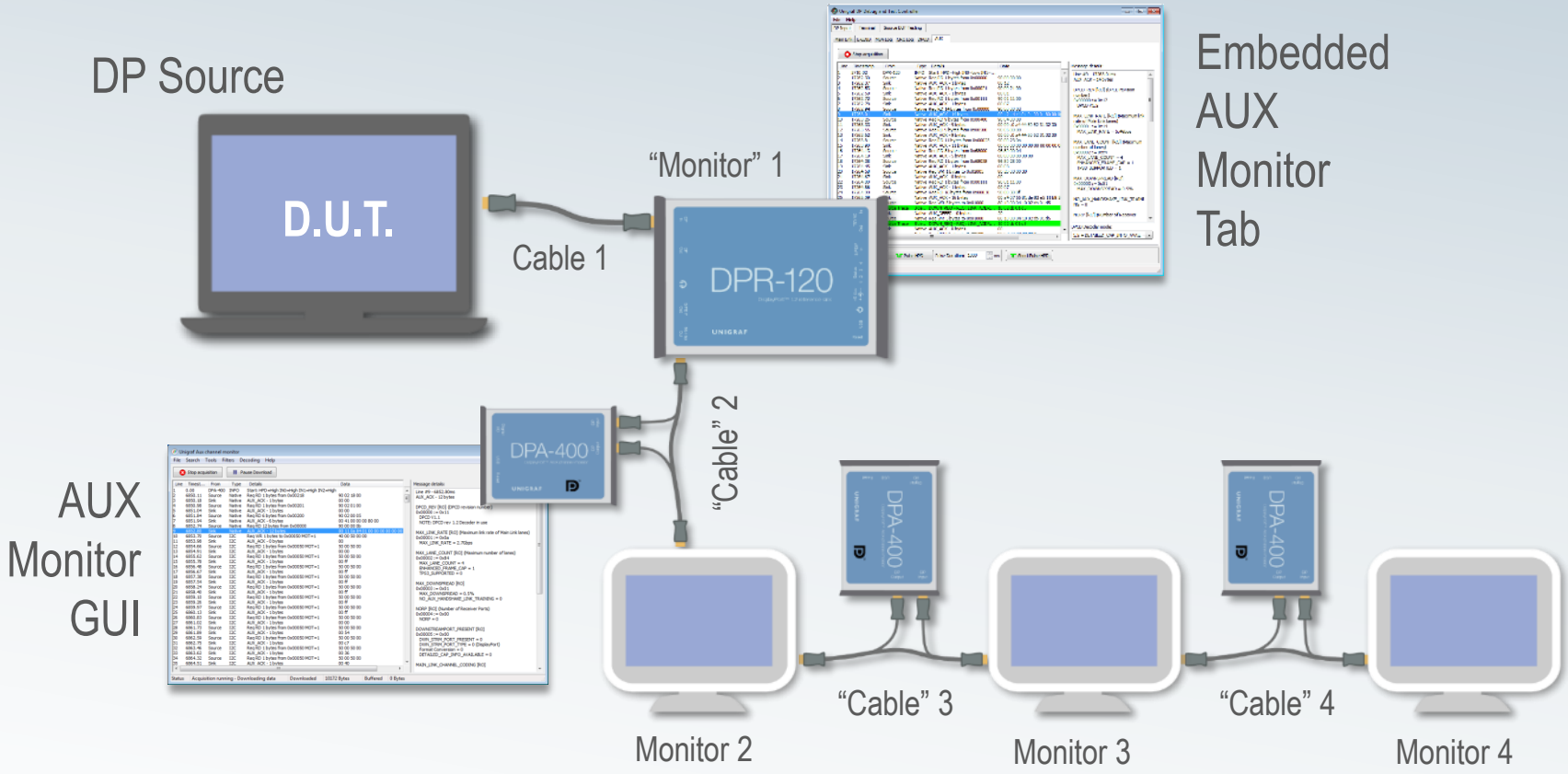
UNIGRAF

Case: MST Interoperability Testing



UNIGRAF

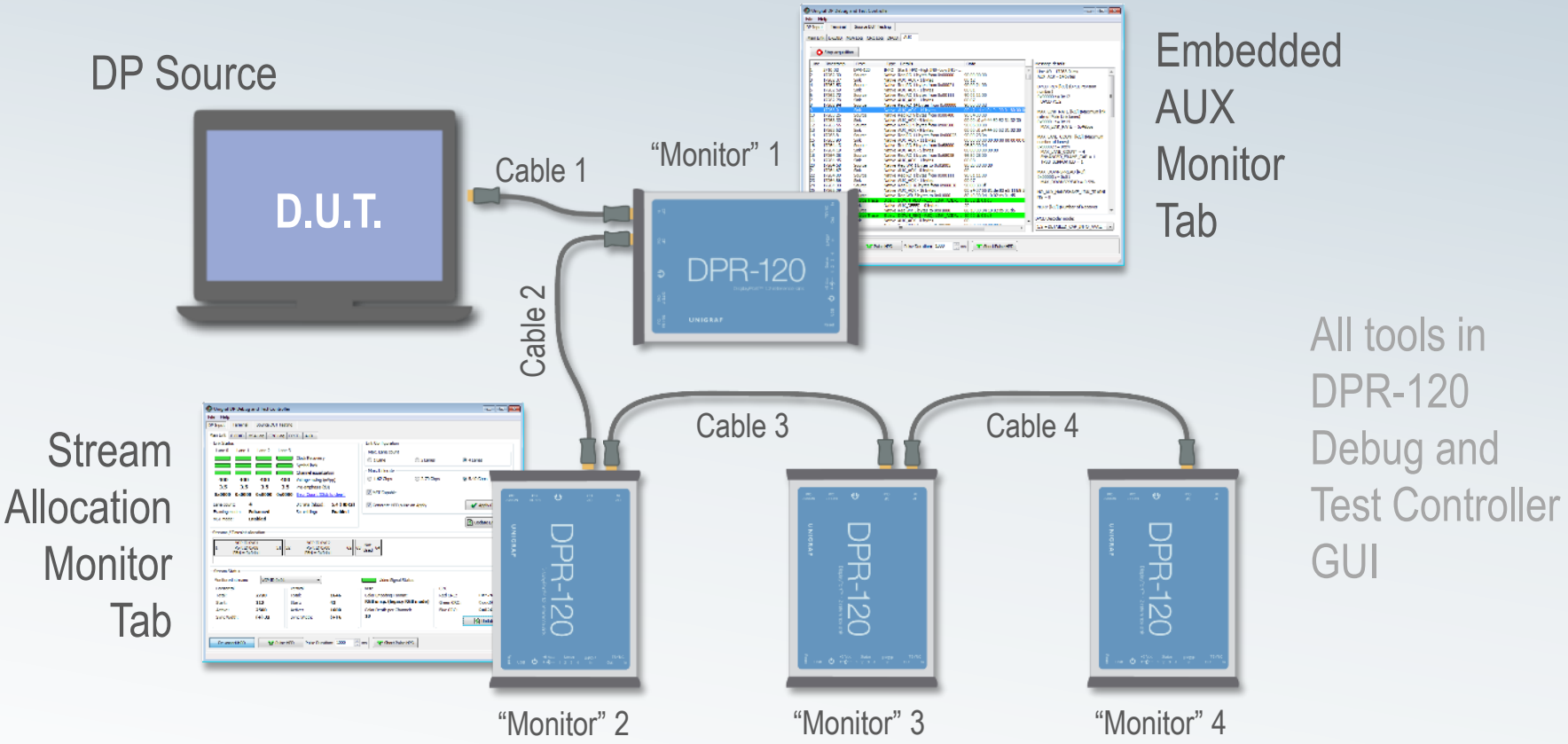
DisplayPort MST Interoperability Test Procedure



Please refer to: VESA DisplayPort® Multi-Stream Transport Certification Test Procedure; Revision D

UNIGRAF

DisplayPort MST Interoperability Test Procedure



All tools in DPR-120 Debug and Test Controller GUI

Please refer to: VESA DisplayPort® Multi-Stream Transport Certification Test Procedure; Revision D

UNIGRAF

Summary

- DPA-400 Advantages:
  - ✓ Can be used between any Source and Sink
  - ✓ Needed between MST Branch and Sink

- DPR-120 Built-in AUX Advantages:
  - ✓ Link CTS tool and AUX Monitor in the same GUI
  - ✓ Reduces the # of connectors in the stream path

UNIGRAF

Thank You!

Please visit www.unigraf.fi
for more information.