What is DisplayPort Alt Mode?

TI Precision Labs – Video Interface
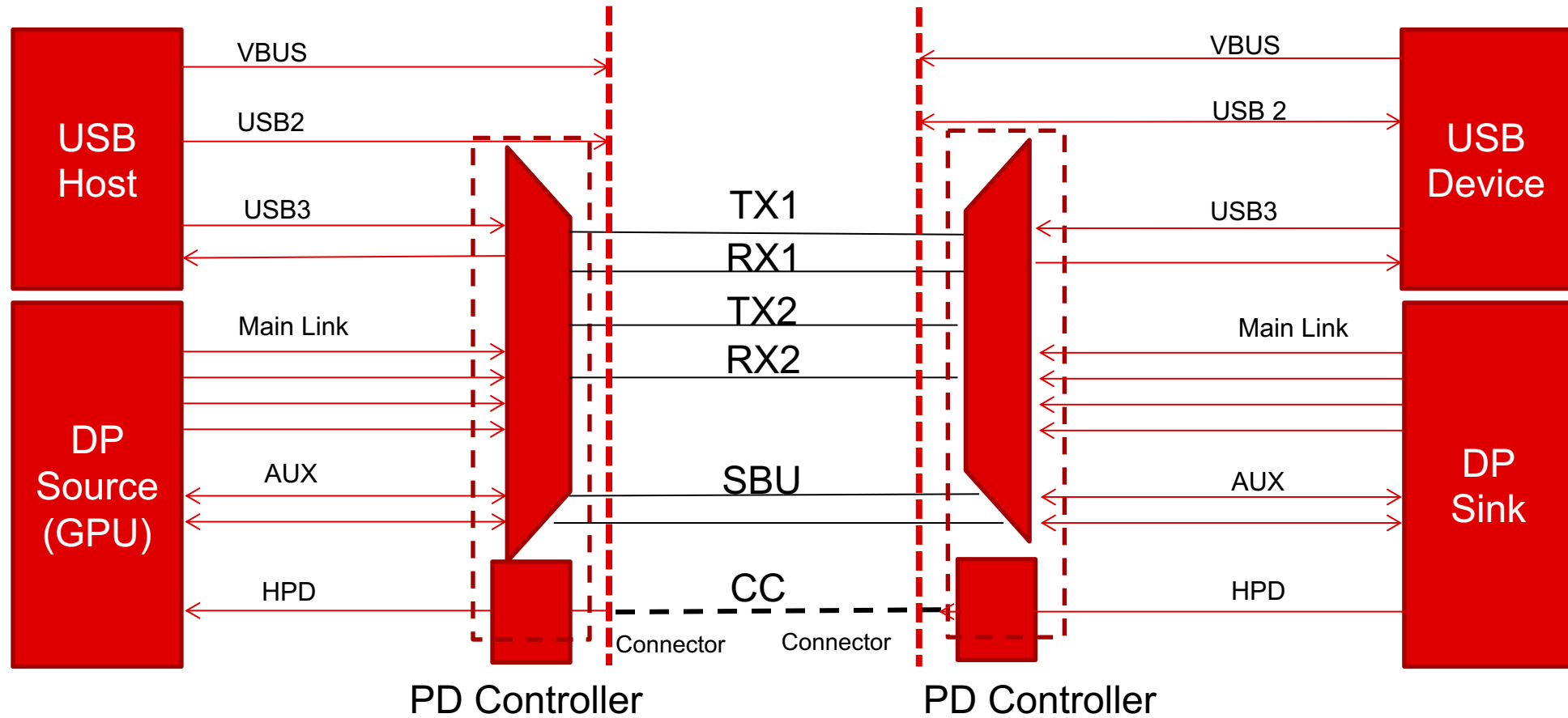
Presented by Ryan Kitto

Prepared by David Liu

What is DP Alt Mode

- An Alternate or Alt Mode allows the transfer of a non–USB data over the USB-C connector

- An Alt Mode example includes the increasingly popular DisplayPort or DP video interface

- A USB-C port capable of transferring DisplayPort signals are either called USB-C DisplayPort or DP Alt Mode. They allow you to connect video sources (e.g. PCs, Blu-Ray players, etc.) and display devices (e.g. TVs, monitors, etc.) that support DisplayPort to each other via their USB-C ports to broadcast high-definition video
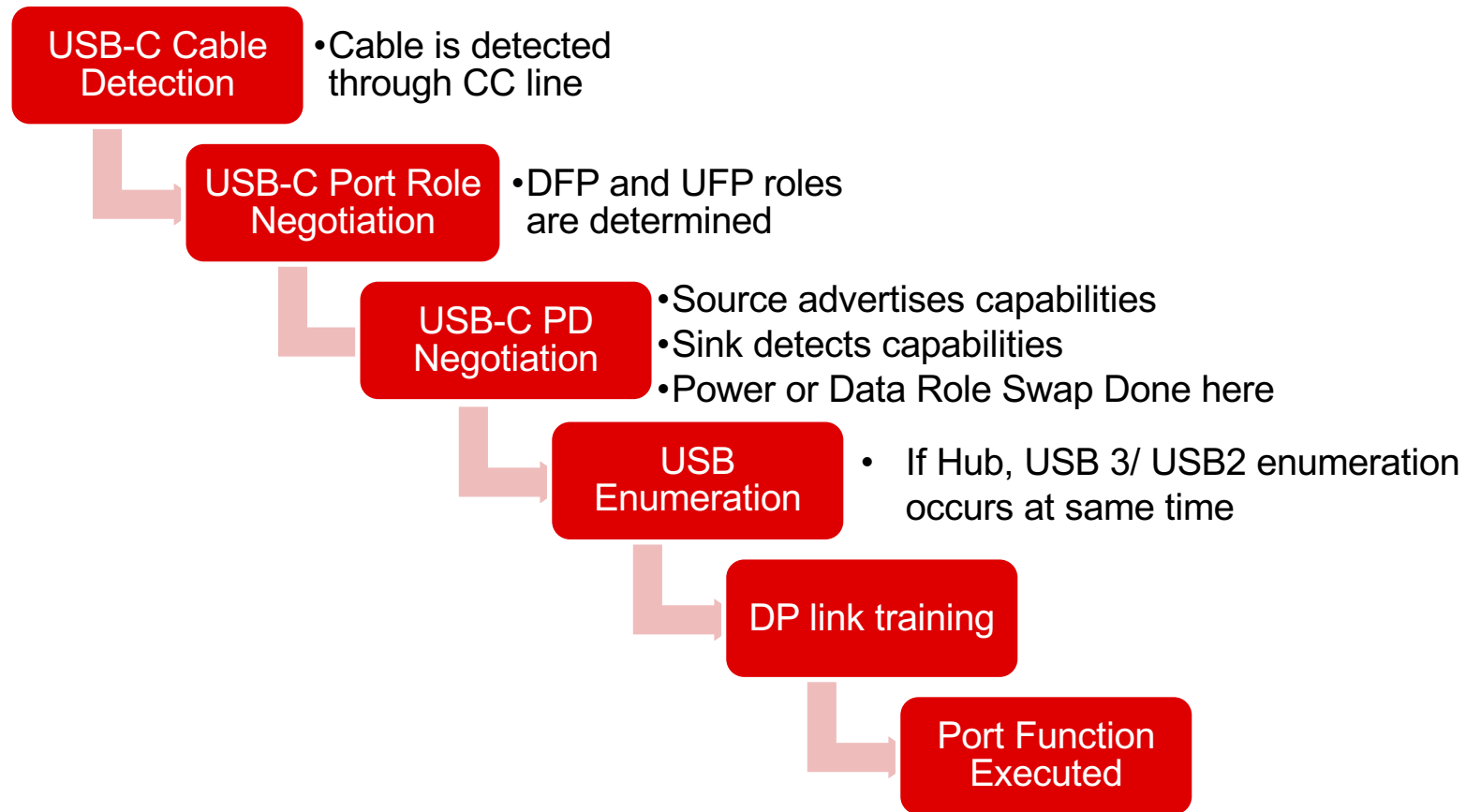
TEXAS INSTRUMENTS

DP Alt Mode General Block Diagram

DP Alt Mode

- Add one more transaction layer (CC log) to communicate DP Alt Mode and Assignment between the source and the sink

- SSTX/SSRX pairs are repurposed to carry Main Link lanes

- SBUs used to carry side band traffic over AUXP and AUXN

- HPD is propagated through PD messaging over the CC

- Multiple pin assignments depending on the mode of operation to be supported by the Alternate mode DFP/UFP systems

TEXAS INSTRUMENTS

DP Alt Mode Flow

USB-C Cable Detection
- Cable is detected through CC line

USB-C Port Role Negotiation
- DFP and UFP roles are determined

USB-C PD Negotiation
- Source advertises capabilities
- Sink detects capabilities
- Power or Data Role Swap Done here

USB Enumeration
- If Hub, USB 3/ USB2 enumeration occurs at same time

DP link training

Port Function Executed

TEXAS INSTRUMENTS

USB-C Receptacle DP Source Device Pin Assignment

(DFP_D)	C	D	E
	USB-C to USB-C or Protocol Converter	USB-C to USB-C or Protocol Converter	USB-C to DP
USB Host	Required	Optional	Required
USB Device	Required	Optional	Required

TEXAS INSTRUMENTS

USB-C Receptacle DP Source Device Pin Assignment

(UFP_D)	C	D	E
	USB-C to USB-C	USB-C to USB-C	USB-C to DP
USB Host	Required	Optional	Required
USB Device	Required	Optional	Required

TEXAS INSTRUMENTS

DP Alt Mode Pin Assignment C Normal Plug Orientation

DFP_D Assignment C: Normal Plug Orientation

Receptacle Interface(Front View)

B12	GND	GND	A1
B11	ML3+	ML2+	A2
B10	ML3-	ML2-	A3
B9	VBUS	VBUS	A4
B8	SBU2/AUXN	CC1	A5
B7	D-2	D+1	A6
B6	D+2	D-1	A7
B5	CC2	SBU1/AUXP	A8
B4	VBUS	VBUS	A9
B3	ML1-	ML0-	A10
B2	ML1+	ML0+	A11
B1	GND	GND	A12

UFP_D Assignment C: Normal Plug Orientation

Receptacle Interface(Front View)

B12	GND	GND	A1
B11	ML2+	ML3+	A2
B10	ML2-	ML3-	A3
B9	VBUS	VBUS	A4
B8	SBU2/AUXP	CC1	A5
B7	D-2	D+1	A6
B6	D+2	D-1	A7
B5	CC2	SBU1/AUXN	A8
B4	VBUS	VBUS	A9
B3	ML1-	ML0-	A10
B2	ML1+	ML0+	A11
B1	GND	GND	A12

TEXAS INSTRUMENTS

DP Alt Mode Pin Assignment E Normal Plug Orientation

DFP_D Assignment E: USB C to USB C or Protocol Converter

Receptacle Interface(Front View)

B12	GND	GND	A1
B11	ML3+	ML2+	A2
B10	ML3-	ML2-	A3
B9	VBUS	VBUS	A4
B8	SBU2/AUXN	CC1	A5
B7	D-2	D+1	A6
B6	D+2	D-1	A7
B5	CC2	SBU1/AUXP	A8
B4	VBUS	VBUS	A9
B3	ML1-	ML0-	A10
B2	ML1+	ML0+	A11
B1	GND	GND	A12

UFP_D Assignment E: Normal Plug Orientation

Receptacle Interface(Front View)

B12	GND	GND	A1
B11	ML0-	ML1-	A2
B10	ML0+	ML1+	A3
B9	VBUS	VBUS	A4
B8	SBU2/AUXN	CC1	A5
B7	D-2	D+1	A6
B6	D+2	D-1	A7
B5	CC2	SBU1/AUXP	A8
B4	VBUS	VBUS	A9
B3	ML2+	ML3+	A10
B2	ML2-	ML3-	A11
B1	GND	GND	A12

Please note the lane order, polarity and AUX polarity difference between UFP_D Assignment C and E

TEXAS INSTRUMENTS

DP Alt Mode Pin Assignment C Flipped Plug Orientation

DFP_D Assignment C: Flipped Plug Orientation

Receptacle Interface(Front View)

B12	GND		GND	A1
B11	ML0+		ML1+	A2
B10	ML0-		ML1-	A3
B9	VBUS		VBUS	A4
B8	SBU2/AUXP		CC1	A5
B7	D-2		D+1	A6
B6	D+2		D-1	A7
B5	CC2		SBU1/AUXN	A8
B4	VBUS		VBUS	A9
B3	ML2-		ML3-	A10
B2	ML2+		ML3+	A11
B1	GND		GND	A12

UFP_D Assignment C: Flipped Plug Orientation

Receptacle Interface(Front View)

B12	GND		GND	A1
B11	ML1+		ML0+	A2
B10	ML1-		ML0-	A3
B9	VBUS		VBUS	A4
B8	SBU2/AUXN		CC1	A5
B7	D-2		D+1	A6
B6	D+2		D-1	A7
B5	CC2		SBU1/AUXP	A8
B4	VBUS		VBUS	A9
B3	ML3-		ML2-	A10
B2	ML3+		ML2+	A11
B1	GND		GND	A12

TEXAS INSTRUMENTS

DP Alt Mode Pin Assignment E Flipped Plug Orientation

DFP_D Assignment E: Flipped Plug Orientation

Receptacle Interface(Front View)

B12	GND	GND	A1
B11	ML0+	ML1+	A2
B10	ML0-	ML1-	A3
B9	VBUS	VBUS	A4
B8	SBU2/AUXP	CC1	A5
B7	D-2	D+1	A6
B6	D+2	D-1	A7
B5	CC2	SBU1/AUXN	A8
B4	VBUS	VBUS	A9
B3	ML2-	ML3-	A10
B2	ML2+	ML3+	A11
B1	GND	GND	A12

UFP_D Assignment E: Flipped Plug Orientation

Receptacle Interface(Front View)

B12	GND	GND	A1
B11	ML3-	ML2-	A2
B10	ML3+	ML2+	A3
B9	VBUS	VBUS	A4
B8	SBU2/AUXP	CC1	A5
B7	D-2	D+1	A6
B6	D+2	D-1	A7
B5	CC2	SBU1/AUXN	A8
B4	VBUS	VBUS	A9
B3	ML1+	ML0+	A10
B2	ML1-	ML0-	A11
B1	GND	GND	A12

Please note the lane order, polarity and AUX polarity difference between UFP_D Assignment C and E

TEXAS INSTRUMENTS

Short Quiz

- AUXP and AUXN sideband signal is carried over the CC bus

- DP Alt Mode can support USB only, USB and DP, and DP only

- Assignment C and E is different on the source side

- Assignment C and D is same on the sink side

TEXAS INSTRUMENTS

Short Quiz

- AUXP and AUXN sideband signal is carried over the CC bus
  - False

- DP Alt Mode can support USB only, USB and DP, and DP only
  - True

- Assignment C and E is different on the source side
  - False

- Assignment C and D is same on the sink side
  - True

TEXAS INSTRUMENTS