Delphi Data Connectivity

presentation to

9 June 2017

EX.
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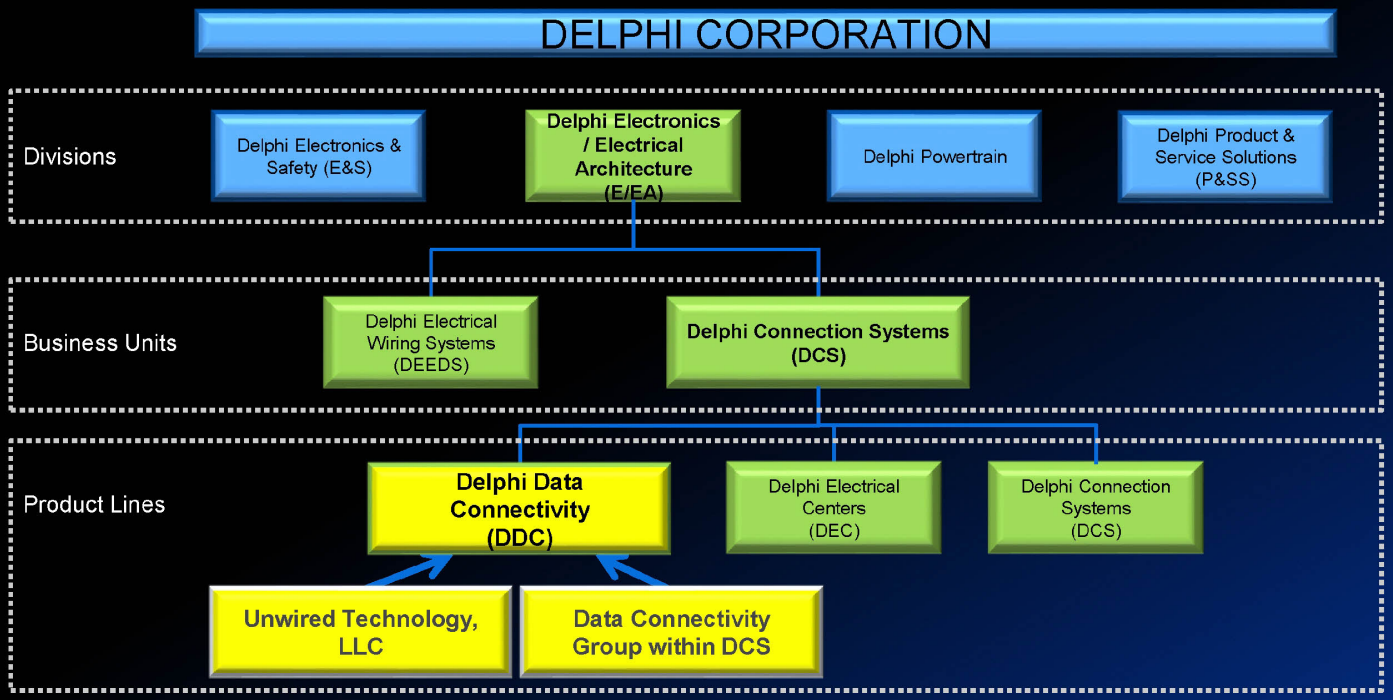
Innovation for the Real World

Agenda

- Introduction to Delphi Data Connectivity
- Overview of Product Lines
- Media Modules Overview
  - Key Advantages
  - CarPlay Support
  - Lighting Experience
  - Technology Roadmap
- Discussion of Delphi's Current Products with VW
  - Current Products
  - Opportunities to Improve Products for NA

Delphi Data Connectivity (DDC) Formation



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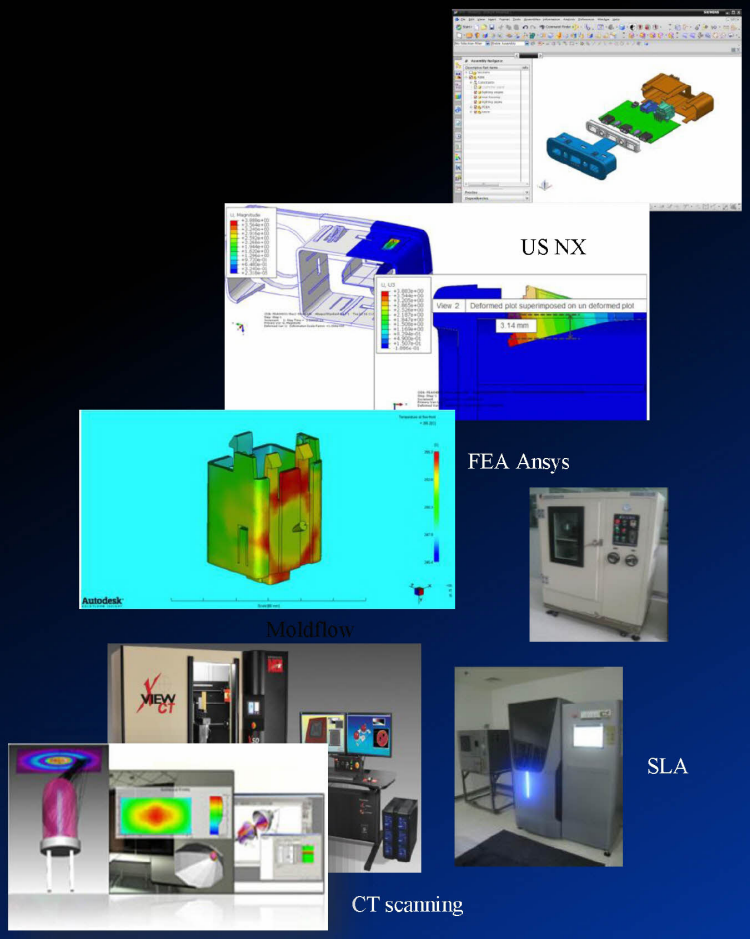
Mechanical Engineering

- Multi-CAD software
  - ❖ UG NX, CATIA, Pro/E, TeamCenter
- Simulation
  - ❖ FEA (Ansys, Abaqus), Moldflow
  - ❖ Lighting Simulation
- Reversed technology
  - ❖ CT scan and re-modeling
- Rapid Prototyping
  - ❖ SLA, FDM, 3DP
- TALC Capabilities
  - ❖ Trim, Appearance, Lighting, and Color



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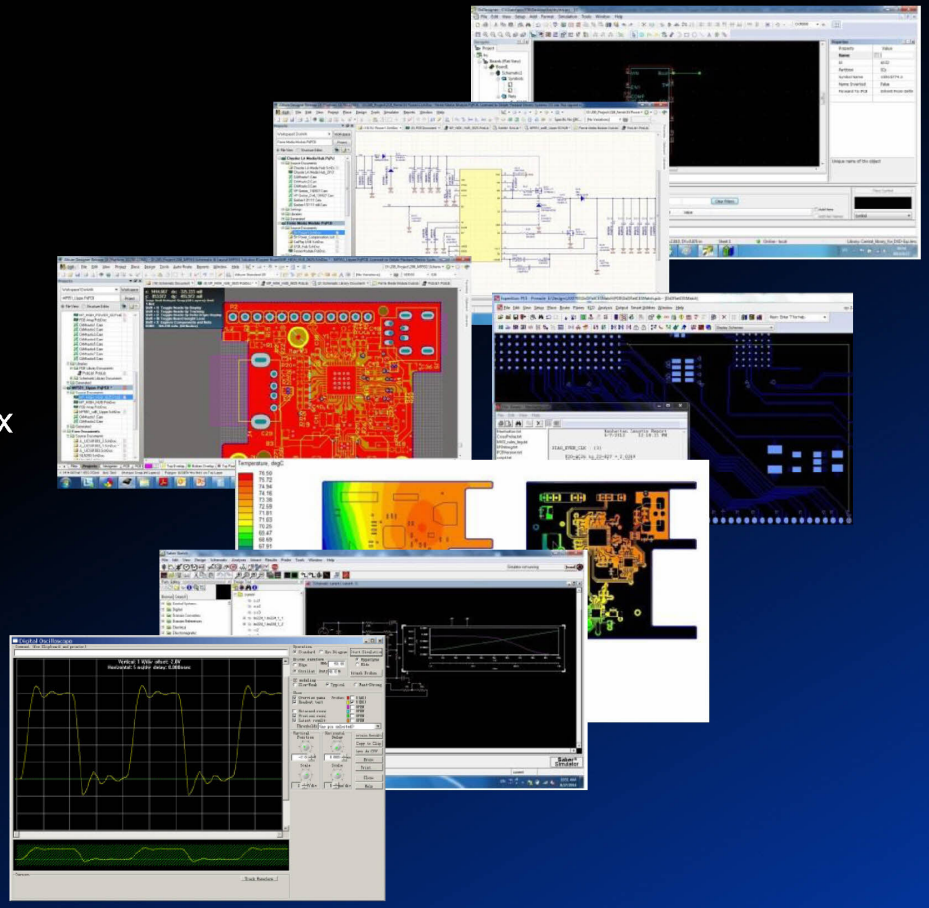
Electrical Engineering

- Schematic Design
  - DxDesigner, Altium
- Layout
  - Expedition, Altium
- Circuit simulation
  - Saber, Multisim, HyperLynx
- Worst Case Analysis
  - Mathcad
- USB Specific
  - Eye pattern testing



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DDC Product Lines

High-Speed USB & A/V Media Modules

Wireless Rear-Seat Entertainment Headphone Systems

Wireless Charging Solutions

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Wireless Rear-Seat Entertainment

- Analog or Digital Headphones
  - WhiteFire Infrared or RF Wireless
  - Superior Sound- CD Quality
  - Up to 4 Stereo Channels at same time for WhiteFire IR (only 2 for RF)
- Transmitter Solutions
  - Ray-tracing services for optimal module placement, piece cost & IR coverage within the vehicle
  - UT60c dual-mode ASIC available in component form for RSE integrators
- Remote Controls
  - Infrared or RF
  - Highly stylized
  - With or without docking features
  - Backlighting
  - Keypad or trackpad, or both

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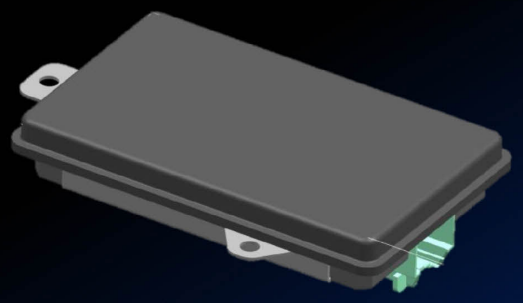
Wireless Charging Solutions

- Inductive and Magnetic Resonant systems
- Meets Qi, PMA and/or A4WP standards
- NFC (Near Field Communications) capability
- Automotive compliant design incorporating CAN/LIN interfaces
- Eliminates the need for distracting charge cords
- Enhances the consumer experience
- Potential for Integrated Antenna Amplification
- Customer specific packaging
- Seamless vehicle architecture integration



Standard Module Design

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Data Connectivity
Media Modules … Current Portfolio

Charge Only and Data Ports

USB Hubs

Data Serializers

- Product Description
  - Data and charge ports & hubs include charge only and data ports, USB hubs and data serializers
  - Support for all current data and charging standards
    - Data: USB 2.0/3.0, AUX, SD, SIM, HDMI, MHL
    - Charging: USD 2.0/BC 1.2/Apple Charging
- Customer Benefits
  - Flexible styling and lighting options
  - Efficient support for Apple CarPlay™ for vehicle
  - Enables consumer connectivity to latest consumer devices
- Delphi Advantages
  - Fast implementation of latest consumer connectivity
  - Product innovation (custom ASIC)
  - Comprehensive “in-house” expertise and engineering

Key Advantages of Delphi Media Modules

- **Substantial Experience**
  - Market leader for media modules and hubs
  - Significant content in production at 4 OEMs
  - Designs based on validated building blocks → lower risk
  - System-level integration and head-unit collaboration

- **Proven Innovation & Technology**
  - Custom hub ASIC to offer efficiency, expanded functionality and unique support for CarPlay™
  - 2016 Automotive News PACE award winner for Dual Role Hub
  - Hub ASIC products Apple Certified at Vehicle System Level with first 3 OEMs to launch
  - Hub ASIC is USB certified

Apple CarPlay

Automotive News PACE AWARD 2016 WINNER

- **Understanding and Implementation of Latest Consumer Device Technologies**
  - USB, HDMI, MHL, SD and SIM hardware and communications
  - Industry and company specific charging specifications (BC 1.2, Apple Charging)
  - Apple CarPlay™ and Apple certification experience
  - Emerging technologies (Type C, UPD)

- **Speed to Market**
  - Delphi has launched products with OEMs within 1 year of concept to launch
- **Global Scale and Reach**
  - Global product development and customer support
  - Global low-cost manufacturing capability

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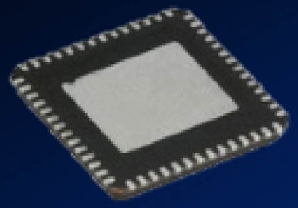
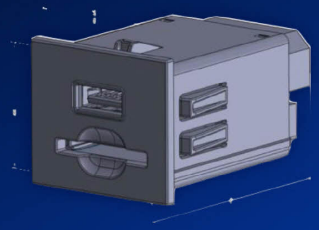
How do we support CarPlay™ in Hubs and Media Modules?

- What differentiates us is our own ASIC to support Apple CarPlay™ – which recently won the PACE award!
- This chip is designed for multi-port architecture with CarPlay™ support through unique Host-to-Host bridging technology.
- A fully functional system of downstream ports is enabled with a single USB connection to head unit
- Any of downstream ports may host CarPlay™.
- While one of the ports is occupied with Apple CarPlay™ session, the rest of ports in the system stay active and may exchange data.
- No need for USB MUX switches that can cause USB eye diagram degradation.
- Our ASIC is in production with 3 OEMs currently, with 1 more OEMs planned for later this year.





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Demonstrated Delphi lighting experience

35 lit products under development for 2016-2019 MY programs.
- Three Custom remote controls for Rear Seat Entertainment
  - 2 using LED direct back lighting
  - 1 Using LED & light guide film

Multiple connectivity modules currently under development
- 27 @ NA OEM customers
- 5 @ EU OEM customers
- 10 products at PPAP complete & starting initial production
- 11 at prototype/DV stage
- remainder in design phase

Multiple lit modules in production at multiple OEMs.
Two simulation experts with over 24 yrs combined simulation experience.
Three additional simulation engineers in training.
Four team engineers with multi-program lighting experience in Instrument Cluster, HVAC control, and entertainment system products.

Typical Back lit Module Products

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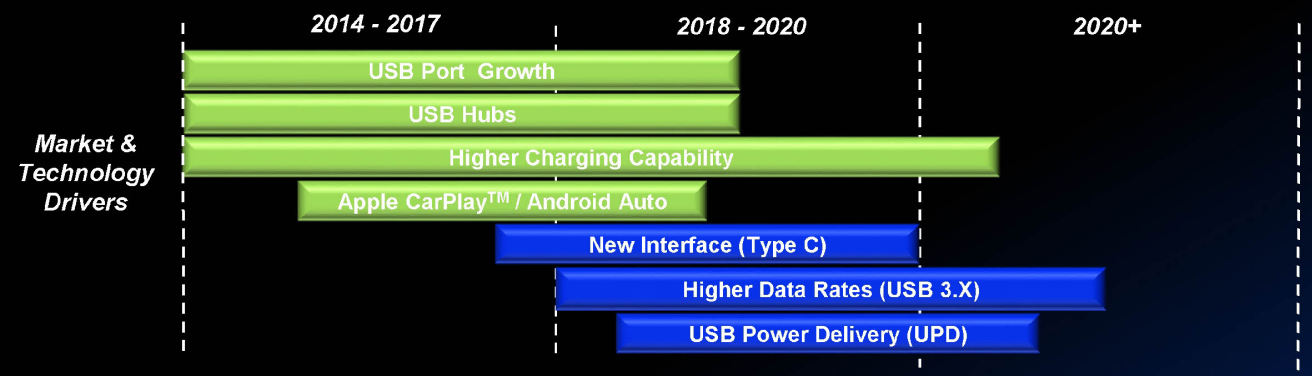
Delphi's media module technology roadmap



Technology available today:

USB charge ports
(USB 2.0, BC 1.2, Apple Charging)

USB/SD/AUX hubs
(supporting Apple CarPlay and Android Auto)

High speed hubs & serializers
(supporting HDMI / MHL / USB 3.0)

Technology in the future: Type C, USB Power Delivery

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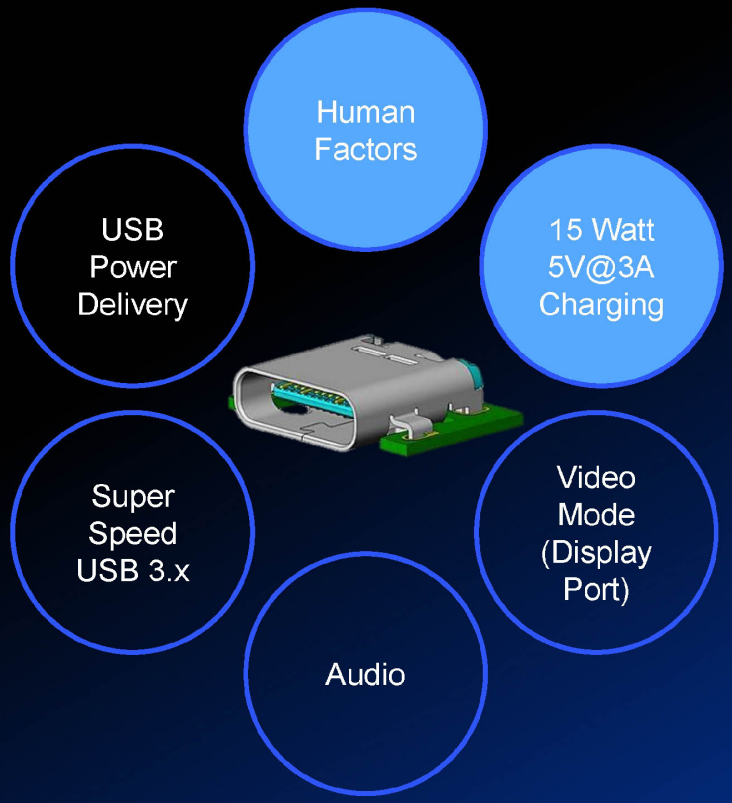
Media Module Global Market Trends

- Trends are grouped by home region of the OEMs, however, global OEMs tend to use the same architecture throughout the world

	NA OEMs (GM, Ford, Chrysler)	EU OEMs (VW, BMW, Renault, Daimler, PSA, Fiat, JLR)	Japan/Korea OEMs (Hyundai, Nissan, Toyota, Honda)	China OEMs (Geely, Chang-An, Brilliant)
Multiple USB data ports	Most vehicles have multiple ports	High end vehicles have multiple ports, lower end vehicles have single ports	Mostly single ports, but some OEMs will be adding multiple	Mostly single ports, not seeing a lot of demand for multiple
Introduction of CarPlay and Android Auto	Most vehicle support both or will in next year	Available on half of OEMs	Available on half of OEMs	OEMs more focused on Baidu Carlife
Illumination of USB ports	Mostly illuminated, more illumination coming	Only high end vehicles now, more illumination coming	Very limited	None
AUX Jacks	Mixed, OEM dependent, generally declining			
SD Card Readers	Mixed, OEM dependent, generally declining		Very limited	None
Charge-only ports	Most OEMs adding in the consoles and rear		Not aware of any being added	Some OEMs adding in future
Type C	In 2017	In 2018	Not aware of any being added	In 2017
USB Power Delivery	Initial discussions with several OEMs. Won't see in market until 2018+.			

USB Type C Connector

- A new USB connector being adopted by consumer devices
- Capabilities:



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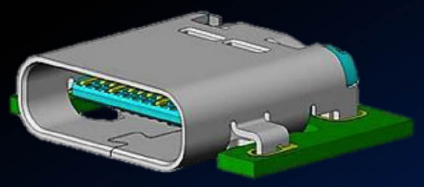
Type C in Media Modules

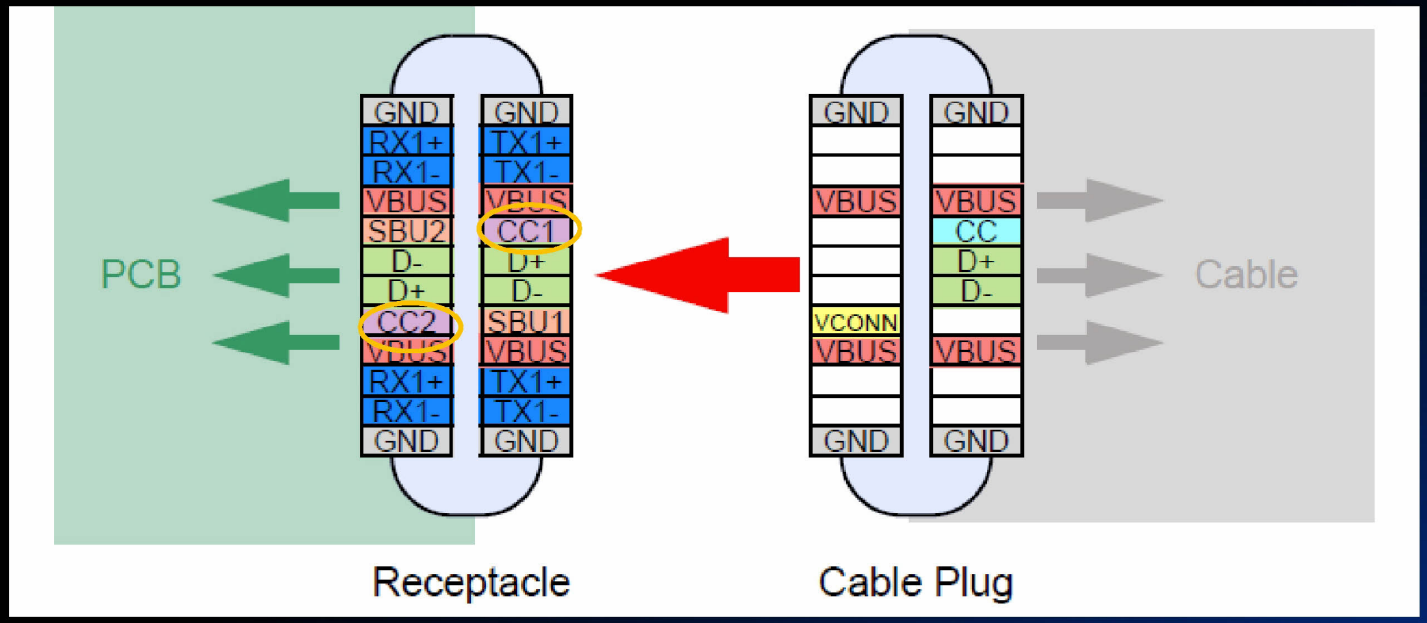
- Type C timeline:
  - 2014: Specification approval by USB Standards Committee
  - 2015: Early Consumer Product Adopter Phase
  - 2016: Mainstream on most new consumer products
  - 2017: Broad consumer awareness and acceptance
  - 2017: Roll-out into Automotive Connectivity



USB Type C

- Type C early adopters: Google Chromebook Pixel, One Plus 2, Nexus 5X and 6P phones, Apple Macbook, Dell XPS laptop, Lenova ZUK phone, LG G5, HTC 10, Samsung S8
- Delphi has developed a low cost solution for Type C connector that provides USB2.0 and 15W charging.
- Delphi is 1st to market with Automotive Type C launching in 2017!

Required Type C Connections for USB 2.0 and Type C Charging



- The CC pins are critical for basic USB Type-C operation
- Voltage to VBUS may only be applied when:
  - Valid cable attachment is detected with Rp pull-up/Rd pull-down resistors
  - Power negotiation done with PD massaging (when USB Power Delivery 2.0 implemented)

USB Type C Charging Handshaking

- USB Type C Uses Multiple Charging Handshaking
  - Backward compatible to other standards
  - "Type C" – 1.5 A and 3.0 A
  - USB Power Delivery

"Standard"	Charging Current	"Handshaking" Method
USB 2.0	500 mA	SDP
USB 3.x	900 mA	SDP
BC 1.2 Charging	Up to1.5 A	CDP with D+,D-, DCP
Chinese Telecomm YD/T 1591-2009	Up to 1.5 A (LS, FS), 900 mA (HS)	CDP with D+,D- and data speeds, DCP
Apple Charging	Up to 2.4 A	D+, D- (divider modes), USB messages
Type C	All USB standards, 1.5A and 3.0A	Dynamically, using resistance over CC lines
Type C – UPD	Up to 100 W (5A, 20V)	Biphase Mark Coding over CC lines

USB Power Delivery UPD

- Power Delivery 2.0 protocol is a singled-ended, 1-wire protocol created by the USB-IF which specifies the methods for serial communication over the USB Type-C CC wire.

- USB Power Delivery is required for implementation of the following advanced features:
  - Communicating with an electronically marked/active cable
  - Elevating the VBUS voltage (12/20V profiles)
  - Increasing current up to 5A
  - Changing default power roles (Provider or Consumer)
  - Using Alternate Modes (Display Port, ThunderBolt)

USB Power Delivery profiles			
Profile	+5 V	+12 V	+20 V
1	2.0 A, 10 W	N/A	N/A
2		1.5 A, 18 W	N/A
3		3.0 A, 36 W	N/A
4			3.0 A, 60 W
5		5.0 A, 60 W	5.0 A, 100 W

- Delphi has developed solution which supports UPD up to 60W (3A, 20V)
- Most of our customers initial approach is to bring low cost solution with Type C that provides USB2.0 and 15W charging.

Discussion of Delphi's Current Products

- Current Products
- Opportunities to Improve Products for NA

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