VESA Display Standards Updates

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Agenda

- VESA Overview

- DisplayPort Market Adoption

- DisplayPort™1.4a Updates

- VESA Certified DisplayHDR

- New VESA Technology Development Areas

- DP Next Generation

- Summary

VESA OVERVIEW

VESA Standards Enable Many Market Segments…

PCs and laptops

Gaming consoles and headsets

Smartphones and tablets

Automotive

Digital projectors

Digital signage / kiosks

…As Well as Many Aspects of Display Technology

Display Interfaces

- DisplayPort
- DisplayPort over USB-C (DisplayPort Alt Mode)
- Embedded DisplayPort
- Next-gen DisplayPort

High Dynamic Range

- DisplayHDR

Display Data Compression

- Display Stream Compression (DSC)
- VESA Display Codec for Mobile (VDC-M)

Display Capability Parameters

- DisplayID
- Extended Display Identification Data (EDID)
- Multi-Display Interface

Strong Support from Local Members

50 member companies from Taiwan including...

...And many others!

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Strong Support from Local Members

More than 40 member companies from Japan including...

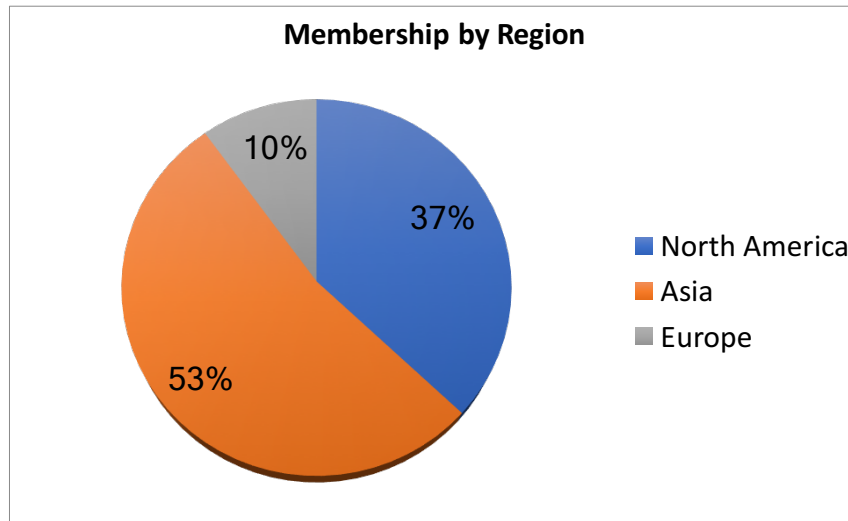...And many others!

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Strong Support from Local Members

More than 30 member companies from China including...

...And many others!

About VESA

Membership by Region

Pie chart:
- North America: 37%
- Asia: 53%
- Europe: 10%

- Global industry alliance with more than 275 member companies

- Leading PC/computer, display, hardware, software, and component manufacturers worldwide

- Mission to develop, promote and support ecosystem of vendors and certified interoperable products for the electronics industry

- Develops Open standards, contribution is open to all companies at all stages of development as well as promotion and marketing

VESA Membership Continues to Grow
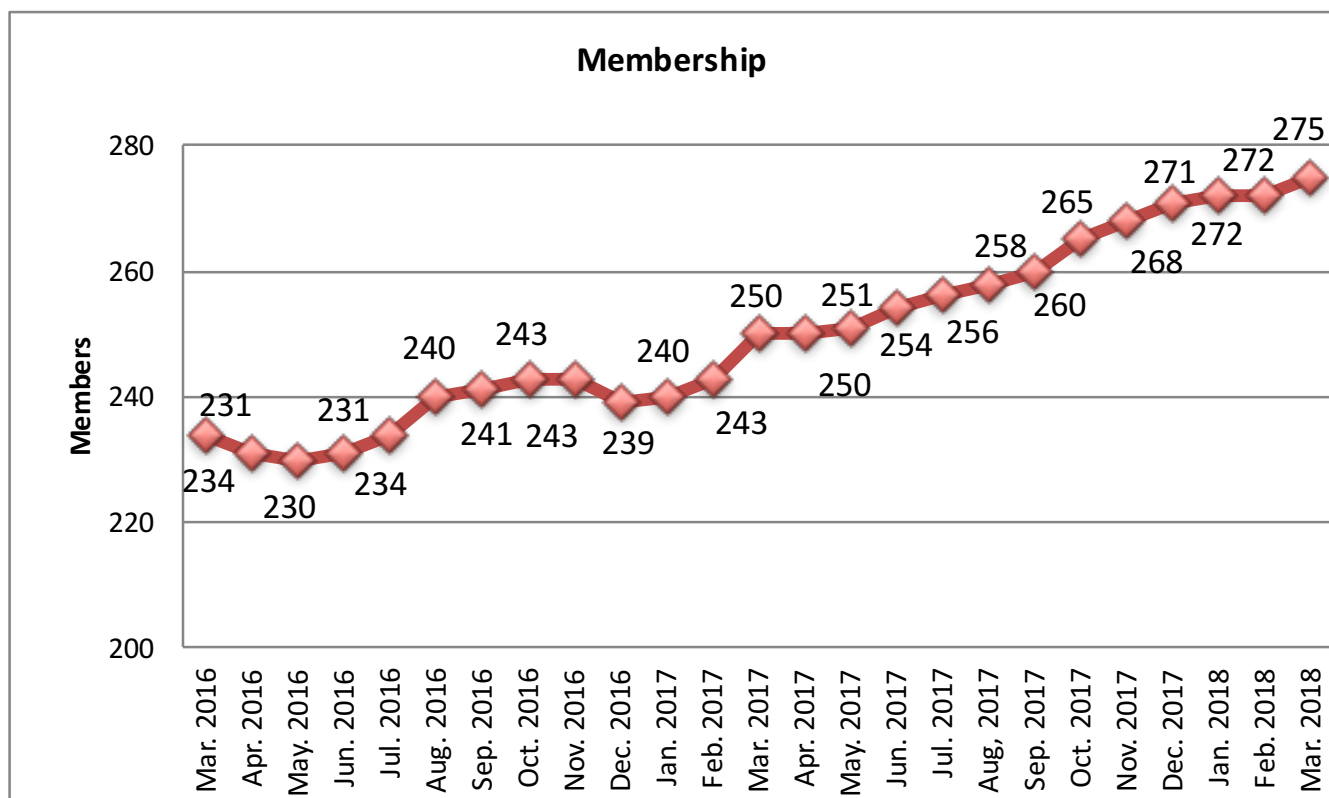
DisplayPort Market Adoption

Handset Shipment Forecast

Global Handset Shipments (Millions of Units)

	2016	2017	2018	2019	2020	2021	CAGR 2016-2021
Total	1849.9	1914.577	1981.0564	2026.4615	2062.6987	2111.85	3%

Global DisplayPort Handset Shipments (Millions of Units)

Region	2016	2017	2018	2019	2020	2021	CAGR 2016-2021
Total	12.3	64.1	157.3	309.3	425.7	545.9	113%
Penetration Rate	1%	3%	8%	15%	21%	26%	

Global USB-C Handset Shipments (Millions of Units)

	2016	2017	2018	2019	2020	2021	CAGR 2016-2021
Total	90.9	251.2	513.4	902.1	1237.1	1473.4	75%
Pentration Rate	5%	13%	26%	45%	60%	70%	

Date: November 2017

STRATEGY ANALYTICS
Research, Experts, and Analytics

PC Shipment Forecast

Global PC Shipments (Millions of Units)

	2016	2017	2018	2019	2020	2021	CAGR 2016-2021
Total	257.1	253.8	249.3	248.6	252.4	257.8	0%

Global USB-C PC Shipments (Millions of Units)

	2016	2017	2018	2019	2020	2021	CAGR 2016-2021
Total	30.3	52.7	86.5	130.2	169.7	207.2	47%
Penetration Rate	12%	21%	35%	52%	67%	80%	

Global DisplayPort PC Shipments (Millions of Units)

	2016	2017	2018	2019	2020	2021	CAGR 2016-2021
Total	130.4	139.2	158.8	168.1	183.1	200.1	9%
Penetration Rate	51%	55%	64%	68%	73%	78%	

Date: November 2017

STRATEGYANALYTICS
Research, Experts, and Analytics

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*"According to market research firm Strategy Analytics, the number of shipped handsets, PCs and tablets incorporating native DisplayPort or DisplayPort Alt Mode will increase from nearly 215 million units in 2017 to more than 345 million units in 2018, a year-on-year growth of **61%**."*

—Strategy Analytics, February 2018

Factors driving increased DisplayPort adoption rates are:
- Demand for high-quality video (4K UHD and higher)
- VR/AR adoption and performance requirements
- Increased adoption of USB-C and Thunderbolt 3
- DisplayPort capable handset growth
- Mobile device docking solutions

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DISPLAYPORT™ 1.4a

DisplayPort 1.4a Summary

- The latest update of the VESA DisplayPort Standard, Version 1.4a, was released April 19, 2018

- Includes updates and improvements for features and capabilities such as Display Stream Compression (DSC), Forward Error Correction (FEC) and enhanced Multi-Stream Transport (MST) feature

- Backward compatible

- *Added new DP 8K cable specification (HBR3 ready)*

- DP 1.4a feature compliance testing is growing fast, with dozens of products certified

DP Link Rate Increase

DP Version Introduction	Link Rate Name	Bit Rate	Max Resolution Support (24bpp, 60Hz Refresh, 4:4:4 format	Max Resolution Support (24bpp, 60Hz Refresh, 4:2:0 format
DP 1.0	RBR HBR	1.62 Gbps 2.7 Gbps	1920x1080 2560x1600	Not supported Not supported
DP 1.2	HBR2	5.4 Gbps	4K x 2K	Not supported
DP 1.4	HBR3	8.1 Gbps	5K x 3K	8K x 4K
DP Next Gen	TBD	>2X	TBD	TBD

Total useable data transfer rate for DP 1.4 HBR3 = 25.92 Gbps

      8.1 Gbps link rate, per lane

    x 0.8 to account for 8b/10b transport coding overhead

    x   4   maximum number of available lanes

    25.92 Gbps total usable data transfer rate

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DisplayPort 1.4a Continues to Support Other Features that are Unique to DisplayPort

- Multiple monitors using Multi-Stream

- High-definition audio formats

- Adaptive Sync

- Protocol converters to VGA, DVI, or HDMI

- Low voltage, AC coupled interface compatible with sub-micron process geometry, simplifying integration

- Data scrambling and fixed link rates simplify EMI and RFI mitigation

- **Royalty free standard** available to VESA members

DisplayPort 1.4a Deployment Update

- HBR3 (32.4 Gbit/s) still remains the highest available mode and is shipping in volume today.

- Early certification of HBR3 Silicon/end products started 2H'2016 and continues to increase in all segments

- DP 1.4a is being deployed in both native DP devices and devices using the USB Type-C interface that support DisplayPort Alternate Mode

VESA PlugTest Events

- PlugTests have significant value to member companies. Particularly as new capabilities and products are deployed.

- Demonstrate and improve Traditional Interoperability

- Test DP 1.4 and DP Alt Mode over USB Type-CTM products
  - HBR3 and other new capabilities
  - Verify Test Equipment Correlation

- Test DisplayHDR, DSC, FEC and other new features

- VESA hosted three successful PlugTests in 2017

- VESA plans to host three PlugTests in 2018
  - Taipei, Taiwan: May 7-11, 2018 Scheduled
  - Burlingame, CA: Tentatively August
  - Taipei, Taiwan: Tentatively November 2018

New and updated VESA Compliance Test Areas

- DP 1.4 PHY CTS final draft under review and will be released after verification of testing targets and procedures at next weeks VESA PlugTest event in Taipei

- Link Layer CTS specification and Test Equipment updates
  - LL CTS updates are top priority for VESA compliance program
  - New and updated tests will be run at upcoming VESA PlugTest

- HDCP Compliance Testing
  - Starting in April 2018 HDCP compliance testing is required as part of DP certification, if supported.

- DP 8K Cable Certification (HBR3), over a dozen DP 8K cables have been certified since launch of DP 8K early certification program last year.

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DP 8K Cable Specification and Certification

- VESA developed new DP8K (HBR3 ready) Cable Specification as part of DP 1.4a specification update

- DP8K Certified cables provide added assurance of smooth operation and full compliance at the higher HBR3 link rate

VESA Strengthens 8K Video Resolution Ecosystem with Market-ready DP8K Certified DisplayPort Cables

Posted on January 3rd, 2018

DP8K cables are guaranteed to support HBR3, the highest bit rate supported by DisplayPort version 1.4; new DisplayPort developments on the horizon offering even higher bandwidth levels SAN JOSE, Calif. [...]

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DisplayPort 1.4a Compliance Updates

- Aux Slew Rate test added to minimize Aux to Main Link crosstalk
  - Applies to USB-C products, Source, Sink and Adapters
  - Waivers have been granted for failures for existing silicon

- Optimal TP3_CTLE is normative requirement for HBR3 PHY Testing

- Spectral Method is normative method for Voltage Level and Pre-emphasis Level checks

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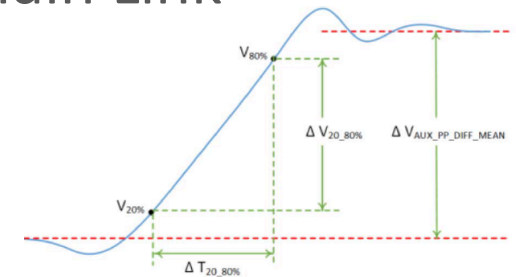
VLS and PE level checks – Spectral Method

- PHY CTS 1.2b used time domain measurements to verify proper ratio changes for VLS/PE setting changes

- Accuracy and test time was always a problem

- Spectral method analyzes frequency content (harmonic amplitudes) to verify changes to VLS/PE are monotonic and meet DP 1.4a specification requirements
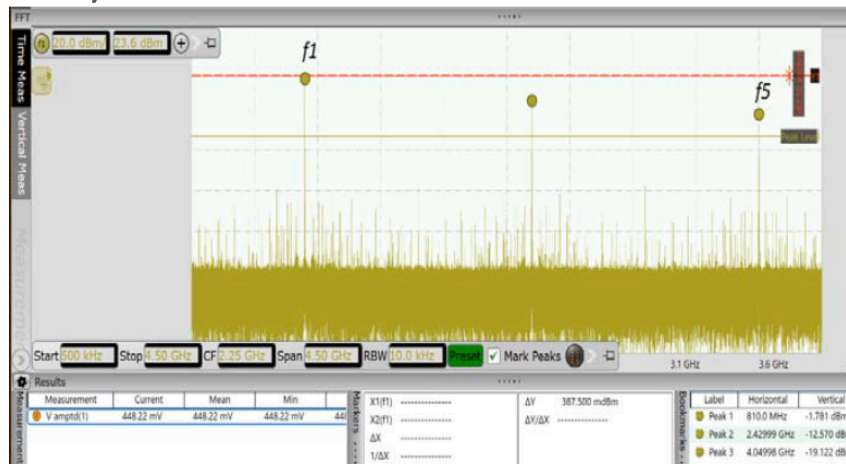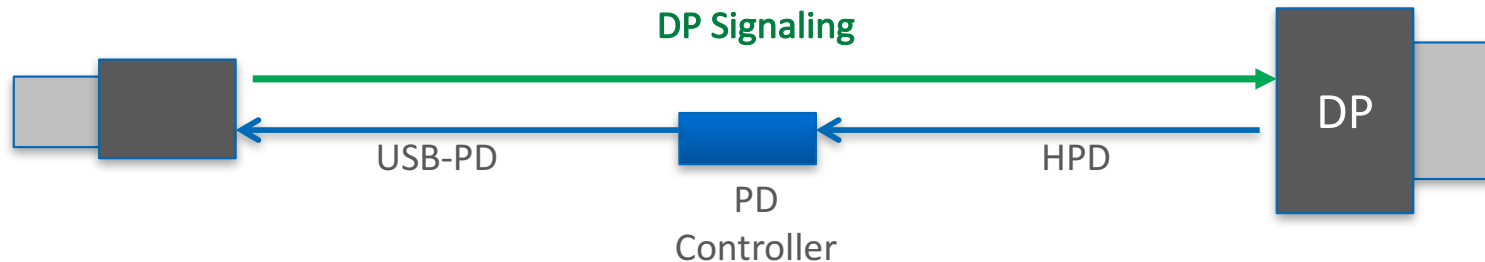

Figure 3-5: HBR3 FFT 1st and 5th Harmonic Amplitude Measurement

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DISPLAYPORT OVER USB-C™ CERTIFICATION

DP Alt Mode Compliance Test Updates

- New USB-C to DP adapter tests added with SCRs to specification and CTS

- Tests also added for adapter and sinks to check for proper support and implementation of pin assignment E

- USB-C to DP Plug cables must also include detection logic to determine if DP Plug is connected to DP Source or DP Sink and report connection properly over USB-PD

- Tests to be verified at Taiwan PlugTest

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Top DP Alt Mode Compliance Test Issues

- Proper Pin Assignment E support for USB-C Sinks
  - Issues with proper implementation of pin assignment E still an issue
  - New tests have been implemented by test equipment to verify correct implementation of pin assignments
  - Sinks MUST NOT enable pin assignment E for compliance but disable in fw when shipping
  - VESA will be auditing Certified USB-C Sinks for this issue in 2H'2018.

- USB PD Protocol failures
  - Use certified USB PD controllers and passing fw
  - DP Alt Mode product certification requires USBIF TID as proof that PD controller has been certified

Additional DP Alt Mode Compliance Test Issues

- 2xDP/2xUSB 3.1 configuration testing
  - Cross talk between USB 3.1 lines and DP lines can degrade the link

- USB Type-C to DP Plug adapter reversibility
  - USB Type-C to DP plug adapters must work connected in both directions

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VESA Certified DisplayHDR

DisplayHDR Summary

- Industry's first open HDR specification with a fully transparent testing methodology

- Go to https://displayhdr.org to learn about the DisplayHDR and certification

VESA Defines New Standard to Help Speed PC Industry Adoption of High Dynamic Range Technology in Laptop and Desktop Monitor Displays

DisplayHDR is industry's first open HDR specification with a fully transparent testing methodology

SAN JOSE, Calif. – December 11, 2017 – The Video Electronics Standards Association (VESA®) today announced it has defined the display industry's first fully open standard specifying high dynamic range (HDR) quality, including luminance, color gamut, bit depth and rise time, through the release of a test specification. The new VESA High-Performance Monitor and Display Compliance Test Specification (DisplayHDR) initially addresses the needs of laptop displays an

DisplayHDR Certified Products

- Certified DisplayHDR performance tiers
  - DisplayHDR 400
  - DisplayHDR 600
  - DisplayHDR 1000

- VESA has now certified products in each tier

- DisplayHDR CTS and Test Tool are available to all companies

DisplayHDR 1000

Philips Momentum 436M6VBPAB

DisplayHDR 600

HP Pavilion Gaming 32 HDR Display

Samsung CHG70

Samsung CHG90

DisplayHDR 400

AOC AGON AG322QC4

Dell S2719DM

LG Electronics 32GK850F

Philips Brilliance 328P6AUBREB

Philips Momentum 436M6VBRAB

USB Type-C information is provided as an informative overview only.
Please refer to the USB Type-C Cable and Connector Specification available at www.usb.org for more information

New VESA Technology Development Areas

VESA technology development

- VESA members are collaborating on several key technology areas

- AR/VR Task Group
  - Focused on creating solutions roadmap to meet performance, power and implementation requirements for future AR/VR needs

- Automotive SIG
  - Working with automotive industry to address needs for high resolution performance in this market segment

DP Next Generation

DP Next Generation Technology Development

- VESA is actively developing standard for DP Next Generation performance requirements

- Development includes work to reduce protocol overhead

- Performance goals are to more than double current DP 1.4a performance capabilities

Summary

Summary

- DP 1.4 product shipments and certifications continue to grow

- DisplayPort over USB-C is a game changer for small form factor and portable products and is rapidly becoming the defacto standard for laptops, tablets and handheld devices

- Testing and certification of DP Alt Mode products is continuing to increase with dozens of products getting certification each quarter

- Development and adoption of new technologies continues to drive increases in VESA membership growth

- DP Next Generation development will define performance requirements to meet future needs of the industry and consumers

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THANK YOU
DisplayPort.org
DisplayHDR.org
VESA.org

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Questions?

Demo Station Overview – at end of presentations quick description of demo stations – 2 minutes each.