June 2017

WAINHOUSE Research

Evaluation of Polycom Pano

Hands-on testing of a feature-rich wireless presentation solution

This evaluation sponsored by ...

Polycom

Background

Founded in 1990 and headquartered in San Jose, California, Polycom is a privately-held [1] company that develops, manufactures, and markets video, voice, and content collaboration and communication products and services. The company employs approximately ~ 3,000 people and generates more than $1B in annual revenue.

In June 2017, Polycom announced a new solution called Pano – a wireless and wired presentation solution intended to make it quick and easy for meeting participants to present and share various types of content.

In May 2017, Polycom commissioned the Wainhouse Research (WR) test team to perform a third-party assessment of Pano. To facilitate this effort, Polycom provided a pre-release version of the Pano device, and a Sharp PN-L703B 1080p touch-capable 70" display.

This document contains the results of our hands-on testing.

Understanding Pano

Pano is a 4K-capable wireless presentation solution (WPS) that includes an array of advanced features and capabilities.

The Pano package is available with an MSRP of US $1,990 from a network of Polycom channel partners / resellers, and includes the following:

- Pano base unit
- Accessories (VESA mount, cables, etc.)

The Pano base unit includes the following:

- Support for PoE+ or an external power supply
- One (1) 4K HDMI output (capable of 60 fps with RGB 4:4:4 color)
- One (1) 4K HDMI input (30 fps)
- Two (2) Ethernet ports – one active, and one for future use
- One (1) Analog audio output (3.5 mm jack)
- Built-in 2.4 GHz and 5 GHz Wi-Fi radios (for use with Miracast sources)
- Support for Bluetooth 4.0
- Two (2) USB ports (for touch control, mouse control, etc.)

Pano supports up to five (5) concurrent live connected sources (one wired and four wireless), four (4) of which can be displayed simultaneously on the connected display.

[1] Polycom was acquired by private equity firm Siris Capital in September 2016

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Hands-On Testing

System Installation

The Pano base unit can be placed on a table or inside a credenza, installed in an equipment rack (requires a rack shelf / mounting kit – not included), or mounted almost anywhere (on a wall, under a table, on the back of a display) using the included VESA-compatible mounting adaptor. Given the base unit's small size, we expect some customers will simply affix the device to the back of the in-room display using Velcro.

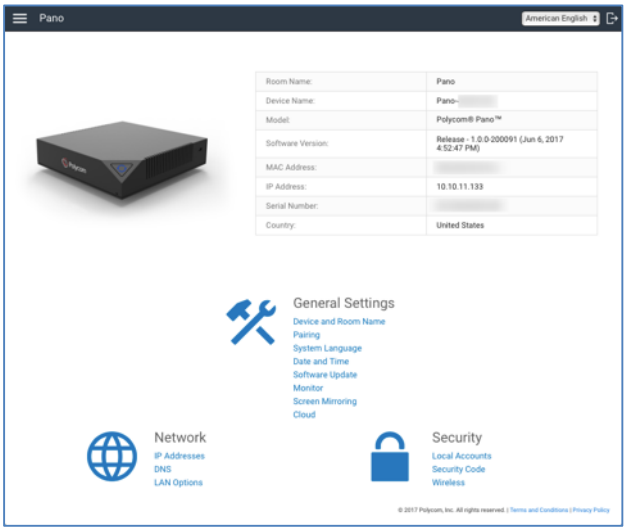
Installing Pano requires only power, network, and a single HDMI connection between the base unit and the display. Thanks to PoE+ support, both power and network can be provided via a single CATx cable.

When power is first applied, the system boots up and displays the Pano initial setup page (see image at right).

To configure the system, the installer (user, administrator, etc.) simply enters the IP address displayed on-screen into any web browser and steps through the setup wizard which includes:

- Change Password – the installer must change the default password
- System Language
- Cloud Registration – allows the installer to either sign-in to an existing Polycom Cloud account or create a new account
- Device Name

The installer then clicks the Finish button, at which point the Pano system reboots and is ready for use.



After the system reboots, the installer now sees the Pano web user interface in his browser. This UI provides access to various additional system settings (e.g. enable wireless sharing protocols, define whether pin-codes are required for sharing, etc.).

For our hands-on testing, we used Pano's default settings. All in all, it took us less than 10 minutes to install Pano within our lab environment.

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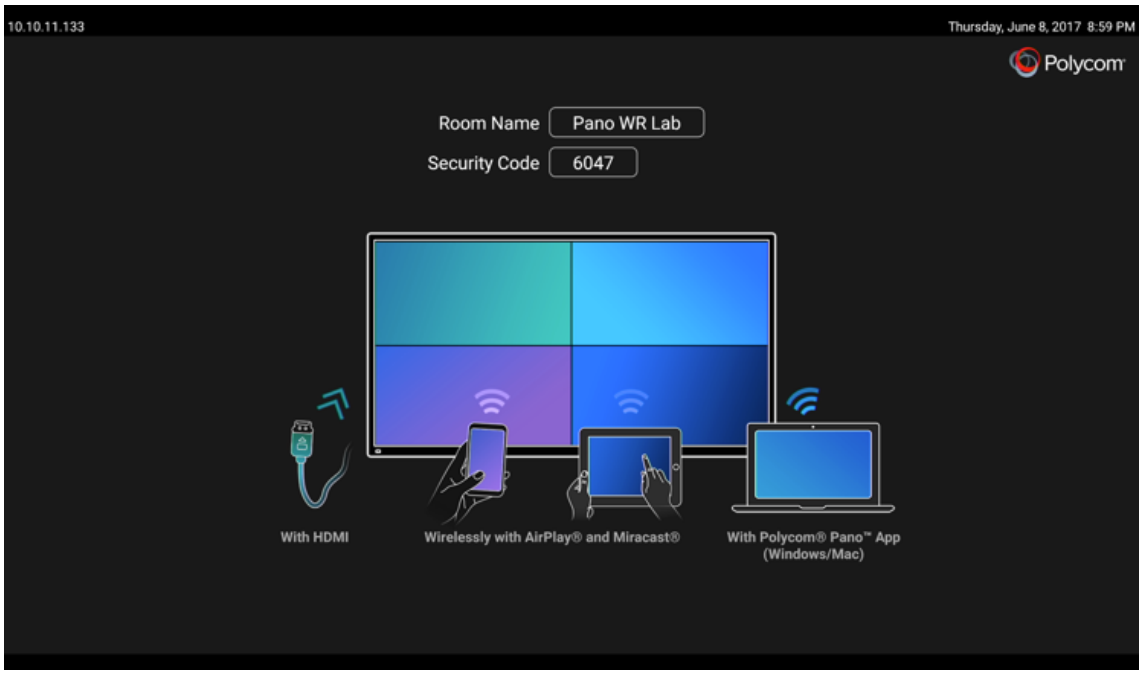
Wired and Wireless Presentation Testing

Once configured, Pano displays an animated welcome message (see below) on the room display.



For our first round of testing, we focused on Pano's core competency – wireless and wired content presentation. Pano supports the following presentation methods / protocols:

- Wired (HDMI) presentation
- Wireless presentation using the Polycom Pano App (Windows and Mac PCs only)
- Wireless presentation using Apple AirPlay
- Wireless presentation using Miracast

The table below highlights the methods / protocols available to specific users and devices based on the following assumptions:

- Pano is connected to the corporate LAN
- Internal users are connected to the corporate LAN
- Guest users cannot connect to the corporate LAN

	Wired	Pano App	AirPlay	Miracast
Guest user	X			X
Internal Users				
Windows PC user	X	X		X
Mac PC user	X	X	X	
iOS user (iPad, iPhone)			X	
Android user				X (if supported)

The decision as to which method / protocol to use depends on the user, the device(s) in use, the features / capabilities required, and even the corporate culture.

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For the presentation testing, we used the following devices – each connected to the same network as the Pano device.

- Microsoft Surface Pro 4 notebook running Windows 10 Pro
- Dell Inspiron 15 notebook running Windows 10 Pro
- MacBook Air notebook running macOS 10.12.5
- iMac 5k desktop PC running macOS 10.12.5

Wired (HDMI) Presentation

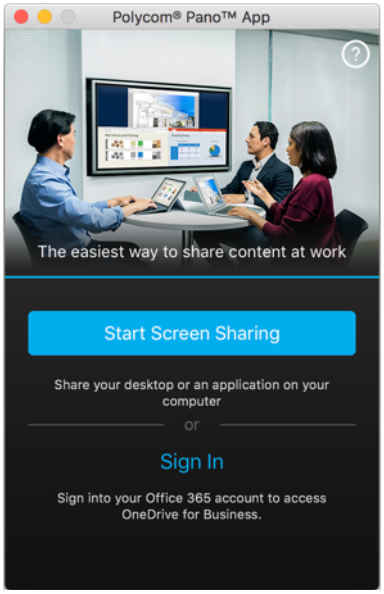
To test wired presentation support, we connected an HDMI cable between the Pano device and the four test PCs listed above. In all cases, the HDMI content was displayed on the room display properly.

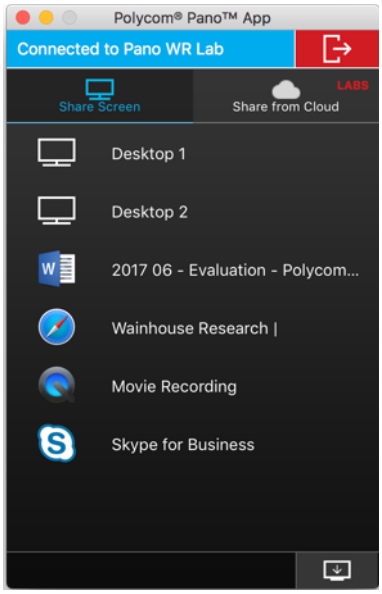
Wireless Presentation using the Pano App

The Pano app is a free software app, available for Windows and Mac PCs, which can be downloaded from the Polycom website. To share content with the Pano app, we completed the following:

- Installed the Pano app on our four test PCs
- Clicked on the "Start Screen Sharing" button (see image at right), at which point the app presented a list of nearby Pano devices (dubbed rooms within the app) [2]
- Selected the Pano device to use from the list
- Entered the room's presentation pin code (if the system is configured to require a code)
- Selected the content to share from the on-screen list presented within the Pano app (see image below at right)

We used the Pano App to share content from both Windows and Mac PCs, and in all cases the system worked as expected, providing a high quality content sharing experience.





[2] The Pano App uses Bluetooth 4.0 to detect nearby Pano devices. This methodology eliminates the need for the IP network to support device discovery protocols. PCs lacking Bluetooth support can enter the IP address of the desired Pano device directly.

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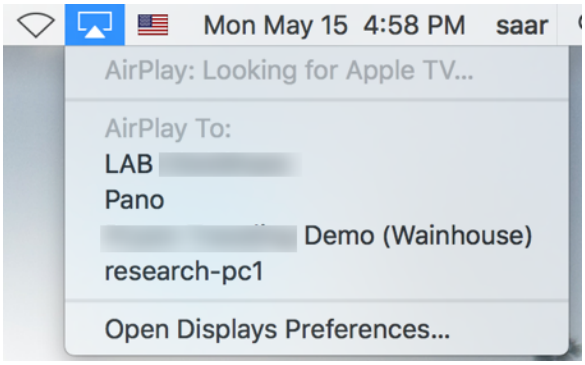
Wireless Presentation using Airplay

For our AirPlay presentation testing, we used the following AirPlay-capable devices; an iPhone 7, an iPad Mini 2, and a MacBook Air notebook. To share content with AirPlay, we completed the following steps:

- Clicked (on the notebooks) or pressed (on the mobile devices) the AirPlay icon.
- Selected Pano as the "AirPlay To:" device (see image at right).
- Entered the required pin code, at which point our device's display was mirrored on the Pano display. On devices with multiple displays, the main display was mirrored.



When we shared from a Mac PC, we then had the ability to choose:

- Which display to mirror (our test Mac PC has two displays)
- Whether to mirror or extend the device's display. Extending essentially creates an extra virtual display on that device that is presented on the Pano display.

We tested all of the above capabilities, and Pano met or exceeded our expectation. We especially appreciated the fact that Pano's implementation of AirPlay included advanced features like orientation awareness (when we turned the mobile device, the image turned) and the ability to share audio.

Author's Note on AirPlay:

As a bit of background, AirPlay is a proprietary protocol developed by Apple that enables the sharing of content from Apple Mac and iOS devices over IP (usually wireless) to any device running an AirPlay server (e.g. AppleTV). All Apple PC and mobile devices include native AirPlay functionality

AirPlay, as well as some other wireless presentation protocols (e.g. Google Cast), follow a workflow in which the client (e.g. notebook PC, mobile device) broadcasts a discovery message over the IP network to discover compatible servers that will accept a connection. All compatible servers that receive the discovery message then respond with a confirmation message including connection information. Unfortunately, not all IP networks are configured to allow the device discovery / response traffic.

AirPlay also supports device discovery over Bluetooth 4.0 instead of the IP network. Unlike many competing vendors, Polycom implemented Bluetooth discovery within Pano's AirPlay support, so AirPlay users can see a list of nearby Pano devices without depending on the IP network.

In addition, AirPlay includes a mode called Direct Play in which Internet media (e.g. a YouTube video) that a user tries to open on a Mac or iOS device is instead opened and played directly on the AirPlay server. This provides a better viewing experience than opening the media on the device and using screen mirroring to share it with the AirPlay server. Unfortunately, Pano does not currently support Direct Play mode.

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Wireless Presentation using Miracast

We tested Pano's support for wireless presentation using Miracast with the following devices:

- A Microsoft Surface Pro 4 running Windows 10 Pro
- A Samsung galaxy tab 3 Lite running Android 4.4.4

While we have a number of concerns related to the Miracast protocol and workflow, Pano's implementation of Miracast worked as expected, allowing us to present content from our Windows and Android devices on the Pano display.

Author's Note on Miracast:

As a bit of background, Miracast is a standard for wireless presentation ratified by the Wi-Fi alliance.

Unlike other wireless presentation protocols (e.g. AirPlay, MirrorOp, ChromeCast, etc.), Miracast uses Wi-Fi direct (a.k.a. Wi-Fi P2P or Peer to Peer) to discover and send content from the source device to the Miracast server.

The advantage of this methodology is that devices can send content wirelessly to devices without the need to be on the same IP network.

Unfortunately, there are many disadvantages associated with Miracast including limited device support, possible Wi-Fi interference, the fact that shared content is often scaled (reduces quality), a complex workflow that is not consistent between devices, and more. A detailed review of Miracast is beyond the scope of this study, but suffice it to say Miracast is not ideal.

Automatic On-Screen Layout

Pano allows up to four sources, each at up to full HD (1080p) resolution, to be displayed on screen simultaneously.

- The first shared source will be displayed in full screen.
- Sharing a second source automatically changes the view to a side-by-side layout.
- Sharing a third source automatically changes the view to a one above, two below layout.
- Sharing a fourth source automatically changes the view to a quad-screen layout.

Blackboard and Annotation Capabilities

Pano includes a few features normally found on advanced collaboration / ideation solutions: local (display-based) blackboarding and annotating over shared content.

To use these features, Pano must be connected to a compatible touch-capable display or standard USB mouse. Currently, Polycom has tested and verified that the following touch displays provide an "optimal touch experience" with Pano:

- Sharp PN-L703B - 70" 1080p touch display (used for this assessment)
- Volanti VB-6500 - 65" 4K touch display

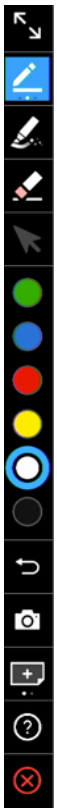
Hopefully Polycom will expand the list of tested and supported touch displays in the near future.

When connected to a compatible touch display, the Pano animated welcome message automatically expands to a looping message that invites the users to share / present content or walk up to the display and start writing (see image at right).

Blackboard Capabilities

To use the electronic blackboard function, users simply need to tap on the board and start writing.

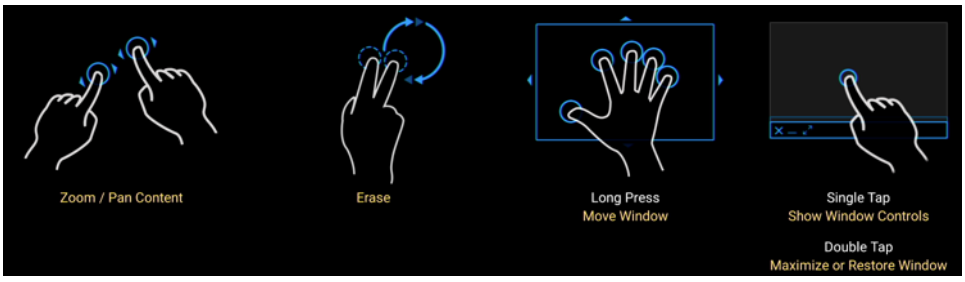
Pano's blackboard supports the following capabilities accessible from a vertical toolbar along the left side of the display:



- Three pen sizes / widths
- Six pen colors (green, blue, red, yellow, white and black)
- A magic highlighter function (writing disappears after a few seconds)
- An advanced eraser function (see detail below)
- Undo the last writing stroke
- Take a snapshot
- Create new page (with white or black background)
- Display help page
- End the session (which also clears the entire workspace)

First we tested the blackboarding function on the Polycom 'tested and approved" Sharp touch display. With this display, Pano provided an exceptional blackboarding experience. We were especially impressed by the low (~ 80 ms) delay while inking.

Pano also supports a range of gesture controls. For example, moving two or more fingers in a circular motion activate eraser mode. Similarly, moving two fingers from one area to another activates a pan function (move content from one area to another). Two-finger pinch and zoom are also supported, and together they provide an almost unlimited virtual blackboard size. These controls make it quick and easy to jump between writing to image manipulation.



We also tested Pano using an additional touch display we had in our lab environment. On this mon-Polycom-approved display, the blackboarding features worked fine, but the responsiveness was slower.

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Annotation Capabilities

Pano allows users to annotate over any shared (wired or wireless) content. But unlike some solutions that support annotation over static images only (via screenshots), Pano supports annotation over live and screenshot images.

Viewed another way, annotation is essentially the blackboarding function with a different background – in this case the shared content image(s).

Annotation is always available on the left side of the display whenever a content source (wired, wireless, or even blackboard images) is on screen. By default, the annotation markings act as an overlay on top of the live content stream.

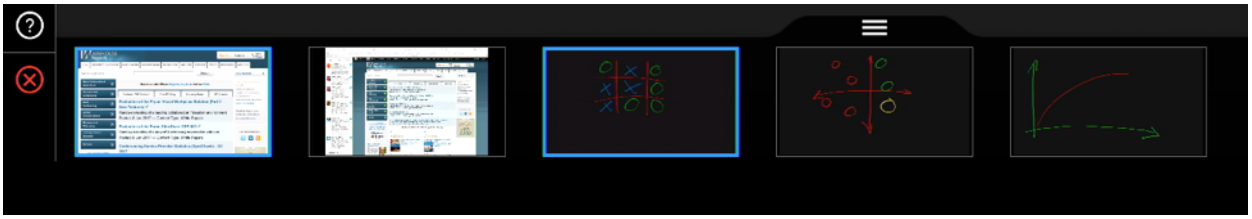
We tested Pano's annotation capabilities with excellent results.

The Pano Content Tray (with Advanced Layout Control)

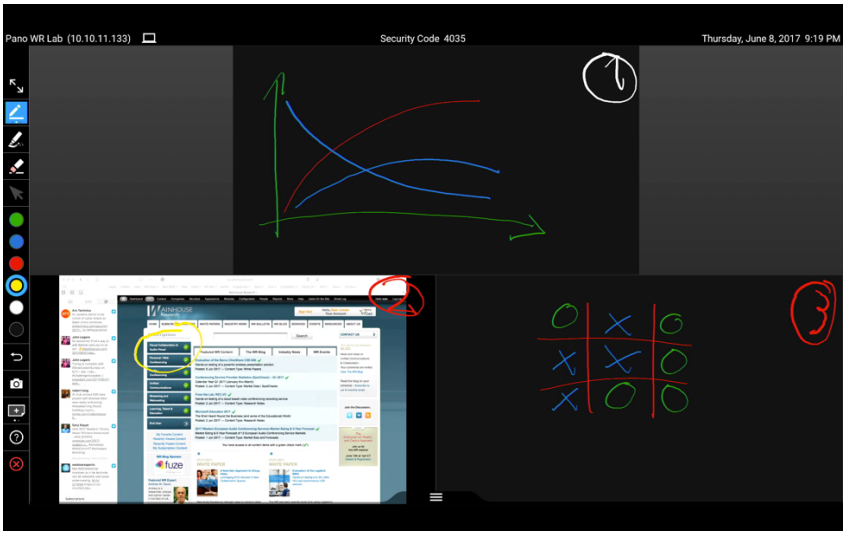
One of Pano's most powerful and compelling features is the ability to not only share multiple content items, but also to control and manage the Pano on-screen experience.

Pano supports live sources (shared wired and wireless content, and blackboard content), as well as static content items (snapshots). And each of these items lives within an area called the Pano Tray.

Essentially, the Pano Tray is a queue of available content items that users can choose to display (make active) or not display. The image below shows the Pano Tray (lower area) with several content items.



Clicking on a content item within the Content Tray causes that item to be displayed (become active). Clicking on another makes that second content item active as well (see screenshot below showing three active content items – one live source and two blackboards).



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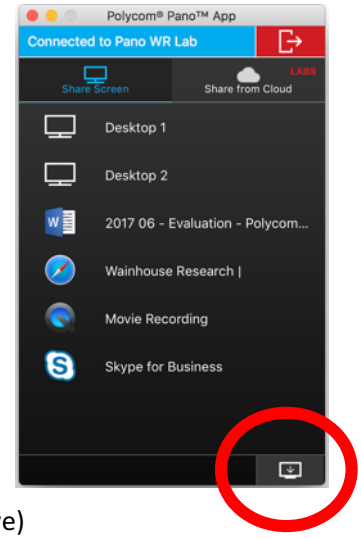
This content item selection process continues until all four (4) on-screen positions / quadrants are used. Making a fifth content item active causes the first active item to be de-activated (first-in first-out).

In addition, a multi-finger press on an active content item allows the user to move that item to a different on-screen location.

The process of choosing which content items to display and positioning them on-screen sounds much harder than it is. The controls are quite intuitive, and a help page is just a single touch away.



The Content Tray and on-screen layout controls make it quick and easy to create and manipulate content with Pano. However, the Pano on-screen UI does not currently offer a way to save or email the content to others.

Fortunately, the Pano App offers a save function (see the display icon at the bottom right of the screenshot at right) which:

- Takes a snapshot that includes all of the currently active content items being shown on the Pano device
- Takes snapshots of each content item (live sources, blackboards, etc.) currently within the content tray
- Saves all of these snapshots on the user's PC (or network / cloud drive)

We tested the save function, and it worked fine. However, this is less convenient than an on-screen save or email button, and this workflow requires the user to open the Pano App and connect to the Pano device.

Additional Features / Functions

Integration with Polycom RealPresence Group Series Endpoints

It comes as no surprise that Polycom has included some degree of integration with Polycom Group Series video endpoints within Pano.

As shown in the Polycom-provided diagram below, Pano's HDMI output can be connected to the content input of a Group Series endpoint. In addition, the Pano web user interface allows admins to "pair" the Pano device with a Group Series endpoint.

Once paired, Pano will send an API command to the Group Series endpoint instructing it to activate content sharing whenever someone works with the Pano device (e.g. connecting the Pano app to the device, sharing wired or wireless content, etc.).

We tested this capability, and it worked as expected. However, as it stands today, the integration is one-sided only, meaning that the Group Series endpoint does not change its behavior because it is connected to a Pano device. As a result, the resulting experience is not as seamless as it could be.

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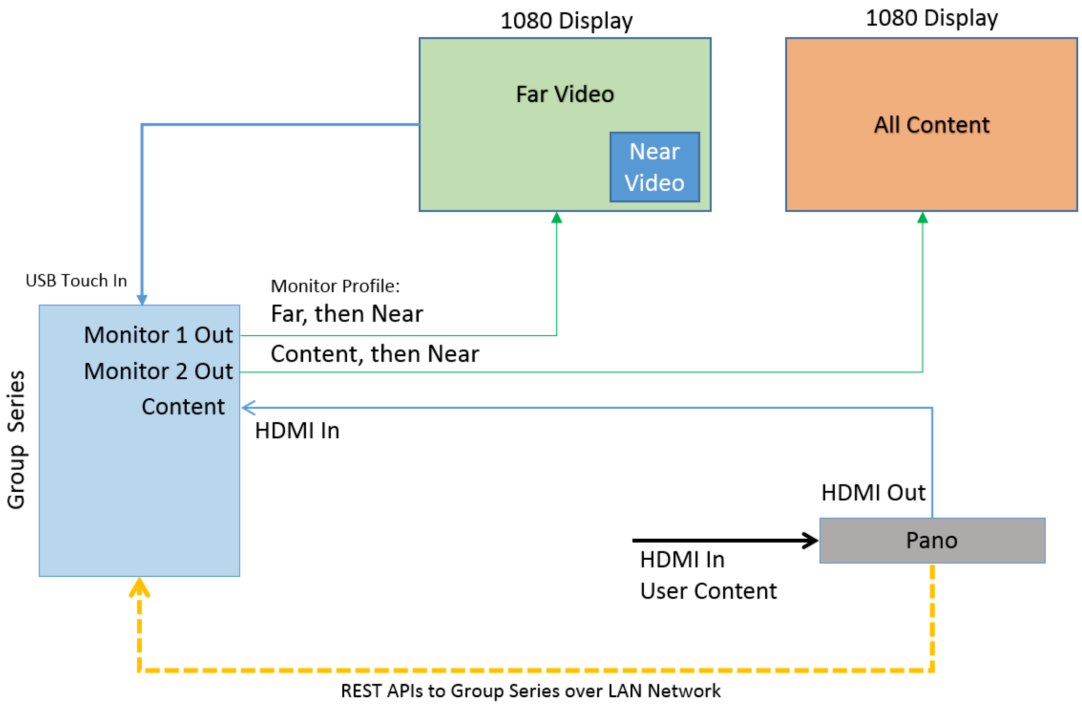

For example, while in this configuration, Pano's user interface is not always visible. To see the Pano UI (and the instructions user's need to connect to and use Pano), one of two things needs to happen:

- A user needs to activate content sharing on the video system. However, there's nothing that prompts the user to activate content sharing; the second ("all content") display is either blank (while not in a call) or displaying near-end video (while in a call).
- A user needs to connect to Pano so that Pano commands the video system to activate content sharing (via the API). However, in most cases, to connect to Pano, the user must enter a pin code. Unfortunately, the pin code is displayed on the Pano screen only, which is not visible until the Pano UI is visible on screen.

The above situation is somewhat of a Catch-22.

Additional Note – the Pano Administrator Guide highlights additional ways to use Pano with Group Series video endpoints in dual and triple-monitor configurations, with or without touch. In some cases, additional AV hardware (e.g. a scaler / splitter) is required. However, each of these approaches involve some degree of compromise.

Hopefully Polycom will enhance this integration in the near future.

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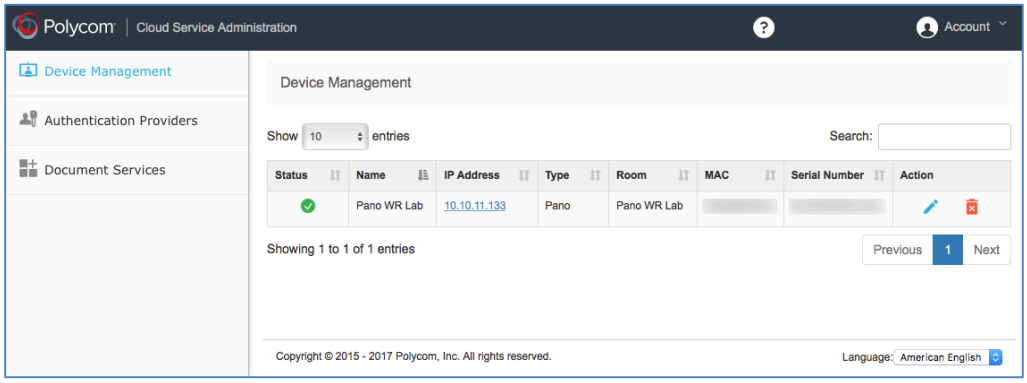
The Polycom Cloud

While installing Pano, we created a free account on the Polycom Cloud service. We then registered our Pano device, using its unique Mac ID, to the Polycom Cloud service.

Registering a Pano device to the Polycom Cloud offers a handful of benefits including:

- The ability to see the device's status (online or offline, name, IP address, Mac ID, etc. via the Polycom Cloud user portal
- Inclusion of the Pano device in the directory of Pano systems
- Automatic firmware updates



In addition, Polycom has introduced a feature called, "Cloud Service Content Sharing" that allows users to share Microsoft OneDrive for Business documents via the Polycom Cloud. Essentially, the Polycom Cloud handles the user's authentication to OneDrive, and the workflow to share OneDrive content is as follows:

- A list of available OneDrive content is displayed within the Pano app
- The user selects the content item to be shared
- The content item is "opened" within the Polycom Cloud
- The content item is then "rendered" on Pano and on the user's desktop

Although the Cloud Service Content Sharing feature is currently listed as a Polycom Labs feature, we took the time to test this functionality. In the end, although we were able to share our OneDrive content successfully via the Polycom Cloud, we think the workflow around this feature is not quite ready for prime time.

Analysis and Opinions

Pano represents Polycom initial foray into the wireless presentation market. And while not perfect, Pano brings quite a bit of power to the meeting room.

As a part of this assessment, we tested various features and functions of Pano including:

- Wired and wireless presentation
- Blackboarding and content annotation
- Advanced features (integration, cloud-based management and content sharing)

Simply stated – Pano is a powerful wireless presentation solution. Regardless of the content source (Windows PC, Mac PC, mobile device, etc.), Pano provided a high quality content sharing experience. Pano's AirPlay support is another area of strength thanks to its support for Bluetooth device discovery. And the wired content input makes it quick and easy for guests to share content.

Pano also supports blackboarding and annotation over shared content while using a compatible touch display. We found the digital inking within the system to be extremely responsive – among the best we've seen. In addition, we were particularly impressed by the broad range of gesture controls supported. Pano's Content Tray and on-screen layout controls also worked extremely well. Some solutions focus on image quality. Others focus on ease of use. Pano covers both quite well.

Our testing also revealed a few weaker areas. For example, sharing content from Android devices depends on Miracast – which is a less than ideal protocol. Hopefully Polycom will release a Pano app for Android in the future. In addition, Pano lacks an on-screen save button. Also Polycom has tested and verified only a handful of touch displays to date. And finally, Pano does not currently offer any APIs, and the current level of integration between Pano and Polycom's Group Series video systems is limited.

Overall, Polycom Pano is a well performing wireless presentation solution that offers a robust feature-set and strong ease of use, at a compelling, sub-US $2k price point. Based on our testing, Pano should be right at home in almost any meeting room.

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About Polycom

(copy provided by Polycom)

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