Data on Wheels

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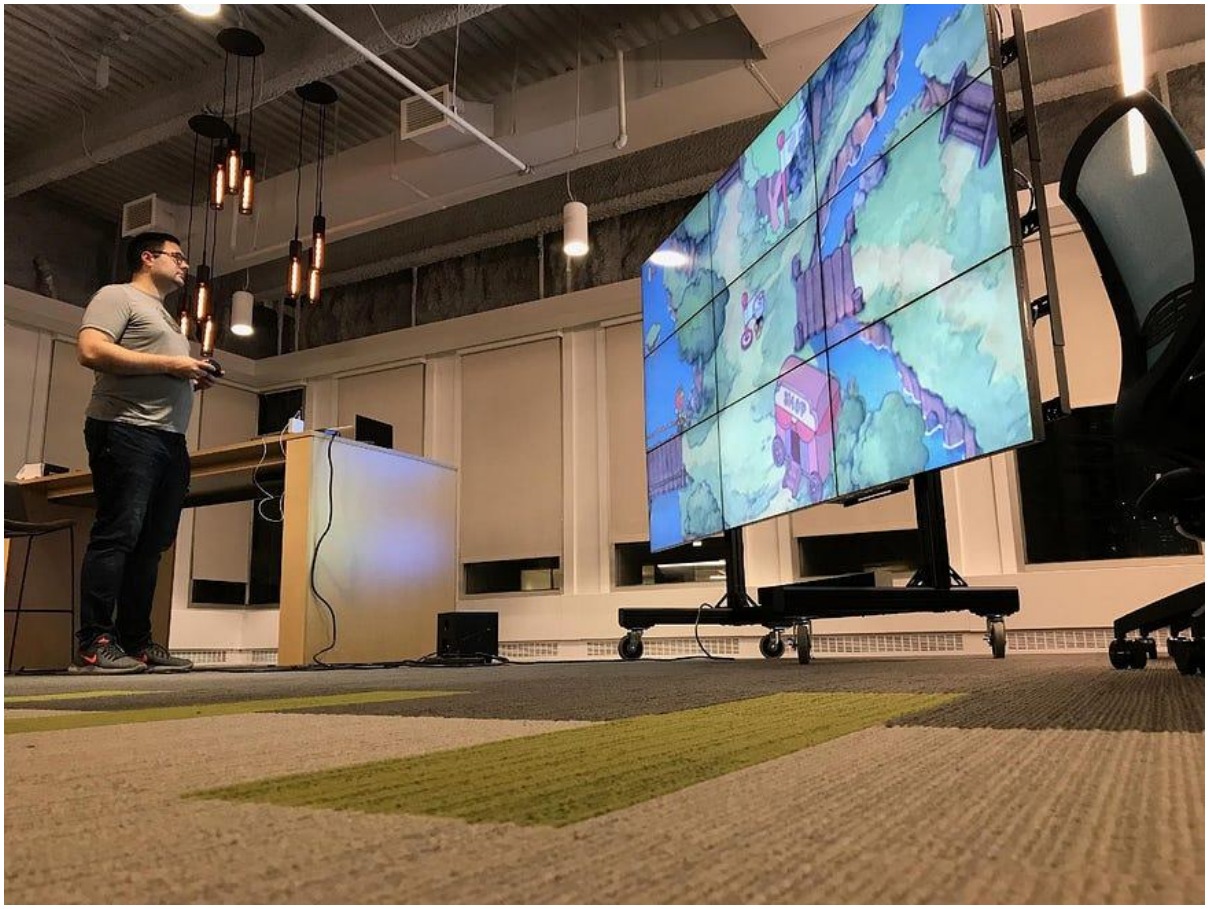
I first knew that Klaviyo was a special company when Andrew Bialecki, our fearless leader, came to me in my first week and asked me to build a massive video wall to support eight to nine dashboards of data for Black Friday and Cyber Monday â€” the most important days of the year for Klaviyo and our customers. In the spirit of this unique request it was obvious that I needed to take a different approach with this project.

First, I began drafting up my vision, which was a twist on the traditional 3x3 display wall that youâ€™d typically find in schools, museums, malls, and airports. I sent Andrew the game plan for this wall, to which he simply replied:

> **â€œ+1 letâ€™s do this**.â€ Klaviyoâ€™s CEO

Thus began our quest to make the ideal data display for Klaviyo.



Cuphead on the big screen. The screen array has a lot of latency. Not recommended for gaming, but still fun!

Most locations have a lot of unused space or large architecture â€” often massive blank walls become the traditional canvas for signage. Klaviyo is a busy modern office with standard sized

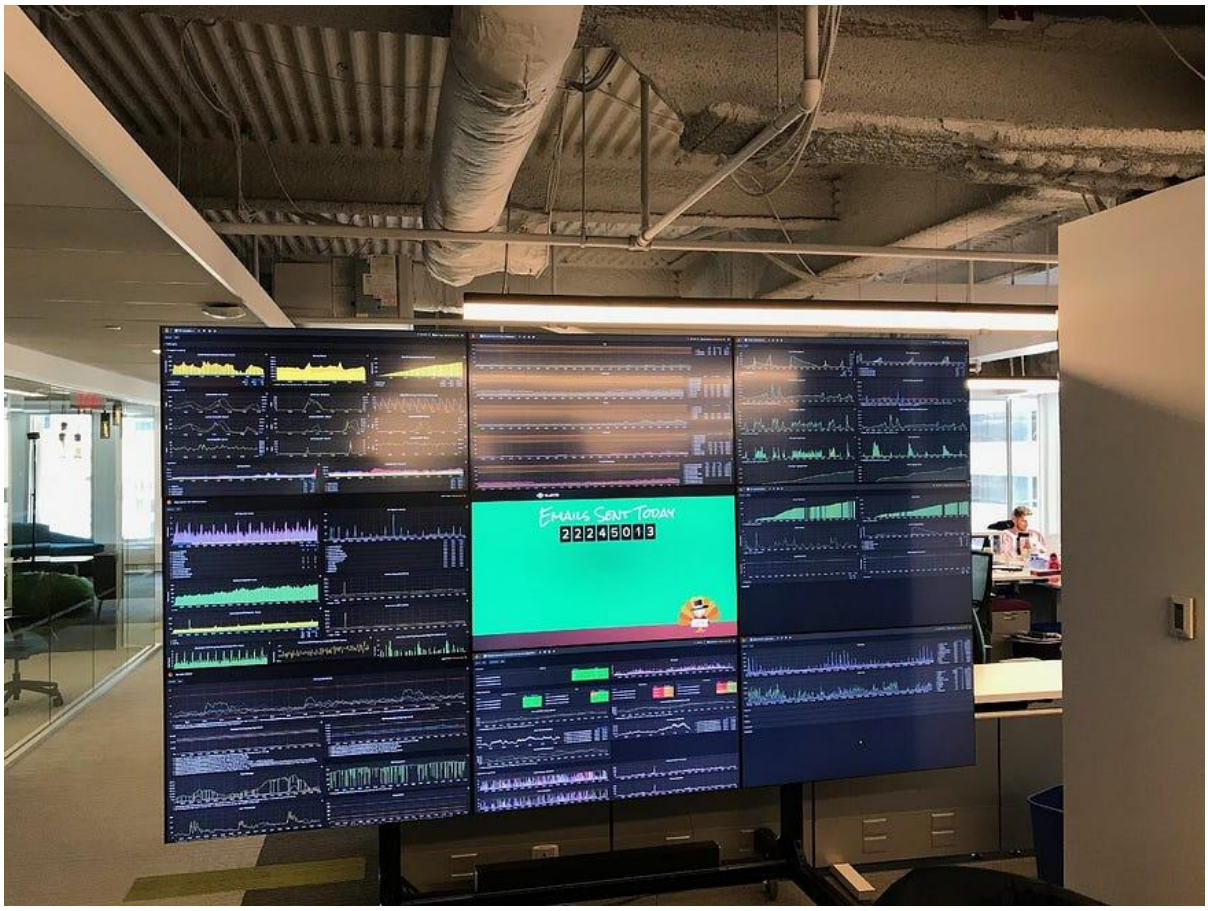
exposed ceilings (9â€“10â€™). We donâ€™t have large unused walls â€” in fact, every spare wall we can weâ€™ve turned an Idea Paint wall that can be drawn on with dry erase markers.

The office space issue posed the first big challenge of the project and for that we looked at multiple options for carts before moving forward with the SmartMountÂ® Portable Video Wall Cart 3x3. A video wall on wheels! Now weâ€™re talking.

When the cart arrived our first curveball emerged â€” it was too tall and risked hitting exit signs, sprinklers and my precious wireless access points! We ended up shaving a few inches off the top and mounting the brackets slightly lower to get around the problem. After that the cart glided gracefully around the office without risking blaring sirens or flooded laptops.

The video displays turned out to be the easy part of the project. They mounted very quickly with the kit. The team I had helping me said this display could be built more quickly than those mounted to a wall despite having never built one like this before. The nice part of assembly for our wall is that anyone can step behind it to cable manage and wire it, which you canâ€™t really do while your stuck against a wall.

Speaking of hardware, we ended up configuring a loaded out desktop computer with an IntelÂ® XeonÂ® E5â€“2650 v4 Processor (12 cores, 30MB Cache, 2.20GHz) to ensure it could handle the load. The data we had to display was huge, and it covered 9 screens. This worried me: was I going to bring the computer powering the data wall to its knees? Fortunately, there was has a slot for a 2nd processor (if needed), and support for some ridiculous amount of memory (512GB of RDIMM if I calculated it correctly). We also needed graphics cards that would support nine displays. We ended up going with two NVIDIAÂ® NVSâ„¢ 810 which Iâ€™ve found to be pretty reliable. These cards can each support up to eight displays and we ended up putting five of the displays on one of the GPUs and four on the other. While our use case separated the data onto nine separate displays, we also utilize NVIDIA Mosaic**â„¢** which is this cool built in technology which allows you to display the signage as a one full image across nine displays and itâ€™s fairly easy to switch between the two options.



The screen at work. Engineers love it, and it is eye candy for everyone!

Now letâ€™s talk software. Our engineers are rabid users of the open source software package called Grafana. Supporting this ended up being the biggest challenge of the project as nine Grafana windows require a tremendous amount of CPU, video processing power and RAM. Knowing this we planned to have plenty of all of these things to spare. Surprisingly, the biggest challenge was a limitation (and bottleneck) caused by loading so many web browser windows simultaneously. We tried several options before finding a browser that we could get the device to last an entire work day without crashing from the sheer amount of web requests (and likely memory leaks). Through testing we proved that *using the nightly build of Chromium, Googleâ€™s open source web browser project, proved the most stable.*

The final question in delivering this data was **â€œhow do we get nine different browser windows to appear in full screen with each of the Grafana dashboards?â€�** For that we turned to a Chrome Extension called Window Positioner and a little bit of hacky scripting put together by another engineer to randomize the loading timing of the windows and minimize the startup thrashing placed on Chromium. Positioner allowed us to simultaneously pull from nine preconfigured URLs and then expand them to full screen on each of our displays. It was hard to find a solution that would do this job and we didnâ€™t have time to write our own program but Iâ€™ve found the Chrome extension to be very simple and elegant. You have to do a little manipulation with X/Y coordinates to get the screens to pop up in the correct locations (I recommend setting the Width and Height to 800 x 600 respectively), and then thereâ€™s a simple checkbox for Full Screen. There are also tools and scripts out there if you have trouble finding the X/Y coordinates.

Simple hack to prevent every Grafana window from loading at the same time

Everything was pulled off in the nick of time to make for a spectacular Black Friday and Cyber Monday. The project was ultimately a huge success that helped our Engineering team respond rapidly to changes on the busiest days of the year and has helped them be data driven every day since by having their performance graphs and SLAs prominently displayed.

All these pieces came together to create a beautiful data machine on wheels! The wheels provided added flexibility for office events. We even recently used the setup to watch Olympics coverage in a big way!