Figure 1. Voyager's converging interior and exterior spaces with summit roofline
Image Source: Gensler | Jason O'Rear Photography

SIZING UP VOYAGER'S 5G NETWORK 10X FASTER

NVIDIA FINDS DRAMATIC TIME, COST SAVINGS WITH ALTAIR 5G WIRELESS NETWORK SOLUTION

About the Customer

Since its founding in 1993, NVIDIA (NASDAQ: NVDA) has been a pioneer in accelerated computing. The company's invention of the GPU in 1999 sparked the growth of the PC gaming market, redefined computer graphics, and ignited the era of modern artificial intelligence (AI). NVIDIA is now a full-stack computing company with data-center-scale offerings that are reshaping the industry.

Their Challenge

NVIDIA built a massive 750,000 sq. ft. building named Voyager – a reference to both Star Trek's Voyager and the "v" in NVIDIA. Indeed, entering Voyager, one goes where no one has gone

> "NVIDIA found that virtual validation using Altair solutions was dramatically faster—by at least an order of magnitude—than physical deployment, testing and measurement data analysis. The solutions were also extremely cost effective because they eliminated the need to purchase any network equipment.
>
> Joseph Boccuzzi Ph.D., 5G Systems Architecture, NVIDIA

before. The base camp reception area sits at the foot of a mountain and features numerous tiers interspersed with people, offices, and garden spaces (Fig. 1).

To accompany the architectural innovation, NVIDIA wanted an equally impressive, private 5G network to support multi-access edge computing (MEC) applications and leverage the unlicensed Citizens Broadband Radio Service (CBRS) band. The first MEC application required intelligent video analytics with 5G cameras in the lobby area (Fig. 2.).

A network development challenge was the 150 MHz limit within the CBRS spectrum. To handle this, NVIDIA decided to use 100 MHz minimum bandwidth to maintain the desired throughput levels and use the same frequency carrier for all radio units. This made the 5G network's needed throughput challenging. NVIDIA also wanted to compare two different vendor radio units, one with directional transmission and one with omni-directional transmission, each with 4 downlink (DL) multiple-input multiple-output (MIMO) layers and 2 uplink (UL) MIMO layers.

Figure 2. Voyager lobby
Image Source: Gensler | Jason O'Rear Photography

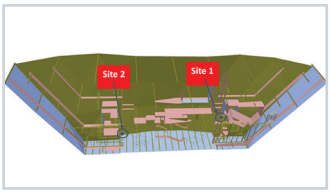

Figure 3. Voyager surrogate model (horizontal layers hidden) with optimal radio unit locations

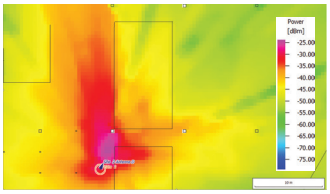

Figure 4. Maximum received power for a 4x4 MIMO scenario

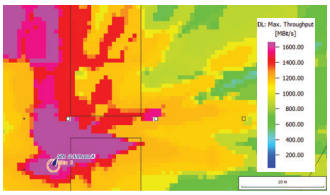

Figure 5. Maximum DL throughput for a 4x4 MIMO scenario

Our Solution

NVIDIA wanted to maximize throughput for the desired inbuilding coverage area. However, traditional testing and physical deployment to determine the best radio-unit locations and antenna orientation were costly and time-consuming. Instead, NVIDIA deployed Altair's simulation-driven, network-planning and optimization solution.

Altair developed a Voyager surrogate model (Fig. 3) including all aspects that affected the building's wireless propagation. In an integrated system workflow, the team used Altair® HyperWorks® for geometry cleanup; Altair® Feko® with Altair® WinProp™ modules for material assignment, wireless propagation, and network analysis; and Altair® HyperStudy® for optimizing the number and positions of radio units. Next, Altair performed a two-part 5G network analysis with specifications for duplex separation, transmission modes, numerology and channel bandwidth, UL/DL slot structure, data streams, radio unit positions, and individual antennae transmit power.

Altair's initial analysis identified the best radio unit locations and orientations using WinProp's dominant path model, a fast, accurate prediction model for wireless coverage analysis. With the radio units optimally positioned, Altair performed the final analysis with WinProp's full-3D-ray-tracing models.

Results

With its integrated simulation and optimization platform, Altair was able to quickly explore numerous design iterations. With these, Altair determined the optimum number of radio units that would produce the desired throughput throughout the lobby—especially in locations for mounting cameras—and compared the performance of the two different vendor radio units. Both units operated over the same carrier frequency, which caused co-channel interference that Altair minimized by optimally positioning the units. The solution provided NVIDIA with an optimal 5G network design and eliminated time and costs associated with physical testing (Figs. 4 and 5). Looking forward, NVIDIA will use Altair's solution to investigate network deployment topologies and system parameters that address requirements for other MEC use cases.

To learn more, please visit **altair.com/5g**