PEAK3

ATSC 3.0 enabled Edge Caching as a Service

DigiCAP® cachengo Pente Networks

Combining the Datacast capabilities and national coverage of ATSC 3.0 with Edge Caching as a Service is a compelling alternative to traditional point-to-point streaming, content, and file distribution.

ATSC 3.0

Introduction

With the licensing of the ATSC 3.0 spectrum to the Broadcasting community by the FCC 2018, comes the challenge and opportunity for these organizations to embrace a shift in how they interact with their traditional end consumers, their content & advertising partners, as well as expand their reach and value proposition into the world of Technology focused customers.

ATSC 3.0 has the potential to be a unique catalyst for the Broadcasters to begin thinking, operating, and partnering with large Tech-based organizations that deploy and demand critical, secure communication pathways to their edge-devices in the marketplace.
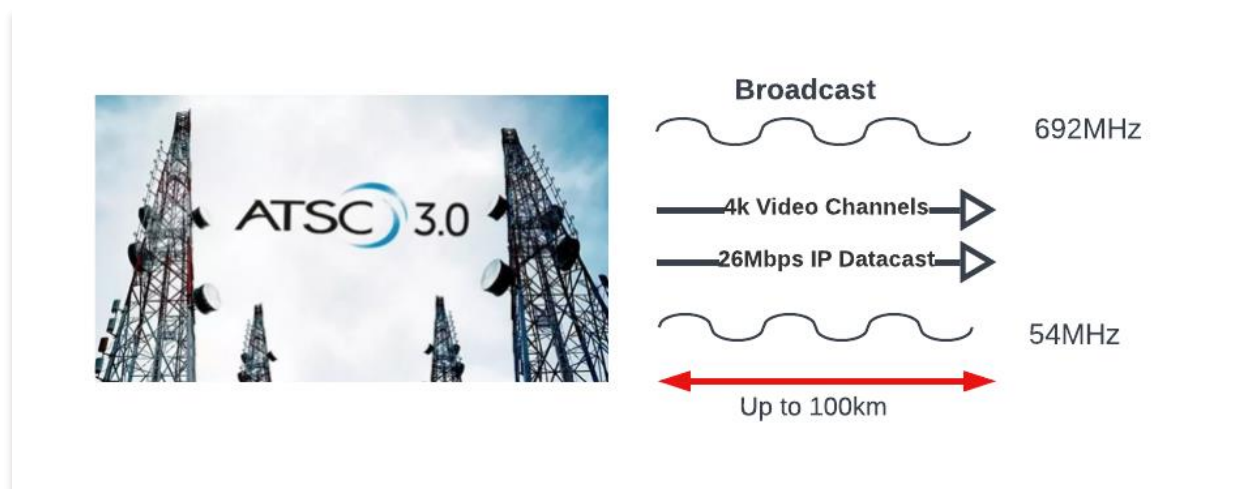
The IP-based ATSC 3.0 standard changes the playing field. ATSC 3.0 ushers in a large-scale advance for broadcasting technology that brings together the capabilities of over-the-air (OTA) broadcasting, the internet, and a host of additional use cases that provide the opportunity for companies like PEAK3 to partner with the broadcasters and demonstrate the true value of the spectrum they now possess.

While IP networks have traditionally been asymmetric, many of today's applications further drive an explosion in usage such as Video Streaming, firmware updates (Autonomous vehicle, Gaming consoles, IoT, etc.) and distance learning only accelerate the trend. One way to offload this glut of bandwidth demands is to deploy Analytic Edge Caching which uses predictive models to distribute and cache the content most likely to be demanded.

This paper will focus on the benefits of leveraging the existing capital investment of ATSC 3.0 Datacasting infrastructure with Edge Caching as a Service to combine the lower cost of national content distribution with the low Capex, multi-tenant usage of Smart Edge Caching.

ATSC 3.0 Overview

ATSC 3.0, also known as NextGen TV, is the next generation of Digital Broadcast Television.

In addition to higher quality 4k video channels, the ATSC 3.0 standard includes provisions for a 26Mbps per tower Datacast channel. Datacasting is the broadcasting of data over a wide area via radio waves. It

most often refers to supplemental information sent by television stations along with digital terrestrial television but may also be applied to digital signals on analog TV or radio.

ATSC 3.0 has a significant advantage in price/cost for content distribution due to the ability to reuse the capacity many times over i.e. one file can be sent to many endpoints at the same time.

This one-way connection opens a broad range of applications such file distribution, improving position accuracy, improving time accuracy, GPS replacement in denied applications, industrial automation, software upgrades, security token distribution and CDN offload.

ATSC 3.0 is an established standard with a broad range of chip sets embedded in a wide range of form factors include dongles, SDR radios, compute boards and gateway devices. More information can be found at www.atsc.org.

ATSC 3.0 Enabled Edge Caching as a Service (ECaaS)

Today's Network

In today's network design, clouds services serve up digital content in a fundamentally peer to peer architecture – 1000 customers ask for the same movie, there are ultimately 1000 copies of the movie passed through the network. If 100 million PlayStation PS4 and PS5 consoles all need the latest firmware upgrade or a new game release, they all ask for and get the same multi-GB file. This results in significant ongoing costs associated with operating these services. There are many more similar use cases.

While Core and Edge caching is deployed today, when considering all the various types of content and network segments, peer-to-peer distribution of digital content is still common.

Figure 1 provides a high-level overview of today's distribution network from the Cloud Services to the End User device.
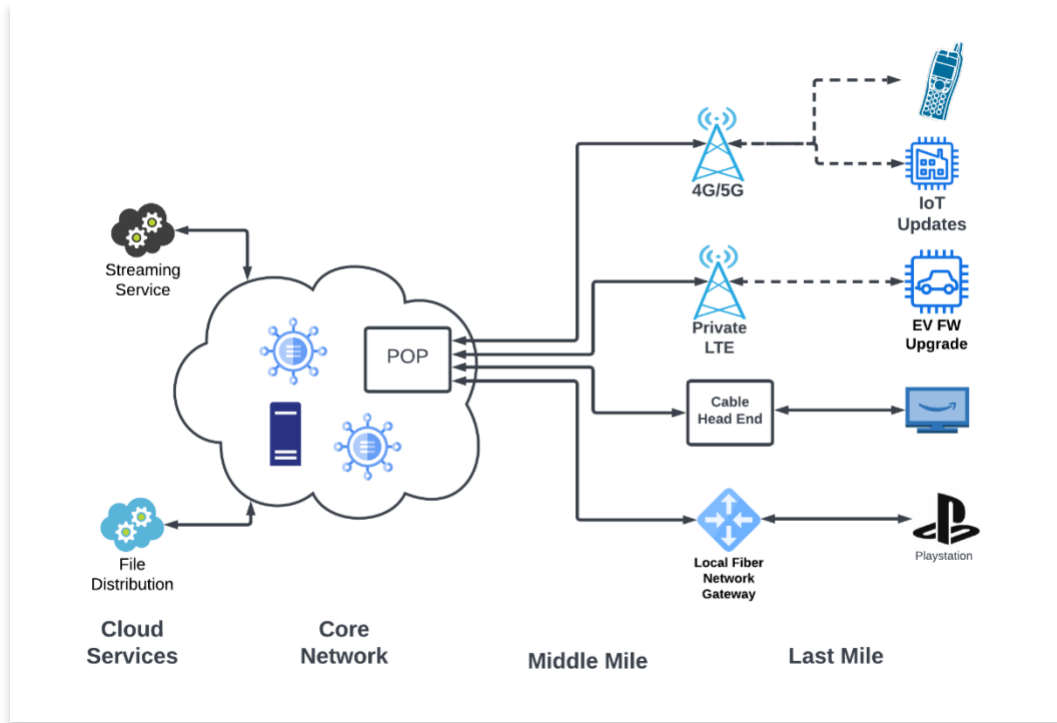
Figure 1 Today's Network

Cloud Services – Cloud applications which serve up the content including streaming services, file distribution, etc. These cloud services are typically hosted in the hyperscale cloud providers such as AWS, Azure, and Google Cloud.

Core Network – Core backbone of the Internet which connects the POPs. Usage of this part of the network is typically paid by the big streamers.

Point of Prescence – Multiple Internet Exchange Points (IXP) are the onramp to the core backbone of the Internet which are used by local providers.

Middle Mile – The Middle Mile enables transport and transmission of data communications from the central office, cable headend or wireless switching station to POP.

Last Mile - is a figurative term which refers to the last leg of the network, or the final physical portion of the network from the Middle Mile to the end user.

ATSC 3.0 Enabled Edge Caching as a Service

With ATSC 3.0 enabled ECaaS, a broad range of content is datacasted directly to the ECaaS nodes.

When a customer edge point in the network needs, or demands, the content the locally cached version is immediately provided rather than using the Middle Mile and Core network to access the resource in the Cloud Service. This dramatically reduces network usage and bottlenecks while reducing download latencies.

National coverage maps for ATSC 3.0 means that this benefit can be gained both by reducing Core Network tariffs for the content provider and reduced network costs for Middle Mile providers who have borne the brunt of the explosion of content and streaming services in particular "Rural Broadband and the Unrecovered Cost of Streaming Video Entertainment" Layton & Potgieter, 2021).
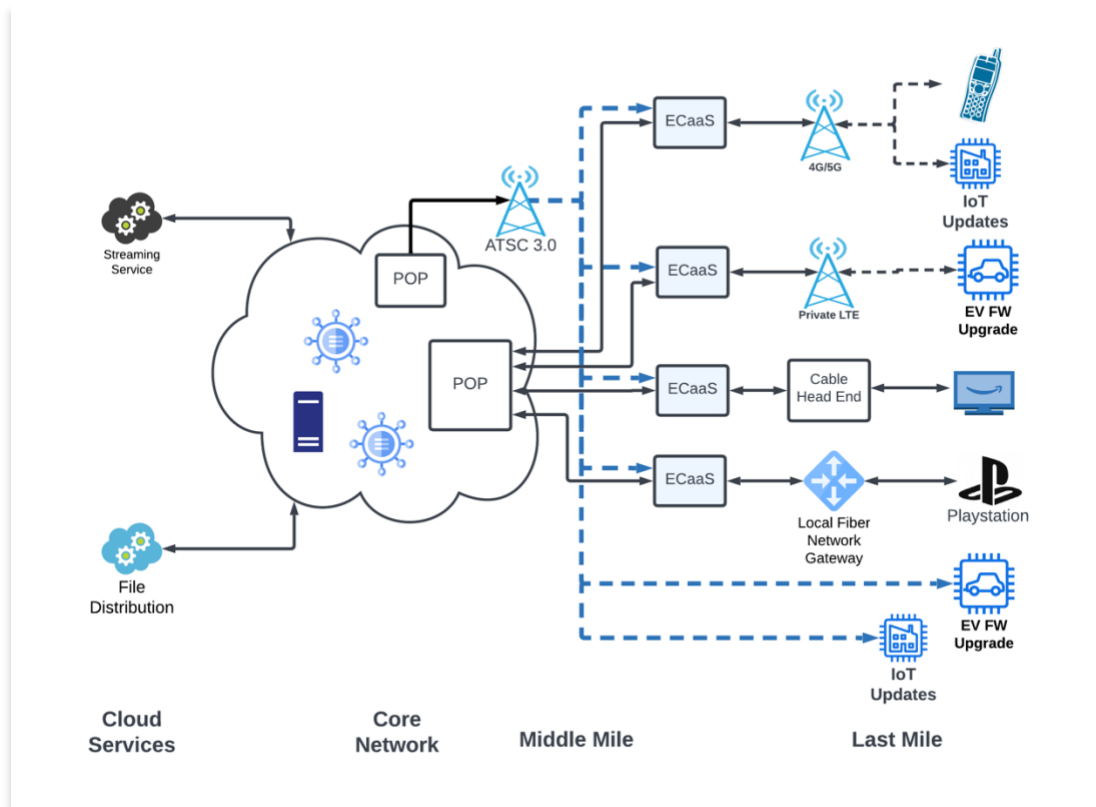

Figure 2 ATSC 3.0 Enabled ECaaS

ECaaS Cache management leverages analytic and predictive algorithms to monitor usage and proactively increase the chances that the content in the local ECaaS nodes have the highest chance of being available. This includes monitoring the "Top 100" most popular content list, latest software releases for a PS5, EV or a Nest security update for example.

With ATSC 3.0 enabled ECaaS, future infrastructure costs can be mitigated by distribution plans which includes a flat rate cost to distribute content to all endpoints on tiered bases such as:

- **National:** release of the summer blockbuster to a streaming service or a software release for an Autonomous Car
- **Regional:** IoT updates for electric meters for a regional Power Utility or a TV series which is most popular on the West Coast
- **Super local:** a single tower to replay a local High-School football game

Why Edge Caching as a Service?

For the benefits of Edge Caching to scale, significant resources and risk are required to be deployed to the Edge, which, for a single entity such as a Streaming service, Middle Mile ISP or IoT manufacturer, is difficult to justify the capex to deploy and Opex to operate.
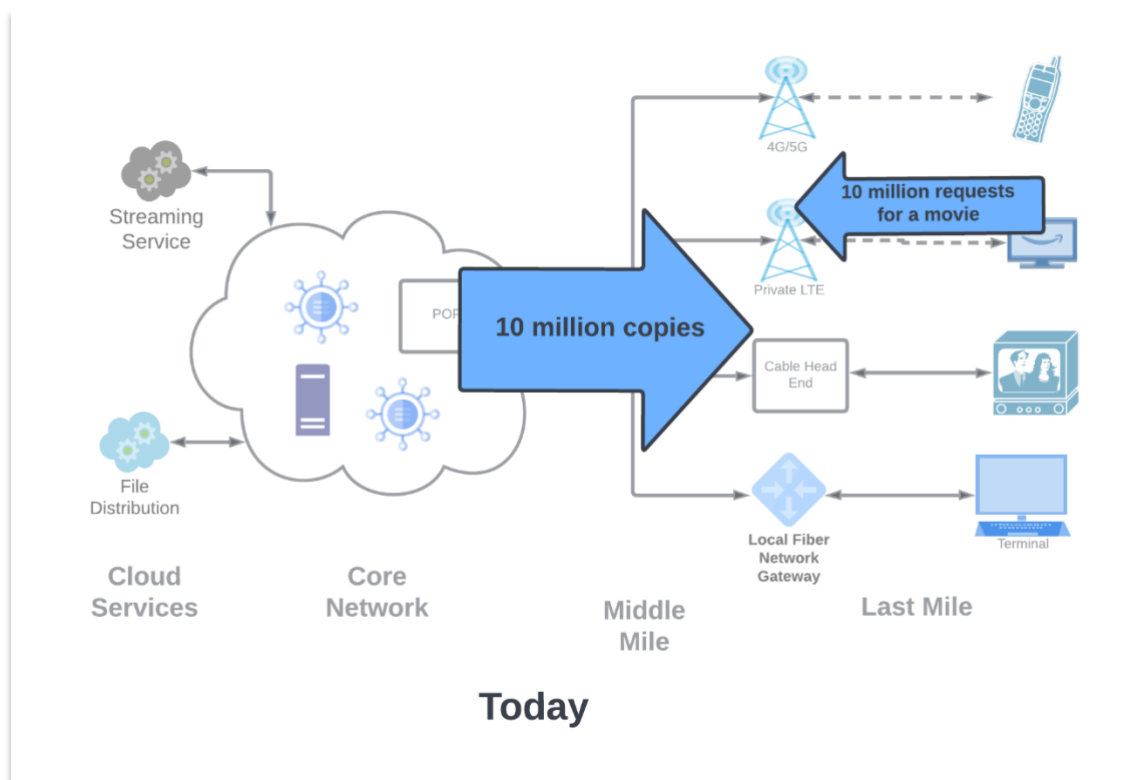
However, if the cost of deploying smart caching to the edge is amortized across multiple customers and applications and built around a service model including the ATSC 3.0 capacity, the economies become compelling. The risk to deploy the service is limited to the terms of the service agreement while the benefit of ECaaS would be immediately realized.

ATSC3.0 enabled ECaaS provides benefits for the Content Provider, Manufacturer, Network operator and the End Customer.

ATSC 3.0 ECaaS Use – National Streaming Movie distribution

The following use case illustrates the real-world value of ATSC 3.0 enabled ECaaS with a practical example. For this example, we assume:
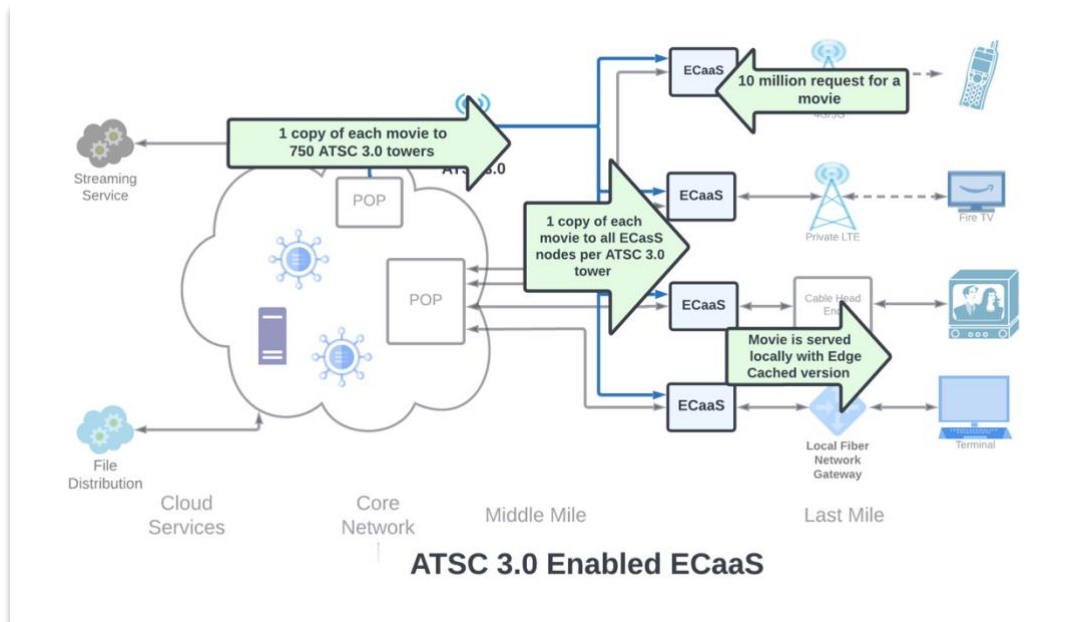
- No caching in the Core and Telco networks
- The 100 most popular movie titles across the United States have 10 million requested downloads per month
- Each streaming 4k movie has an average file size of 20GB

Using this example, where each user request results in a streaming copy of the movie title from the Cloud Service provider all the way to the end-user's device, the resulting combined bandwidth across the Core and Middle Mile would be as follows:

Cloud Services to POP	Middle Mile	Total Bandwidth
1 streaming file transfer per request	1 streaming file transfer per request	**400 PB (Peta) for both segments**
10 million requests * 20GB	10 million requests * 20GB	

On the other hand, ATSC 3.0 Enabled ECaaS has significant advantages for content distribution as compared to Today's network.

ATSC 3.0 Enabled ECaaS

For national ATSC 3.0 coverage, the Cloud services and Core Network will transfer a single copy of each movie to approximately 750 ATSC 3.0 towers. Once the content has arrived at each ATSC 3.0 tower, no Middle Mile distribution is required as ATSC 3.0 will datacast the content directly to all Last Mile ATSC 3.0 receivers.

Cloud Services to POP	Middle Mile	Total Bandwidth
Cloud Services to 750 ATSC 3.0 towers for 100 movies	Zero terrestrial bandwidth with ATSC 3.0	**1,500 TB**
(100 movies *20GB) * 750 towers	0	

Summary: Using traditional distribution channels results in 266 times more required bandwidth compared to ATSC 3.0 Enabled ECaaS.

Furthermore, more and more streaming content continues to be delivered by cellular which further creates a bottleneck in 5G networks.
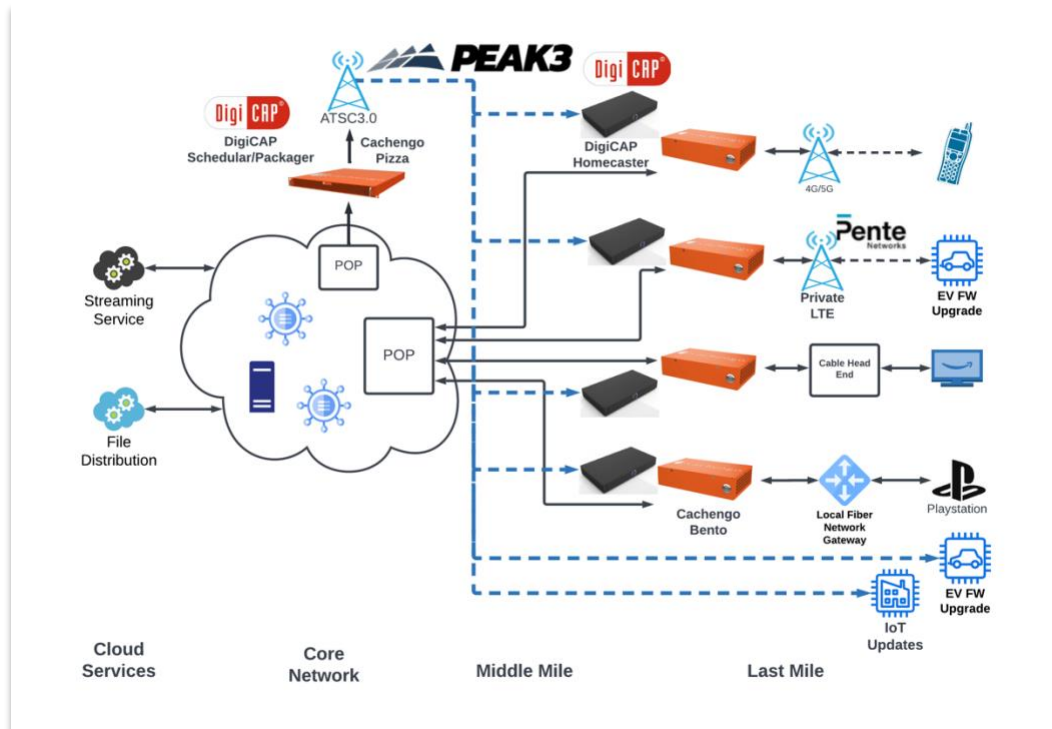
ATSC 3.0 ECaaS Solution Partners

Figure 3 ATSC 3.0 and ECaaS Solution Partners

About Peak3

PEAK3 has a long-term engagement with the spectrum owners to offer this alternative data highway to its many technology partners, its enterprise clients, and to its engineering teams to further develop novel applications where the ATSC 3.0 value proposition can enable the edge-device community. From hardware architecture through the application layer, the PEAK3 team has a rich history of successful enterprise edge deployments and IT system designs and operations.

We recognize unique value proposition ATSC 3.0 provides in delivering secure, efficient, data-delivery methods to the edge. The foundation of our business model is Data-Streaming as a Service for organizations wanting to efficiently get data from one point to many.

PEAK3 provides a standards-based, open, end-to-end, nationwide, wireless, IP, multicast network. In simple terms, we provide a cost-effective datacasting pipe for Internet Service Providers, public and private cloud providers, and any organizations operating large edge device architecture.

About DigiCAP

For the past 20 years, DigiCAP has used advanced software development to make television and telecom systems easier to use, less costly, and more profitable. DigiCAP's ATSC 3.0 air chain, DigiCaster, has now been deployed in over half of the ATSC 3.0 market deployments in the US. DigiCaster contains all the software components for ATSC 3.0 transmission, including ROUTE/MMT packager, NRT, ESG, multiplexer and broadcast gateway (or scheduler). DigiCAP also has been providing major telecom providers,

broadcasters, and government agencies with end-to-end software solutions to optimize their multimedia business operations.

DigiCAP manufactures the HomeCaster device, an ATSC 1.0/3.0 home gateway product, and supplies broadcasters and system integrators with B2B solutions.

One application of HomeCaster is transmitting learning materials with ATSC 3.0 datacasting. HomeCaster has been deployed in 14 states in the US as a distance learning solution to K-12 students and proved especially useful during the COVID-19 pandemic. DigiCAP is working with broadcasters and system integrators to continue to expand its use cases for other business applications including IOT, precise location positioning, digital signage among others.

About Cachengo

Cachengo unifies data, analytics, computing, and a choice of blockchains.

Figure 4 Cachengo Bento, Micro Server Stack up, Pizza

The Bento delivers managed and highly dense Compute, Storage, Network, and an Analytics Engine with excellent SWAPc. While the Pizza leverages the same clustered capabilities to 4x the capacity for data center, private datacenter rack mounted installations.

Cachengo provides a **Management** tool for easy point-and-lock operation in Air Gapped, Tethered and connection operation.

The Cachengo **App Store** provides and delivers a broad range containerized applications with point and click deployments. The broad range of ECaaS applications can be easily integrated with the App Store using a standardized recipe methodology.

Cachengo support a **Rent-a-Node** capability which supports on-prem dedicated, on-prem shared and in cloud operation which is perfect for Edge Caching as a Service operation.

Cachengo Peer-to-peer Hive networking enabled communication between any node in the peer group – anywhere. It does not depend on VPNs, has no man-in-the-middle (MITM), and works through firewalls and is 100% peer-to-peer.

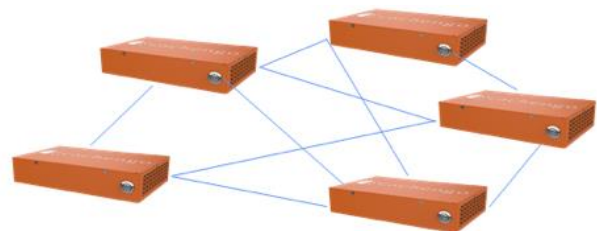This Ultra Secure architecture is Push button deployable.

Figure 5 Cachengo Deploy Anywhere Networking

About Pente Networks

Pente provides enterprise LTE/5G Mobile Core & Management Platform. Established in 2015, the company is headquartered in Israel and the U.S., with R&D centers in Israel, India, and Eastern Europe. With deep knowledge of telecom and enterprise solutions and experience in building networks and business applications for dozens of enterprises and mobile operators, Pente has a growing partner ecosystem with leading system integrators, service providers, and equipment manufacturers focused on delivering end-to-end, wireless communications solutions to enterprises.

Pente's IT-friendly solutions feature guaranteed latency, security, and quality of experience, optimizing public and private clouds to deliver fully secure and economically efficient services designed to support enterprise digital transformation. Learn more at https://pentenetworks.com

Conclusion

ATSC 3.0 content Datacasting combined with Edge Caching as a Service provides compelling cost savings for both the Content and Middle Mile Provider.

ATSC 3.0 Datacasting's ability to reuse the same "bit" many times over significantly reduces distribution costs while leveraging the upgraded infrastructure and spectrum of the ATSC 3.0 national network.

Edge Caching as a Service uses smart and predictive modeling of content demand to optimize and amortize the caching of content at the Edge to dramatically reduce the need to pass the same copy of data across Core and Middle Mile networks. When deployed as a subscription or usage-based service, the benefits of reduce network costs and improved latency can be immediately realized with much lower risk and cost.