VANTIQ

Distributed (MEC) Applications With VANTIQ

White Paper by

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Executive Summary

We are about to experience a major shift in how computing and therefore software will be distributed throughout the world. This will be enabled primarily by the Telecoms as they look to add advanced capabilities to their 5G networks to create significant new revenue streams. New capabilities enabling local processing and shorter response times via 5G Multi-Access Edge Computing (MEC provides computing resources at the edge of the network closer to where it is needed) will be the means by which this is accomplished. The world will be sensed, analyzed, and acted upon in real time.

Innovators around the world will exploit the capabilities of these new networks by developing revolutionary new applications for safety, security, efficiency and sustainability that simply were not possible before.

The Vantiq platform empowers the Edge by enabling highly scalable and responsive applications to be rapidly developed and deployed anywhere in the network. These applications will be very dynamic to meet quickly changing business requirements and network topologies. Because of Vantiq's unique and innovative features, numerous Telecoms worldwide have decided to closely partner with Vantiq.

Introduction

“Gartner predicts that by 2025, three-quarters of enterprise-generated data will be created and processed at the edge – outside a traditional centralized data center or cloud. That’s up from just 10 percent in 2018.”

Worldwide, Telecoms are now building out their networks with 5G for lower latency and with MEC for distributed software processing. The build-outs are moving at a rapid pace and will be accelerating over the next few years as the hardware and cloud infrastructure becomes less expensive and more prevalent. The IoT sensors are also becoming far less expensive to deploy and far more powerful. At the same time, the ability to do local intelligent processing such as image analysis via AI on the edge (MEC), is rapidly advancing to perform analysis in real time. This paper discusses MEC use cases and how Vantiq enables them.

5G Networks

5G represents a qualitative and quantitative improvement in connectivity, bandwidth and latency for wireless devices. The connectivity and bandwidth improvements afford an opportunity to the 5G wireless network operators to offer local area networking services in competition with wired LANs and Wi-Fi. Integrated LAN and 5G wireless networking in a single managed service could provide an operationally and economically attractive alternative to traditional unbundled network services.

Effectively, we can think of the 5G network operator as offering both:

- LAN as a Service
- Wide Area Networking as a Service (aka traditional mobile networking services)

In addition, 5G offers lower latency and higher bandwidth for traditional mobile phone services–voice, text and data.

MEC

In order to fully exploit the connectivity, bandwidth and latency improvements offered by 5G, computing capabilities must be located “near” the network access points in order to reduce latencies associated with the backhaul network and reduce bandwidth requirements for the backhaul network. By locating computing capabilities close to the access points, latencies of a few milliseconds are possible. Similarly, large numbers of devices producing large quantities of data can be connected to an access point. Processing this data near the access point and then delivering only the useful summaries of that data across the backhaul network to the centralized processing centers will prove far more cost effective than continuing to increase backhaul capacity.

MEC is an edge computing standard, compatible with 4G and 5G mobile networks, for computing capabilities closely integrated with the mobile network. The mobile network operators implement this standard to offer customers compute capabilities tightly integrated with their 5G (and 4G) networks. Effectively, we can think of MEC as Edge Computing as a Service.

The benefits of offering both 5G networks and MEC could provide an order of magnitude simplification in the operation of IoT systems and other forms of edge computing.

For example, an enterprise with a corporate campus and satellite offices could contract for both LAN services and edge compute capabilities for the satellite offices. The satellite offices would need no expertise in installing and/or managing LANs or Wi-Fi implementations and would not need local computers in the office as the local compute is supplied by the mobile network operator’s MEC implementation. Just the improved security posture of the satellite offices makes this highly attractive.

An IoT example might be the use of cameras to detect safety and security events on a corporate campus. Rather than capturing video and transmitting it to some centralized data center for analysis, the video can be analyzed in the MEC and only significant events detected by the MEC need to be transmitted back to the control center for further actions. In addition to lower latencies in processing images and lower bandwidth requirements to the control center, privacy is improved as the images themselves never leave the local MEC environment and can be discarded before they are transmitted over the internet. This architecture inherently addresses surveillance concerns that might exist.

5G and MEC require applications and systems optimized for the 5G/MEC environment in order to realize the benefits of these technologies.

These systems require the following capabilities:

- **Rapid-assembly.**
  Assemble and reassemble quickly to take advantage of new and changing business opportunities available through the use of 5G/MEC.

- **Distributed.**
  Distributed so that some functions in the system are run in the MEC while other components run in the cloud or in corporate data centers. In some cases, the components of the system are operated by separate entities. For example, a manufacturer might be collecting IoT data on the manufacturing process but delegates the analysis of a subset of the data to a third-party equipment maintenance provider.

- **Highly scalable.**
  Inevitably, these applications either start as large systems or start small and grow larger over time. This requires the applications and system to be easily scaled to high data rates.

- **Event-driven.**
  Typically, 5G/MEC systems are built to decrease response times to critical events such as security incidents or real-time control activities or to improve the responsiveness of interactions with customers. Such real time activity is always best implemented as an event-driven system.

- **Dynamic.**
  The 5G and MEC services have the interesting property that many devices, whether they are smartphones or IoT devices, are mobile. The system logic the devices are interacting with must be able to move along with the devices as they move in space throughout the 5G network in order to continue to provide low latencies and lower bandwidth requirements.

VANTIQ (con't)

VANTIQ is a high productivity, highly scalable distributed system assembly platform.

Utilizing VANTIQ for 5G/MEC systems results in systems with all the characteristics stated above:

- Systems can be rapidly assembled or reassembled using low code techniques.
- The resulting systems are naturally distributed and VANTIQ supplies powerful tools for defining the distributed architecture of the system and automatically deploying it.
- The resulting systems are highly scalable and reliable utilizing both edge native and cloud native VANTIQ capabilities.
- VANTIQ is optimized for the assembly of event-driven applications.
- The distributed components of the VANTIQ assembled system can be dynamically deployed to the appropriate MECs as needed to support devices that are transiting multiple access points within the 5G network.
- With a complete set of operational tools, operation of these distributed systems can be very efficient.

VANTIQ (con't)

Rapid Assembly and Reassembly

VANTIQ provides a range of productivity enhancing tools for assembling, reassembling, deploying and operating MEC-hosted systems.

VANTIQ provides a range of low code/no code tools for assembling the MEC-hosted system:

- **The App Builder** is a graphical, no code assembly environment for event driven applications. The applications ingest from multiple inputs, perform streaming analytics to determine the current situation and react in real-time.

- **The Collaboration Builder** is a graphical no code assembly environment for specifying highly flexible interactions with the users of the system. The Collaboration Builder supports truly collaborative interactions between the MEC system and the user; a capability that is very difficult to implement in traditional low code application development tools.

- **The Client Builder** is a WYSIWIG low code presentation builder for constructing the details of the pages seen by the users of the system.

  (con't) The Client Builder can build pages optimized for specific devices or pages that are portable across a wide range of devices including mobile devices and web browsers.

Certain elements of the MEC system are more efficiently specified as code. VANTIQ provides a range of scripting editors, tightly integrated with the low code/no code editors, to specify those elements of an application that are more concisely described as text.

Once the system is constructed, VANTIQ offers a unique tool that can partition the system such that components of the system are automatically deployed across the MEC nodes, local clouds and global clouds, optimizing performance, availability and cost.

Once deployed, VANTIQ offers a set of management tools for monitoring and operating the system. These tools can provide in-depth insights into system operations that can be used to further optimize the system to improve performance and decrease costs.

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Distributed Systems

Effective exploitation of the MEC requires utilizing a distributed architecture for an enterprise system as well as for most consumer applications with each application distributed as follows:

- The MEC interacts directly with mobile devices and IoT sensors to provide the lowest latency data collection and real-time responses to the devices. Key processing located at the MEC includes real-time decision making and real-time analysis of streaming data such as object recognition in image data or trend analysis in industrial sensor data. Performing such analysis at the edge may also better protect privacy and security. For example, images containing people can be analyzed at the edge returning only authorized analytics results such as an attendance count. The images are not transmitted to the cloud where it is far more likely that a bad actor may obtain the images and perform additional analysis for nefarious purposes.

- The MEC may interact directly with a local data center that provides lower latencies than the global data centers for analysis that is more regional in nature.

  (con't) For example, if the MEC is analyzing images to track a vehicle, local data center processing can be used to capture the history of the vehicles route across a number of regional MECs.

- Global data centers are used to store and analyze the results of MEC and local data center activities. The global data centers (aka global cloud) can aggregate data collected from the distributed environment and provide global analysis identifying longer term trends and patterns.

Distributed systems are very difficult to assemble and operate without a fully distributed platform. VANTIQ systems are completely portable and decomposable allowing any component to run anywhere within the distributed topology. In addition, the VANTIQ deployment manager automatically partitions the system components across the distributed topology to optimize overall performance. The development team can graphically tune the partitioning to further optimize it for specific business requirements. Once partitioned, the deployment manager can deploy the system's components to the specified locations dynamically and bring the full system online in a matter of seconds. Vantiq systems can be dynamically re-partitioned while the system is running–no downtime required.

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Scalability and Resilience

MEC systems can potentially supporting millions of mobile devices and IoT sensors. This makes scalability and resilience a critical attribute of these systems. For example, an MEC system managing traffic flow is useless if it cannot scale to the number of sensors and vehicles it is intended to manage. Similarly, if elements of the system fail without adequate plans made for operating in the face of such failures, the system will be unable to effectively manage traffic flow.

VANTIQ provides a wide range of scalability features:

- Vertical scaling within a computing node is particularly important in the MEC where a small number of large, multi-core compute nodes are likely to exist.
- Horizontal scalability across multiple computing nodes which can be exploited with the MEC but is far more effective in the local data center and global cloud where large numbers of commodity computing nodes are available.
- Distributed scalability in which the distributed nature of VANTIQ supports the allocation of processing to multiple regions for applications in which even horizontal scalability is unable to satisfy the system's requirements.

These features can also be used to improve resilience. Systems operating in a horizontally scalable configuration can survive compute node failures by moving the processing to other nodes within the cluster. All VANTIQ applications automatically take advantage of the resilience offered by clustered configurations. Systems that require very high resilience must continue to operate even if a region completely fails. VANTIQ applications can utilize a distributed topology where processing is replicated across regions to operate continuously in the face of a regional failure.

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Event-Driven

The MEC is well positioned to provide low latency processing for event streams. Streams of events may be produced by mobile devices, such as a stream of location events or a stream of images from a camera. The MEC can receive these events, perform real-time analysis and respond with very low latencies. Such event-driven systems will be very common in the MEC environment since it represents the lowest latency processing environment available for many devices and sensors.

The construction of event-driven applications is currently quite difficult as there are few low code/no code environments that support event-driven processing. This is especially true if the event-driven application must be scalable and reliable. VANTIQ is a low code/no code environment optimized for assembling event-driven systems that provide scale and resilience.

VANTIQ systems can be scaled to hundreds of thousands or millions of events per second in a distributed environment such as that offered by MEC topologies. Of course, applications with lower event rates are supported and even easier to build since a number of the scaling features of VANTIQ are unnecessary for lower rate applications.

Operations

VANTIQ includes a number of tools for managing a system distributed across the MEC and the cloud. The deployment manager provides dynamic updates to all nodes participating in a distributed system.

Operational managers collect timely information on both the reliability and performance of each component of the distributed system as well as diagnostic information that helps identify and correct failures.

VANTIQ (con’t)

Dynamic

The dynamic nature of MEC systems cannot be overestimated. The MEC may consist of thousands of nodes interacting with hundreds of local data centers and tens of cloud data centers. Configuration, deployment and management of such highly distributed applications requires a strong platform that natively supports distributed applications. VANTIQ is designed as a distributed platform supporting distributed applications.

The Vantiq deployment manager can configure a single system for multiple distributed environments. Within a single distributed environment, the deployment manager is designed to support the distribution of the system partitions to hundred or thousands of nodes in a fully automated fashion. Updates to the system can be distributed dynamically in real-time.

A unique property of the MEC and the devices it supports is that many devices are mobile. This implies the devices may be connected to one MEC installation for some period of time but then travel to an area serviced by a different MEC installation. In such a scenario, optimal processing will necessitate moving the computation from the first MEC to the second MEC.

VANTIQ’s completely dynamic nature supporting the redeployment of code and the movement of state from installation to installation makes such optimal execution topologies possible. In fact, in some scenarios, VANTIQ includes capabilities to predict the path of a mobile device. This capability can be used to pre-provision MECs in the path of the device with the necessary components and state to support seamless, low latency processing as the device traverses the MEC network.

Summary

VANTIQ is...

...the most productive platform for assembling, deploying and operating real-time, event-driven applications utilizing the recently introduced 5G/MEC environments as well as their companion local data centers and the cloud.

Very importantly, Vantiq applications are highly scalable and reliable. Modern software applications that benefit from these capabilities will soon follow as human creativity figures out what can be accomplished. This will result in the world being a safer, more secure, efficient and sustainable place for us to inhabit.

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