

Private 5G Networks: Solving Video Challenges

Amdocs & Intel showcase joint demo of private 5G network to illustrate benefits of transporting video data

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Private networks are emerging as a critical wireless LAN solution for organizations looking to connect their devices and systems securely, efficiently and with low latency. Amdocs, in collaboration with Intel, has demonstrated a private network solution to help organizations achieve these goals.

The joint solution was presented at MWC Barcelona 2023 as an end-to-end private network deployment. Significantly, its modules can also be flexibly deployed to support varying requirements including reliability and flexibility.

This paper provides an overview of the Amdocs-Intel solution, highlighting the need for private networks, as well as the challenges faced in video-related use cases.

The need for private networks

The first two decades of the 2000s witnessed a significant shift to cloud computing, leading to the emergence of new services that connected new types of client devices, and resulting in the generation of massive volumes of data including IoT sensor data, user-generated data, video and more. This transformative era generated massive volumes of data, including IoT sensor data, user-generated content, videos and so on. However, transporting such vast amounts of information from client devices to the cloud for processing presented numerous challenges, including data transfer economics, processing speed, governance, sovereignty and data regulations. With the market demanding evolution in response to these challenges, rapid growth of edge computing ensued, bolstered by the power of AI.

Edge computing shifts compute infrastructure closer to where data is created (i.e., client devices), and can be deployed at the far edge, telco edge or near edge. In addition to lowering the cost of data transfer, it reduces transport latency and offers enhanced data security and sovereignty.

Private networks are a key enabler of edge computing, offering several benefits, including:

- **Low latency:** Critical for real-time applications, such as IoT devices or robotic control (e.g., autonomous vehicles, remote surgeries, etc.).
- **Security:** Offers more security than public networks, as they can be isolated from the internet and other networks, minimizing the risk of cyber-attack.
- **Customization:** Private networks are customizable to meet specific business needs, enabling organizations to optimize their operations.
- **Coverage:** Private networks can offer coverage deep within an enterprise beyond that currently offered by mobile service providers and require fewer radio resources than a Wi-Fi network.

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Yet beyond enterprise demands, changes in the ecosystem have also played a significant role in driving the growth in private networks. These include:

- **Lower cost:** While 4G devices have decreased in price, the market has become more competitive, leading to even lower costs and greater innovation.
- **Spectrum availability:** The growth of private networks has been further enabled by regulator and government initiatives to make 4G/5G spectrum available to enterprises (e.g., CBRS in the US).
- **Technology advancement:** Technology evolution has introduced new wireless capabilities. For example, 3GPP Rel 15 has brought forth new features for 5G including ultra-reliable low latency communication (URLCC) and massive machine-type communications to support large scale machine-to-machine communication. In addition, the evolution of other technologies like AR/VR, local video processing and AI, enables new use cases across various enterprise verticals.

Intel and Amdocs roles in 5G private network deployments

The solution demonstrated at MWC Barcelona 2023 combines software and processors from Intel, combined with 5G network design and testing services from Amdocs.

Intel® Smart Edge

Intel® Smart Edge is an edge-native distributed computing platform that provides cloud-like ease, resiliency and security for deploying and managing container-based workloads at the edge. This solution is specifically designed to handle demanding workloads like AI, media and software-defined networking functions, supported by pre-validated blueprints and solutions from Intel and its extensive partner ecosystem.

Alongside its advanced hardware components, the platform leverages software tools and frameworks that simplify application development and deployment, including the Intel® Smart Edge Developer Experience Kit®.

Intel® Smart Edge encompasses a CNCF-certified Kubernetes distribution and features multiple standalone building blocks that provide specific functionality within the overall architecture. Meanwhile, the Intel® Smart Edge Developer Experience Kit® provides a comprehensive set of building blocks to support a variety of edge computing use cases.

The power of Intel® Smart Edge was showcased during the MWC demonstration using servers based on Intel® Xeon® Scalable processors. These processors, optimized for performance, scale and efficiency across various data center, edge and workstation workloads, delivered the necessary processing capabilities for AI and analytics workloads.

The Intel® Smart Edge servers used in the demonstration showcased the potential of this solution, combining its edge-native capabilities with the performance and scalability of Intel® Xeon® Scalable processors.

OpenVINO™ Toolkit

Another key component to the solution is the OpenVINO™ Toolkit. This toolkit is designed to accelerate the inferencing and development of machine learning solutions. The OpenVINO™ toolkit seamlessly works with popular AI frameworks, TensorFlow and PyTorch, and offers a variety of model compression techniques to optimize inference performance along with a common API to enable deployment across Intel.

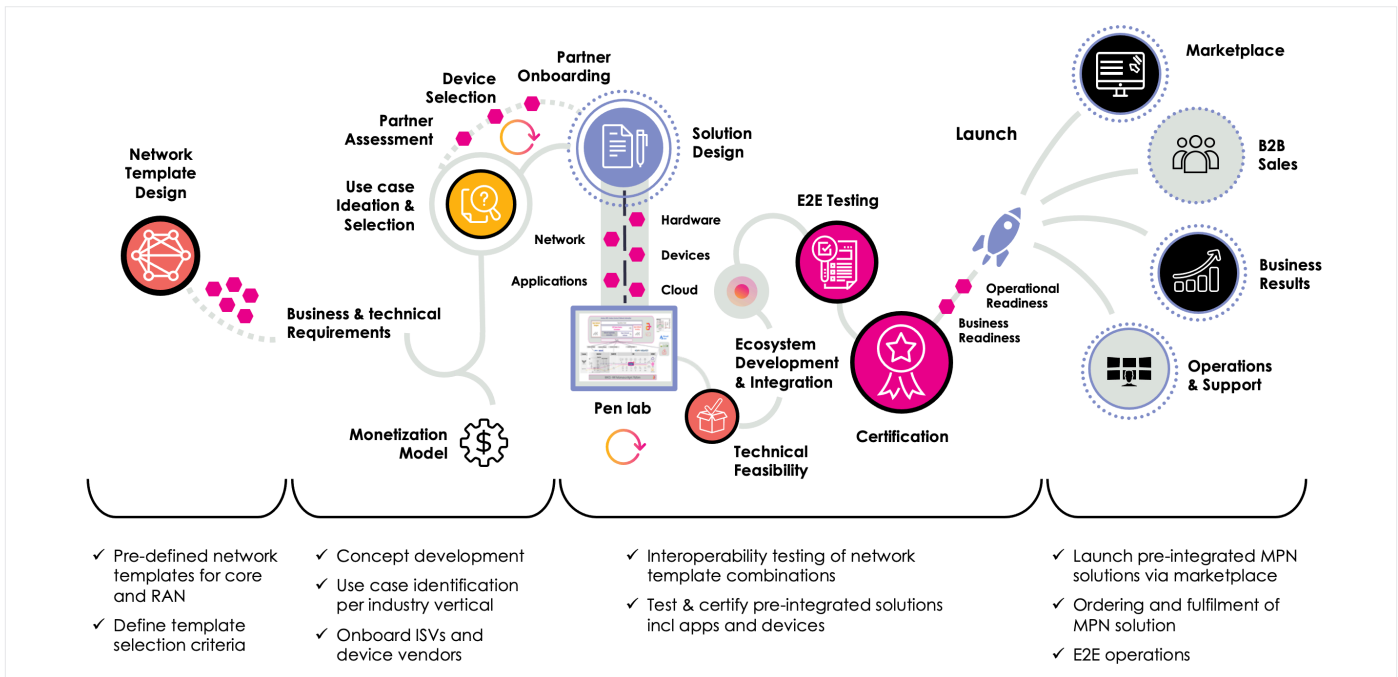


Figure 1. Process flow of Amdocs MPN Design Studio process.

Amdocs solutions

Amdocs addresses the intricacies of private network deployments with a comprehensive set of offerings that include:

- Hardware and software buildings blocks
- A unique management portal that enables enterprises and mobile network operators (MNOs) to manage all aspects of the private network across vendors and devices
- A comprehensive portfolio of services for network deployment and operations, with end-to-end accountability

Navigating the complexities of private network implementation begins with the discovery of business objectives, followed by solution design to achieve those objectives and maximize ROI. Optimal network equipment and vendor solutions are then proposed to address the initial requirements, as well as the long-term vision.

To ensure a successful deployment at the right cost, it is increasingly important to perform prior integration and optimization testing between the different vendors. To this effect, Amdocs provides:

- Amdocs 5G Experience Lab, which is designed to provide hands-on exposure to 5G technology and its use cases. The program gives organizations the opportunity to explore the potential of 5G technology and leverage those capabilities to enhance business operations and drive innovation. Examples include exploring how 5G can be used to improve connectivity, as well as increase speed and reduce latency in various industries, including healthcare, transportation and manufacturing. The Lab includes an ecosystem of partners with access to the Lab program, from which Amdocs can later reuse resources in order to reduce costs.
- Amdocs Mobile Private Network (MPN) Design Studio, which is part of the 5G Lab Experience Center, provides a testing environment and process where partners can trial different radio access networks and packet core network functions, and demonstrate what is needed for the proposed used cases.

It is this lab and the principles upon which the Design Studio was built that provided the basis of the successful demonstration at MWC.

Introducing Amdocs 5G Experience Lab

Amdocs sandbox where service providers and partners can **incubate new 5G solutions** and **accelerate commercialization** of those services.

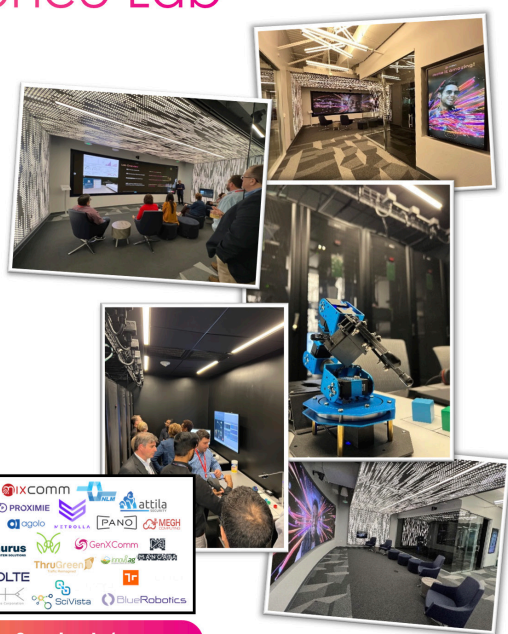
Live 5G SA Network(s)
Built with an ecosystem of diverse partners


Enterprise-driven Use Cases
Field tech support, AI-enhanced commerce, smart industry

Edge Applications
Distributed architecture, edge tuned, cloud core

Innovation Incubation
Use cases built based on customer priority & participation

Proven 5G Blueprints and Use Case Factory
Telcos, universities, school districts, utilities





70+ start-ups, 3 cohorts/year

Figure 2. Amdocs 5G Experience Lab.

Challenges in video-related use cases

Organizations are using video to improve their operations, maintain security and enhance customer experience.

Examples of applications supported by video across different verticals include:

- **Security and surveillance:** monitoring large areas to detect suspicious behavior, such as loitering, trespassing or theft
- **Retail and marketing:** analyzing customer behavior and preferences (e.g., viewed products, visit durations, interactions with merchandise) to optimize store layouts, product placement and marketing strategies
- **Transportation and logistics:** monitoring traffic flow, detecting accidents/congestion, optimizing delivery routes and tracking movement of goods and people in warehouses/ports
- **Healthcare:** monitoring patients in hospitals/nursing homes and detecting falls/accidents
- **Manufacturing:** monitoring production lines to detect defects/malfunctions, optimizing processes for efficiency and quality control
- **Sports and entertainment:** enhancing live event viewing experiences, such as analyzing player performance and providing real-time statistics and highlights

However, since video content can take multiple forms across these use cases (e.g., live streaming, store-forward video, AR/VR video, volumetric video), several challenges can arise:

- **Bandwidth:** Video data requires significant bandwidth, which can strain network resources and impact performance of other applications, especially in areas with high demand.
- **Latency:** Video applications require low latency to ensure smooth playback and real-time communication, which can be a challenge for 4G and 5G private networks, especially in areas with weak network coverage and congestion.
- **Interference:** Interference from other devices or networks can result in poor video quality or even signal loss.
- **Quality of Service:** Video applications require a consistent, high level of quality of service to ensure reliable playback, which can be difficult to achieve in high-density areas and other challenging locations.
- **Security:** Sensitive video data requires secure transmission and storage, which can be a challenge if the network is not properly secured or if vulnerabilities exist in the system.

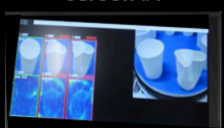
Overall, addressing these challenges requires a robust network architecture, optimized transmission protocols, effective traffic management and advanced security measures. The next chapter describes how these capabilities were successfully demonstrated at MWC Barcelona 2023.

MWC 2023 showcase

At MWC Barcelona 2023, Amdocs and Intel showcased a joint demo of Amdocs 5G Lab Experience and Intel® Distribution of OpenVINO™ toolkit – an optimized edge solution on Intel® Smart Edge MEC platform – representing a real-life manufacturing video analytics use case. The objective was to capture over-the-air video streaming using 5G NR equipment and wireless cameras.


In MWC booth we will see:

Screen #1



Computer vision application View
(live feed/recording from Dallas)

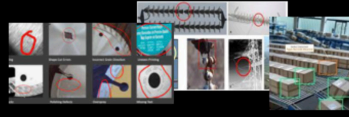
Screen #2



Enterprise Management Portal for e2e automated deploy and operate
(live clickable/recording)

What is the Use Case?

1. How an **Operator** can **manage** its Enterprise customers for operations and deployments
2. How an enterprise customer of the operator can **acquire an application** from marketplace and also manage their private network



Fault detection application (IntelVino)

Key messages

Intelligent Operations

Automated resolution for resource scaling & fault management scenarios, including issue tracking, Day to day SIM management

MPN Deployment with zero touch capabilities

MPN& Edge automatically deployed/tracked on Enterprise by Management Portal

Integration to B/OSS Ordering

Ordering by Enterprise in Amdocs Marketplace

Edge App deploy & Monetization

App onboarding with Management Portal + policy/charging UCs

Security

Security use cases covering several areas

Figure 3. Use case shown at MWC 2023.

The integration of n48 indoor radios, CBRS spectrum and 5G standalone core functions into Amdocs' 5G Experience Lab was facilitated by leveraging the flexibility of Amdocs MPN Design Studio. This integration allowed for a seamless integration process, enabling the efficient capture and transfer of videos for Intel's edge video analytics application, which is hosted on Intel® Smart Edge MEC platform, providing an effective training environment for their ML/AI modules.

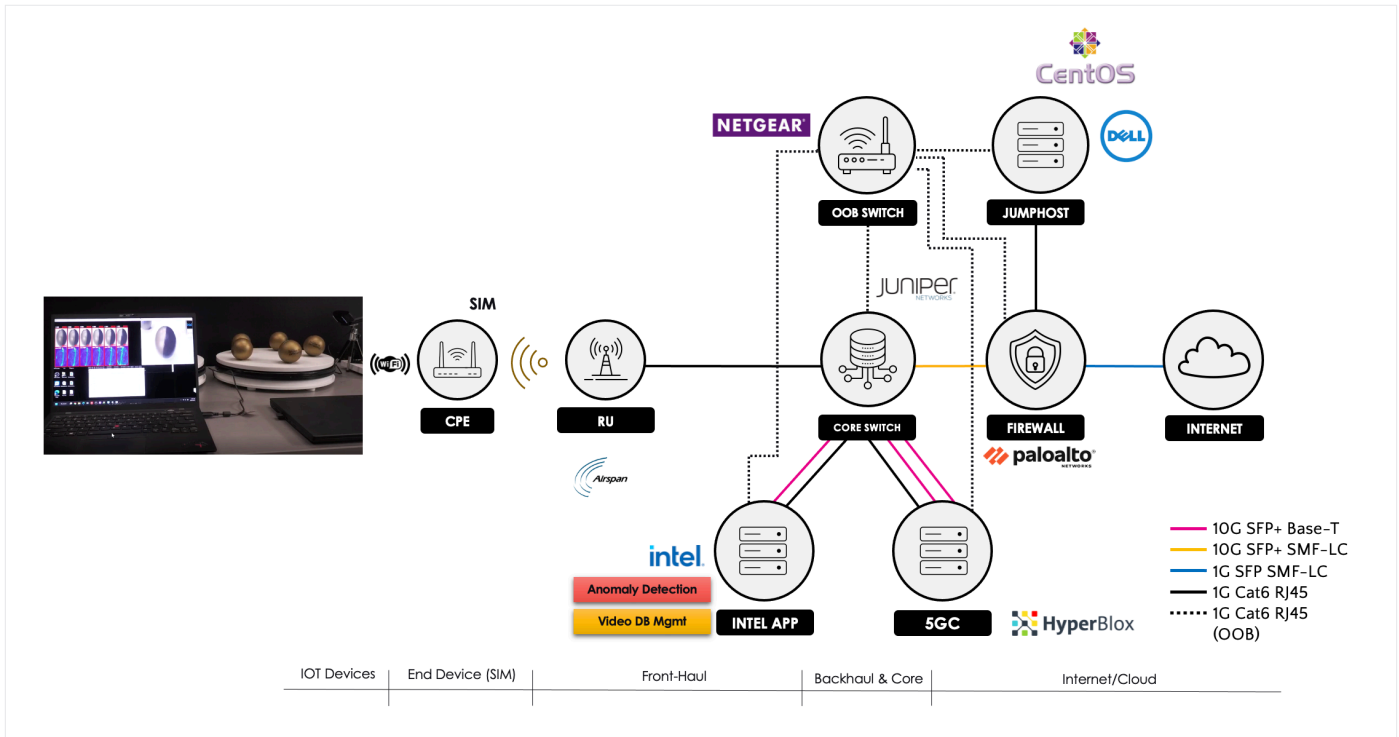


Figure 4. Network architecture and ecosystems of partners used for MWC demonstration.

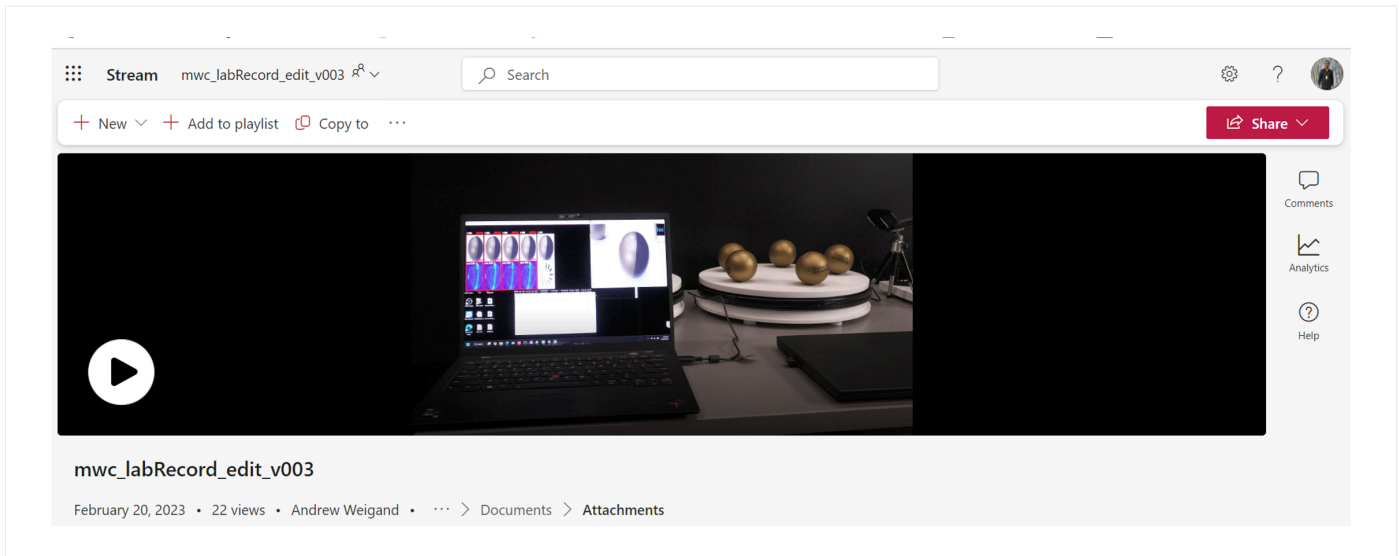


Figure 5. Visualization of fault detection in manufacturing production line.

A key aspect of the solution was the ability to manage the end-to-end deployment, as private networks require different management solutions than public networks. To address this need, the two companies presented the concept of an end-to-end network management portal, which provides enterprises with a clear visualization of their networks. This was critical to the success of the demo, as it showcased the importance of proper management solutions for enterprises and communication service providers, highlighting the significance of end-to-end management solutions in the deployment of private networks.

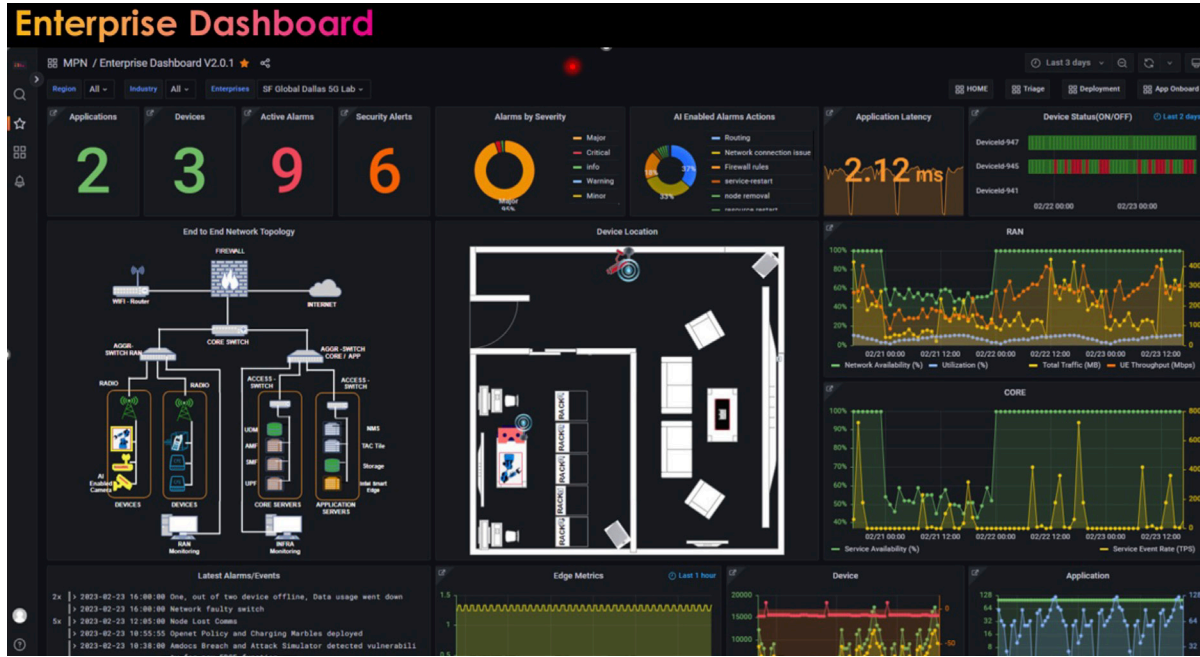


Figure 6. Amdocs MPN "single pane of glass" platform.

5G networks enable real-time anomaly detection for industrial automation

Importantly, real-time anomaly detection is a critical need for many applications, including network security, smart cities and industrial automation. The ultra-low latency and high-speed capabilities of 5G networks make them an ideal solution for real-time anomaly detection, allowing for early identification of potential issues.

To demonstrate the solution’s ability to address this need, the demo showcased the potential of 5G networks for industrial automation, using an anomaly detection application based on Intel’s OpenVINO™ toolkit.

The application was trained using only quality samples (i.e., anomaly-free training data without any prior knowledge of potential defects). As depicted in Figure 7 below, the application uses PCA (Principal Component Analysis) as a linear dimensionality reduction technique on the intermediate features produced by a pretrained DNN. It then calculates the feature reconstruction error (FRE) for use as an “uncertainty score,” after which, using the same FRE concept on convolutional layers, FRE maps are derived that provide pixel-level spatial localization of the anomalies in the image (i.e. segmentation).

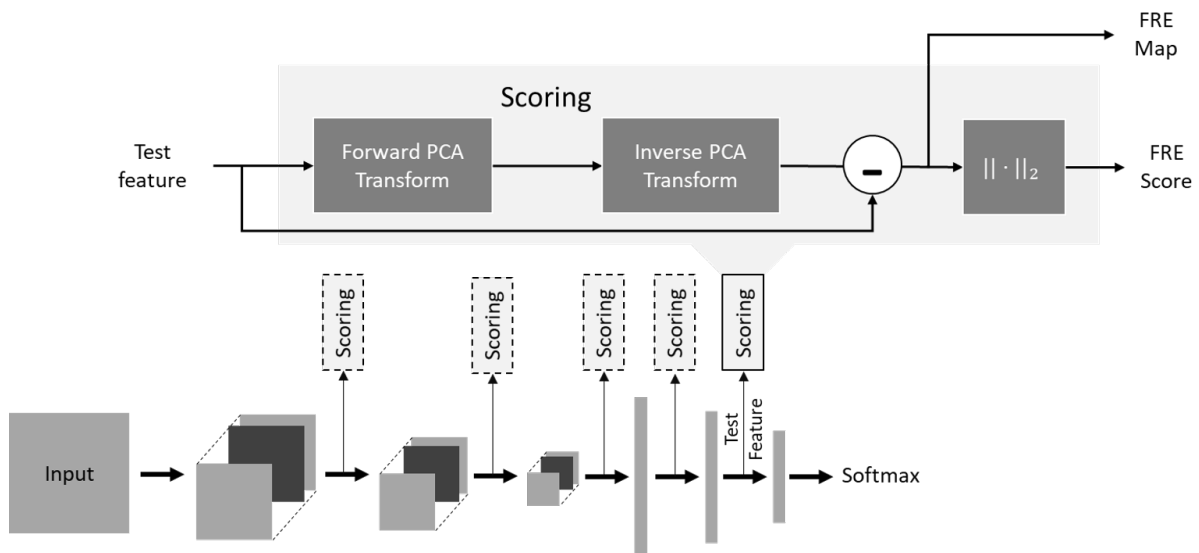


Figure 7. Application logic for detecting & localizing anomalies in the samples.

The application uses a visual inspection system to detect abnormalities in industrial parts. In this demo, a turntable with objects placed on it was used to replicate a manufacturing unit, while a camera connected to a UE was used to capture the visuals. The client component then received the camera feed, performed localization and sent the detected region of interest (ROI) to the server component over a 5G network. The server component then ran inference and detected anomalies, sending the results back to the client component for display.

Overall, the demo highlighted the significance of end-to-end management solutions for enterprises and communication service providers, emphasizing the importance of proper management solutions in the deployment of private networks.

Conclusion

In a world where enterprises are increasingly looking to private networks to connect their devices and systems securely, real-time anomaly detection is becoming critical in maintaining a competitive edge. Amdocs and Intel's joint demo at MWC Barcelona 2023 showcased how the combination of a robust network architecture, optimized transmission protocols, effective traffic management and advanced security measures can achieve those objectives. This end-to-end network management portal was pivotal in demonstrating the importance of proper management solutions for private networks, highlighting the significance of end-to-end management solutions.

About Amdocs

Amdocs helps those who build the future to make it amazing. With our market-leading portfolio of software products and services, we unlock our customers' innovative potential, empowering them to provide next-generation communication and media experiences for both the individual end user and large enterprise customers. Our approximately 30,000 employees around the globe are here to accelerate service providers' migration to the cloud, enable them to differentiate in the 5G era, and digitalize and automate their operations.

Listed on the NASDAQ Global Select Market, Amdocs had revenue of \$4.58 billion in fiscal 2022.

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