BK Medical
Distributed Architecture for Medical Ultrasound

Industrial IOT boosts Healthcare Efficiency and Savings with Distributed Ultrasound Architecture

For more than 30 years, BK Medical has been a leading provider of ultrasound systems to the procedure-driven markets such as urology, surgery and point-of-care. With award-winning systems and unique transducer designs, BK directly addresses the specialized needs and clinical challenges of physicians worldwide.

Over these years, advanced research and innovations have significantly improved the diagnostic and therapeutic capability of BK's ultrasound systems.

These machines however still continue to be single-user, standalone systems. The elaborate instrumentation are mounted on wheeled carts. And ported to where and when it is needed.

The resulting inefficiencies in usability and cost are too obvious.

Today modern healthcare infrastructure and medical platforms call for smarter, reliable and more efficient usage of clinical devices. These systems must seamlessly integrate with existing IT infrastructure of hospitals and medical research facilities. And allow secure, scaled user access.

Standalone systems cannot meet these requirements.

In response to these emerging requirements, BK launched a multi-year research program. This program aims to determine the feasibility of a distributed embedded architecture for ultrasound systems. Without losing the current capabilities and functionality.

Compliance with hospital environment, healthcare regulation and integration of Industrial IOT are prime considerations of this program.

Challenges

Migration from centralized, tightly-coupled embedded design to a distributed architecture unfolds multiple challenges. When the devices themselves become network endpoints, design focus shifts from "devices" to "large systems". And that's where the Industrial IOT enablers come into play.

Some key challenges are:

Deconstruction: How far the standalone system can be deconstructed into constituent elements? Without compromising functionality, reliability and performance. Figure 1 shows data-driven deconstruction into transducers, image processing, display and back-office units.

Autonomous sub-system development: The distributed architecture must ensure that the modular sub-systems can be developed and enhanced independently, with greater autonomy.

Connectivity: Unlike human-centric enterprise networks, device-centric communication needs to be robust, flexible, ultrafast and secure. And sensitive to the high throughput and low latency requirements. Additionally, this technology has to seamlessly run over hospital's existing IT infrastructure.

Customer Profile

BK Ultrasound solutions have played a central role in procedure-driven markets that include urology, surgery and point-of-care. With award-winning systems and unique transducer designs, BK offers unsurpassed imaging capabilities that enable real-time image guidance with easy-to-use, mobile platforms.

Business Challenge

BK's Ultrasound machines are single-user standalone systems. They can be used in only one physical location at a given time. This limits both efficiency of usage and cost-effectiveness.

Solution

RTI's Connext DDS enables Ultrasound system redesign using distributed system architecture. DDS is an Industrial IOT standard. It allows fast, secure and reliable connectivity for distributed real-time, mission-critical applications.

Using DDS enabled distributed design, ultrasound sub-systems no longer need to collocate. They can provide same functionality and concurrent multi-user access by connecting over the cloud.

Results

- Doctors and caregivers need to carry just a handheld transducer, instead of elaborate instrumentation.
- Scaled, secure multi-user access improves utilization.
- Diagnostic results immediately displayable and billable.
- Operational simplicity.
- Significant savings in space, time and money.
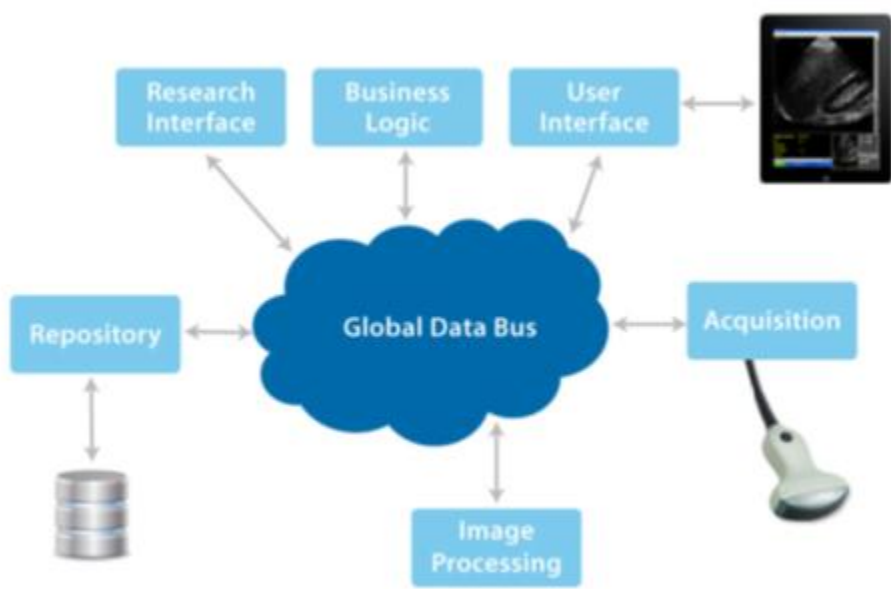- Mission-critical reliability (Downtime in milliseconds)

Figure 1. Future ultrasound system architecture.

Solution

Early in their process, BK Medical identified data as the key integration point. However, the complexity of the data quickly became apparent. They had to consider:
- The type of data
- How it was used in the system
- How often it was updated
- How quickly various sub-systems needed access to it
- How reliably it could be delivered over wired or wireless media

They looked for a way to handle the data consistently across various independent sub-systems. And also to enhance the system performance for very large data-streams produced by the transducers.

Since each sub-system or application is independently maintained, BK Medical needed a mechanism to ensure loose-coupling among the sub-systems, without compromising their data management efficiency.

So they opted to use a global data bus and a data-centric design approach that includes management tools for performance, reliability and other system attributes. This would not only decouple applications from each other, but also from the underlying physical delivery media or network topology.

BK Medical settled on RTI Connext DDS as the best foundation for the BK Medical Global Data Bus.

Benefits

RTI Connext DDS directly addresses real-time systems. It features fine control of real-time QoS parameters, such as reliability, bandwidth control, delivery deadlines, liveliness status, resource limits and security.

It explicitly manages the communications data model, or types used to communicate between endpoints. It is thus a data-centric technology. Like a database, which provides data-centric storage, DDS understands the content of the information it manages. That's why RTI calls DDS a "DataBus."

Connext DDS-based Global Data Bus allowed BK Medical to:

- **Develop applications independently:** A DDS-based system has no hard-coded interactions between applications. The DataBus automatically discovers and connects publishing and subscribing applications.

- **Flexible, Plug and Play Capability:** In this design, a new device can be added to the network without requiring configuration changes. The DataBus matches and enforces QoS. RTI Connext DDS Secure can be easily and smoothly added to any legacy system.

- **Easily scale and interoperate:** DDS implements a connectionless data model. It has the ability to publish and subscribe to data with the desired quality of service (QoS). Sub-systems are either publishers of data, or subscribers to data. DDS automates the discovery and connectivity. This overcomes the limitations of point-to-point system integration, such as scalability, interoperability and the ability to evolve the architecture.

• **Finely control performance:** Meets high-throughput and low-latency demands. Mission-critical reliability (downtime in ms), real-time performance (in ms) and scale (10k data items).

• **Easy integration:** DDS readily addresses the challenge of mixing real-time communications with IT infrastructure, an essential requirement for BK Medical ultrasound systems.

Result

BK's new systems will be completely distributed enabling a variety of efficiencies.

- ❖ For ultrasound, doctors would need to carry just a handheld transducer (size of a smartphone).

- ❖ With a distributed scenario, only one image processing system may be needed for a hospital or clinic. Doctors and researchers can concurrently use this system. It will save significant hardware costs while making the systems more accessible.

- ❖ The imaging data from the scanner can wirelessly connect to the back-office and upload to the cloud for image calculation.

- ❖ Images will now be generated in and distributed over the cloud. The image processing system can even be kept off-site with the cloud service provider. This reduces management overhead.

- ❖ Both patients and caregivers can access images on any display, wherever they are. Diagnostic results can be immediately displayable and billable.

Industrial IOT is enabling new architectures that make medical systems cheaper and far more efficient. And at the same time fast, reliable and secure.

As hospitals and healthcare providers establish their communications infrastructure, their suppliers must adapt their system architecture to meet emerging needs. The data-centric approach adopted by BK Medical ensures that their distributed system architecture will lead the way. Both for ultrasound system technologies, and integration with the Industrial IoT.