STREET SMARTS:

Revolutionizing Traffic Mobility with Modern Processors and Smart Technology

By Amy King

From lumber to eggs, supply shortages caused by the pandemic reached all aspects of our lives. While these inconveniences were abundant and frustrating, the post-pandemic world has opened our eyes to improved ways of doing things. We now have curbside pickup at places we never would have imagined and delivery options for nearly everything. Society was forced to expedite innovative solutions that would have usually taken years to implement, if at all.


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The traffic signal industry was not immune to the effects of the pandemic. Supply issues for PowerPC processors used in traffic signal controllers have plagued the industry for years, but the pandemic was a major catalyst for considering new ways processors can be used in traffic signal controllers. While the impending demise of outdated PowerPC processors has been looming for years, the pandemic forced the industry to focus on more advanced solutions for today's emerging smart technology climate.

The Rise and Fall of PowerPC

In 1990, IBM released hardware for a processor that uses an instruction set architecture known as POWER. This instruction set became the foundation of PowerPC processor technology that Apple, IBM and Motorola developed together to create a modern computing solution at the time. What used to take a minute to preview a complex graphic could take 10 seconds with a PowerPC. However, the problem with PowerPC architecture was that it needed volume to build the infrastructure required to compete with rival developer Intel. By 1995, IBM was slow to create that infrastructure, so third parties did not want to support it. While PowerPC was not able to truly compete with Intel, it was successful in video games, such as the Nintendo Wii, Xbox 360 and PlayStation 3.

A change happened in 2001 when a PowerPC-based chip became the commercially available multi-core microprocessor. It was one of the first processors to reach 1-gigahertz processing power. Two years later, a single-core version was created for Apple, the company's first 64-bit processor. At the time, most processors were only available as 32-bit chips. Ultimately, the PowerPC could not keep up with Apple's demands for innovation and speed. Thus, Apple abandoned the PowerPC chipset for Intel processors in its computers.

The Future of Traffic Signal Processing Begins with ARM

ARM, which stands for Advanced RISC Machine, is a processor based on the reduced instruction set computer (RISC) architecture for computer processors. ARM chipsets speed up the operation process by minimizing the number of available instructions, and they can support modern systems and applications. Compared to PowerPC, the processing power and storage available with ARM processors is unmatched. ARM processors are four times as powerful as PowerPC chips. The ARM chipset has been around since the 1980s, but it was not adopted by the technology industry until the early 2000s with cameras and switches.


Whitney Nottage,executive vice president of operations for Q-Free America

"While PowerPC processors were a popular choice for computers during the 1990s, they were largely replaced by ARM processors in computers and phones in the early 2000s," said Whitney Nottage, executive vice president of operations for Q-Free America, a manufacturer of intelligent transport systems (ITS). "PowerPC has been relatively obsolete for about 15 years."

The mainstream adoption of ARM processors has made PowerPC processors increasingly difficult to find because they have less functionality and are seldom used in modern technology. Therefore, they can come at a premium price, and their availability is unstable. Whereas ARM processors are readily available, there is a stable and reliable market for them.

Nottage adds that the remote work due to the pandemic created exceptional demand for ARM processors combined

Q-Free XN-1 ATC controller, which uses the ARM processor

with natural disasters in Taiwan and facility shutdowns, which reduced chip manufacturer capacity. It was logical that the manufacturers would prioritize the modern ARM processors over the dated PowerPC processors. Unfortunately, the traffic signal industry has outdated specifications that still call for PowerPC processors in traffic signal controllers, and the industry has been slow to adopt new specifications.

Patrick Marnell, director of product management for Q-Free America

"A quirk of our industry is that it is locked into a specific set of chips," said Patrick Marnell, director of product management for Q-Free America. "Phones are a good analogy. Most people don't say they want a particular phone because of its processor. They care about functionality."

Q-Free has been exploring the use of ARM processors in the traffic signal industry for years, long before supply chain issues catapulted ARM into the spotlight. The pandemic accelerated Q-Free's existing plans for implementing ARM processors in the industry. However, industry specifications for PowerPC processors make the transition to ARM difficult for some.

"We have to be cautious and thoughtful because we know our customers are bound to specs that call for the PowerPC," said Marnell. "For agencies that use PowerPC, updating standards to include terms such as 'equal or greater functionality' can provide agencies with a lot of flexibility in their procurements. We can help our customers get approval for ARM processors by showing that they meet and greatly exceed the functional requirements in the specs."

A major benefit of ARM processors in the traffic signal industry is that additional processing power can be used to run multiple software applications. Running more applications on less hardware frees up space inside crowded traffic signal cabinets, where real estate is a hot commodity. Further, each processor generates heat that, in hot environments, may need to be regulated with cooling systems. With fewer boxes in traffic cabinets, there are lower maintenance costs because maintenance workers have fewer boxes to manage. This is also a win for sustainability, helping to control e-waste.

Currently, there are a couple of companies using this technology. One is Q-Free, which is ARM-based. Yunex Traffic uses ARM along with PowerPC in its YUTRAFFIC Blade Controller. Because the technology was introduced in the last year, Q-Free hopes it will increase in 2024 and beyond.

"The feedback is exciting," said Marnell. "Customers don't care about ARM or PowerPC – they care about storage and functionality. We are eager to write exceptions for ARM in specs. The performance boost is too great to ignore. This is the way of the future, and we are willing to stick our necks out to take a chance for our customers."

Despite the excitement surrounding revolutionary traffic signal technology, many people are hesitant to go against the standard. Q-Free is passionate about implementing ARM processors in the industry no matter what it takes.

"It's the right tool for the job," said Marnell. "If the only reason this technology is not being used is because of the standard, then the standard needs to change instead of picking a different tool."

Smart Technology for Smart Cities

Another major appeal of ARM processors is that they have the power to support smart cities in a way PowerPC cannot. ARM processors are the same in our cell phones so that they can transform traffic signal controllers into the smartphones of the intersection. Smart cities are urban areas that use different sensors to collect data from and about people and infrastructure to improve efficiency and quality of life.

The traffic signal cabinet is the perfect hub for smart city applications and devices. It is a securable cabinet with power and communications to the agency's network. It's the perfect place to gather data from smart city field devices before transmitting it to servers at an agency in the cloud.

That data can then be used for data-driven tools to facilitate that city's goals, including safety and traffic flow.

Along with ARM chips, artificial intelligence (AI) is a type of smart technology that is helping to improve functionality in traffic operations controllers by using specialized processors to handle larger datasets more efficiently. This translates to faster processing times and less electrical power. AI accelerators such as neural processing units (NPUs) and graphics processing units (GPUs) are transforming the way traffic signals operate. From traffic conditions such as demand, weather and accidents, Intelligent Transport Systems (ITS) are smart means of transportation that continuously monitor everything happening around vehicles. AI usage can improve traffic flow, safety and travel time while reducing congestion, emissions and accidents. With improved predictability and real-time traffic monitoring, maintenance workers can tend to traffic signal cabinets less frequently and only when required.

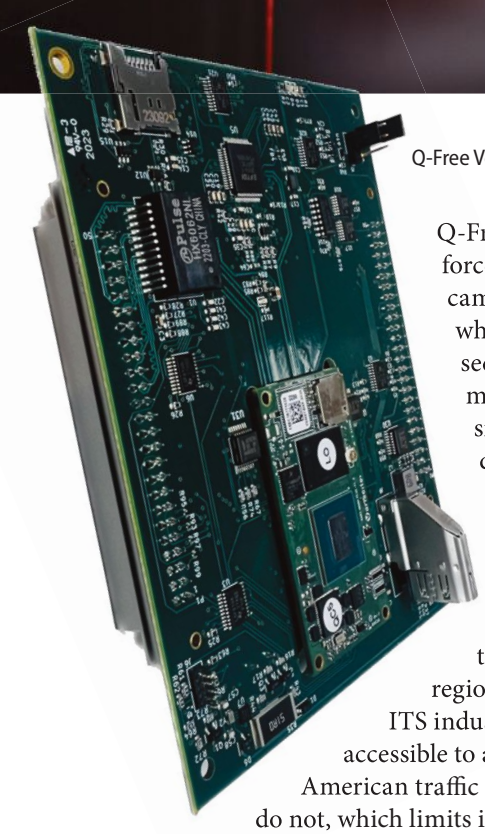
Edge computing is another method for consolidating space and improving functionality within traffic signal cabinets. Edge computing allows devices to process data at the edge of the network by either the actual device or a local server. This process brings applications closer to data sources, such as internet of things (IoT) devices or local edge servers. Close proximity to data can deliver faster results, improve response times and better bandwidth availability. When data needs to be processed in the data center, only the most important data is transmitted, reducing unnecessary transmissions.

> "This is the way of the future, and we are willing to stick our necks out to take a chance for our customers."

"Smart technology is important for the industry because it aligns with the nation's goals to make safer, connected and more sustainable roads," said Nottage.

FREEtheMIBS Promotes MIB Sharing

A critical step to building smart cities is sharing management information bases, commonly referred to as MIBs. According to freethemibs.org, MIBs provide a common language that central traffic management systems and transportation management devices communicate. Smart cities seldom rely on a single brand of traffic control products, which is why communication sharing between vendors is crucial to their success.



Q-Free Velocity ARM processor

Q-Free has been a driving force behind the advocacy campaign FREEtheMIBS, which encourages public sector agencies and manufacturers of traffic signal controllers and ITS devices to come together for the free and open sharing of MIBs. MIB sharing allows for interoperable solutions and innovation across the industry. Some regions and segments of the ITS industry have made MIBs accessible to all. Still, most North American traffic control manufacturers do not, which limits interoperability and competition and drives up taxpayer costs.

MIB sharing promotes competition by allowing customers to choose the best solution for their needs regardless of vendor.

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It also increases competition by letting companies compete based on merit. When more companies compete, taxpayers save money.

Bringing Smart Technology to the Traffic Signal Industry

Time is of the essence for industry leaders to recognize that technology moves fast, so standards and information sharing need to keep up. The availability of modern technology may have occurred sooner than expected due to the pandemic and natural disasters, but it is here to stay and ready to be implemented. Transitioning to advanced technology helps reduce supply chain issues and, more importantly, can transform intersections from outdated and low-functioning to highly efficient, safe and smart systems.

Amy King is a freelance writer and editor. She has 20 years of marketing and public relations experience, including social media, event planning, writing and blogging. Amy is a graduate of the University of Florida with a bachelor's degree in public relations.