ASU Smart City Cloud Innovation Center
Arizona State University
powered by aws

Democratizing access to scientific instruments to speed discoveries

Virtually any scientific discovery made today requires access to specialized and often expensive scientific instruments, explains James McCabe, enterprise network architect at Arizona State University (ASU). In fact, a single instrument can cost more than $150 million.

The Internet has democratized the availability of information, content, and software for billions of people worldwide. But specialized scientific instruments for researchers and scientists continue to primarily affiliate with specific academic institutions, creating an exclusive, limiting culture around research. Local researchers get priority access to instruments near them, but others must travel long distances or only get access through word of mouth from close academic circles. Legacy technology, institutional politics, and inefficient practices around equipment sharing can impede scientific discovery.

James was closely familiar with this problem and reached out to the ASU Smart City Cloud Innovation Center (ASU CIC) powered by Amazon Web Services (AWS) to build an advanced new system to manage instrument access that he believes will largely benefit the scientific community and society.

"We need to revolutionize the landscape of how science gets done through software improvement and new economic models," said McCabe, who understands the issue intimately based on his work at ASU and the Sun Corridor Network (SCN). ASU owns instrument facilities and laboratories and houses an array of tools and equipment, such as supercomputers, satellites, telescopes, microscopes, and numerous Internet of Things (IoT) devices.

The possibilities are endless as shared instruments, platforms, and applications are keys to scientific discovery, from telescopes viewing space to accelerators examining atoms in quantum mechanics.

After engaging with the ASU CIC, James and a team of IT leaders and academics conducted a series of innovation workshops using Amazon's working backwards approach. They concluded that the instrument scheduling process was not streamlined enough to adequately handle the heavy flow of instrument requests. Each facility listing instruments for reservation operated on individual and often siloed networks. In addition, after researchers submitted requests, credentialing and authorization took too long and posed security concerns.

The SCN and ASU CIC teams built a cloud-based, open-source solution powered by AWS called the Science Instrument Reservation and Access System (SIRAS). The system benefits both users and equipment owners through automation that simplifies access using web-based services. The software application features a catalog of instruments to connect researchers to requested equipment and consists of three components. The first component is a software-defined network that optimizes performance for remote access, operation, and collaboration; the second is software that integrates with the instruments to enable virtualization; and the final segment of the system is a self-provisioning service that helps researchers search available equipment, submit reservations, and make payments.

Users can log in via a web interface, select desired equipment, and click a verification button prompting a request for authorization from the equipment owner. The owner has the ultimate approval and control of equipment access, and the SIRAS application will not impact the performance of the instrument. SIRAS capabilities are robust enough to support an unlimited number of users, but academic institutions have leverage to configure permission-based guidelines and specific requirements depending on the tool.

Each software component can be implemented separately for immediate use and benefit. However, McCabe is planning to make these components work in harmony by developing a software-defined exchange prototype to orchestrate the delivery of instruments through a cloud-based framework. It works by routing data and intelligence through multiple domains as opposed to separate networks at individual institutions. This new concept for distributing instruments is showing promising use cases by freeing the instrument from its location or existing system and making it widely available to researchers at remote sites. The possibilities for SIRAS are endless as shared instruments, platforms, and applications are keys to scientific discovery, from telescopes viewing space to accelerators examining atoms in quantum mechanics.

The system is currently being deployed in a local test bed at Arizona's tri universities (ASU, University of Arizona and Northern Arizona University), as well as the University of Nevada-Reno. Ultimately, McCabe and the ASU CIC envision worldwide reach for the SIRAS infrastructure, including a wider community of researchers, STEM school teachers, and even the general public. SIRAS also has the potential to bring scientific discoveries to students of all ages with opportunities, such as virtual field trips to planetariums.

Get in touch with the CIC team and learn more about this challenge:
smartchallenges.asu.edu/challenges/asu-accessing-scientific-equipment

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James McCabe
Enterprise Network Architect at Arizona State University