Connected
Fall 2017
A Biannual Newsletter for Connected Corridors Stakeholders

New Caltrans Team Members Join CC Efforts

Over the last few months, the I-210 Project welcomed some new team members, including three Caltrans District 7 engineers: Mr. Morteza (Mort) Fahrtash, Mr. Farid Nowshiravan, and Mr. Ken Young. Mort is the new I-210 Connected Corridor Project Manager, a role previously held by Sam Esquenazi and Farid is the new Corridor Manager, responsible for traffic operations for all of Interstate 210, 10, and 605. Ken is the new office chief responsible for the safety and operations for the San Gabriel Valley. Allen Chen remains the technical project manager for the I-210 Project. Given Farid's and Mort's close involvement in Connected Corridors, below is a quick overview of their background and current responsibilities.

Mr. Morteza Fahrtash, P.E.,
Office Chief of District Traffic Manager

Mort has been with Caltrans since 1991. In September, Mort joined District 7 and is now the new District Traffic Management Office Chief. In this role, Mort is responsible for the managemant of the LA Regional Traffic Management Center (LARTMC) and all LARTMC operations, the Lane Closure System team, Traffic Management team, and the Traffic Management Plan. In addition to his duties as DTM Office Chief, Mort is also the I-210 Connected Corridors Manager. Mort will manage the planning and development of the CC Project through deployment for Caltrans.

From 1998 to 2017, Mort was the Chief of Traffic System Development, Ramp Metering and Vehicle Detection System branch in District 12. Concurrently, he was the manager of the Transportation Management Center (TMC) in District 12. During his time in the Division of Traffic Operations, Mort developed many innovative projects in the area of Intelligent Transportation Systems and published information about his work and new developments as often as he could. Most recently, Mort was responsible for defining the Traffic System Management and Operations (TSMO) requirements for D12 and was in the process of developing the System Engineering Management Plan and Concept of Operations for the Orange County Triangle ICM project. Additionally, Mort was coordinating efforts to establish protocols for V2I interoperability.

In 1994, and again in 1999, he was the Excellence in Transportation Award recipient for Major Freeway Widening in District 12, an ASCE Project Achievement Award winner for the State of the Art TMC Building in 2002, and a recipient of the Orange County Engineering Council Merit Award in 2003.

Mr. Farid Nowshirvan, P.E.,
Senior Transportation Engineer/Corridor Manager

Farid has almost 24 years of experience at Caltrans and has worked in all Traffic Operations functional units during his public sector tenure. He started his career with Caltrans in 1989 at District 11 and worked in the Traffic Engineering Study Branch performing safety and operational studies. Most recently, Farid was the branch chief in District 12 and managed the Encroachment Permits office and the Truck Services Office. From 2002 to 2005, Farid lead the I-5 Corridor System Management Pilot project in Orange County. From 2005 to 2010, he led the Corridor System Management Plan (CSMP) and micro-simulation related efforts in District 12's Division of Traffic Operations and helped deliver CSMPs and

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Micro-Sim Models for all corridors in D12. Farid also managed and coordinated efforts related to the Managed Lanes program and Mobility program between 1999 to 2004. Over the past 17 years, he has worked with Headquarters and several Districts, and served on various technical, advisory, and steering committees to improve policies, processes, and practices related to various programs.

In addition to serving as the Corridor Manager in charge of Interstates 210, 10, and 605, and the Connected Corridors I-210 Project, Farid is the Intersection Control Evaluation (ICE) Coordinator, Inter Governmental Review (IGR) Coordinator, and the North Area Safety Device Coordinator for District 7.

Farid believes in the importance of building strong teams to create strong programs and changing inefficient processes for the betterment of all.

Six Vendors Agree to Standardize ICM Interfaces

Integrated Corridor Management (ICM) can be expensive and risky. It requires the involvement and integration of multiple stakeholders, data feeds, and technical systems. Simplifying and standardizing the agreements, the data formats, and the technical systems is one of the primary goals of the Connected Corridors Program. Standardization reduces the cost and risk of ICM implementation.

One way the CC Program is accomplishing this is by defining technology standards and working with the private sector to test and implement standardized interfaces. Once the interfaces are tested and certified to work together to implement an ICM system, government agencies will be able to more easily choose between vendors, with the assurance that their integration challenges will be lessened.

The Connected Corridors architecture uses the TMDD (Traffic Management Data Dictionary) standard for data exchange between the core system and external software components, such as Traffic Control Systems, Arterial Sign Management Systems, and the Caltrans' ATMS. This includes the data hub, Decision Support System, Corridor Management System (CMS), Traffic Control Systems (TCS), sign control systems, and other systems. The interfaces are what enable communications between the equipment in the field, the traffic management centers and stakeholder agencies, and the ICM core system. Without information flowing between these systems, response plans cannot be generated or implemented efficiently. To fill these communication requirements, the CC team is working with three companies to provide TCS interfaces and three other companies to provide the ICM core functions of user interfaces, mapping, and response plan management.

The importance of the TCS interfaces, also called center to center (C2C) communications, has been stressed in previous Connected newsletters, most recently the Spring 2017 issue. Without a way for the centers to send and receive information, the I-210 Project cannot be implemented. Additionally, by standardizing all of the systems, integrating the interfaces with the ICM core system will be much easier for the CC Project, and for the statewide rollout.

Over the summer, the team made substantial progress with both groups, resulting in the following six private sector vendors agreeing to participate in the pilot:

Company	Product	Type	Affiliation
Kapsch	EcoTrafix	CMS	Core ICM System, All Stakeholders
Parsons	iNET	CMS	Core ICM System, All Stakeholders
Telegra	topXview	CMS	Core ICM System, All Stakeholders
Kimley-Horn	KITS	TCS	LA County, Duarte, Monrovia
McCain	Transparity	TCS	Pasadena
TransCore	TransSuite	TCS	Arcadia, Caltrans

As a part of their participation, all of the companies have agreed to modify their interface and its functionality using the standard TMDD format to meet the needs of the CC Project. A vendor will also be selected for the sign technologies being implemented in the corridor. PATH will oversee the vendors and ensure the various interfaces match the system requirements as developed by Caltrans and the stakeholders. The goal will be for PATH to certify each interface verifying its ability to be readily integrated into CC's core system.

Once they are tested and validated for the I-210 Project, all of these products will then be available statewide, with the knowledge that the interfaces work using a TMDD standard. Caltrans Districts and other agencies will be able to select from a list of vendors with ready

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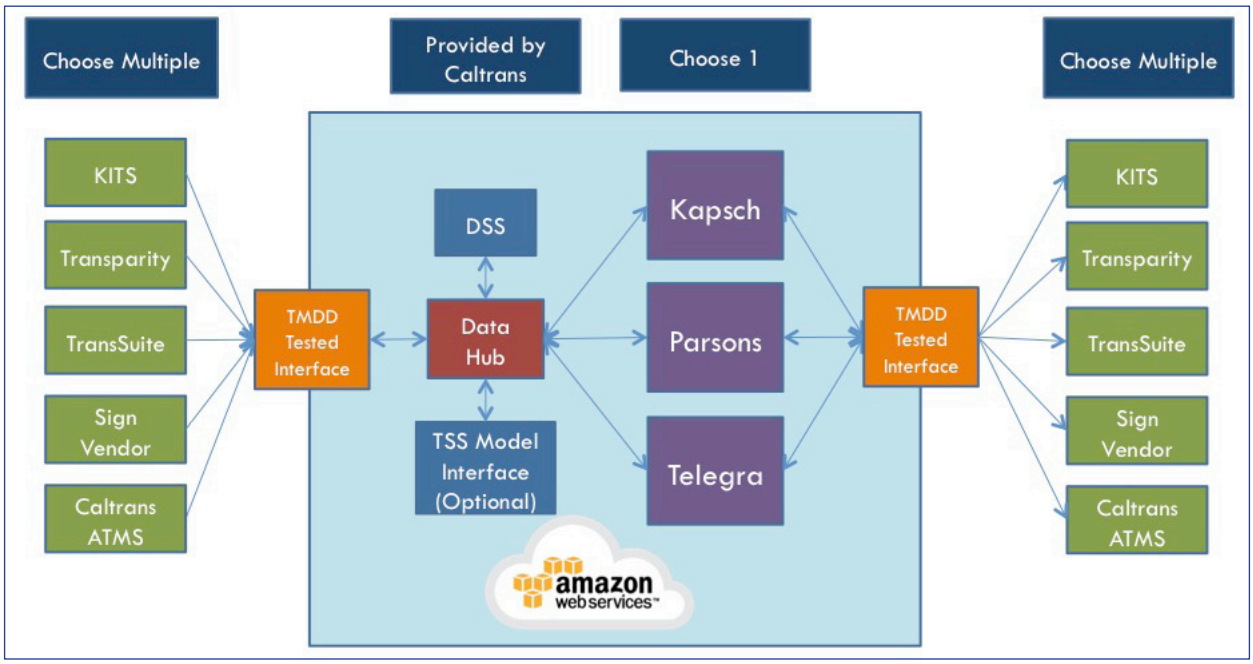
to go systems, rather than starting from scratch. Specifications and detailed requirements for the Project and its supporting systems will also be available. This will greatly reduce the risk and costs associated with implementing ICM and pave the way for better systems and technologies to be accessed across California and beyond.



The interfaces will be standardized and tested to ensure compatibility within the Connected Corridor System

Connected Corridors Wins Amazon Award

Caltrans and the Connected Corridors I-210 Project were recently honored by Amazon Web Services (AWS) as an Honorable Mention in their 2017 City on a Cloud Innovation Challenge. Connected Corridors was among 13 finalists in the "Best Practices (Large)" category, which recognizes a local or regional government leader, or public or private school or district who has deployed an innovative solution to solve a government challenge. The I-210 Project is using the Amazon cloud to host its Data Hub, real-time Decision Support System (DSS), and Corridor Management Subsystem. The award includes a $10,000 credit to CC's AWS account, where the Pilot's cloud services are being developed and will eventually be hosted.

"The future is in the cloud," says Joe Butler, PATH's Connected Corridors Program Manager. "We are designing our systems to enable Caltrans to leverage the scalability, shared access, and reduced maintenance costs associated with cloud applications. Amazon has been an excellent supportive partner in helping us achieve this goal."

The CC team is already seeing a cost savings and improved workflow by moving to the cloud. UC Berkeley's data center had over 45 devices dedicated to CC, but is now down to one physical server (and its days are numbered). At the same time, the program gains the ability to scale resources as needed, paying only for what is used. Research engineers are able to do new work supported by simulation runs in AWS at scales not previously supported by the physical hardware environment.

"This new way of working has allowed the PATH team to focus on core program deliverables, and we've enjoyed working closely with our Caltrans IT colleagues throughout the process," says Greg Merritt, PATH Connected Corridors Technology Transfer Coordinator. "We appreciate this recognition and support from Amazon as we move towards deployment."

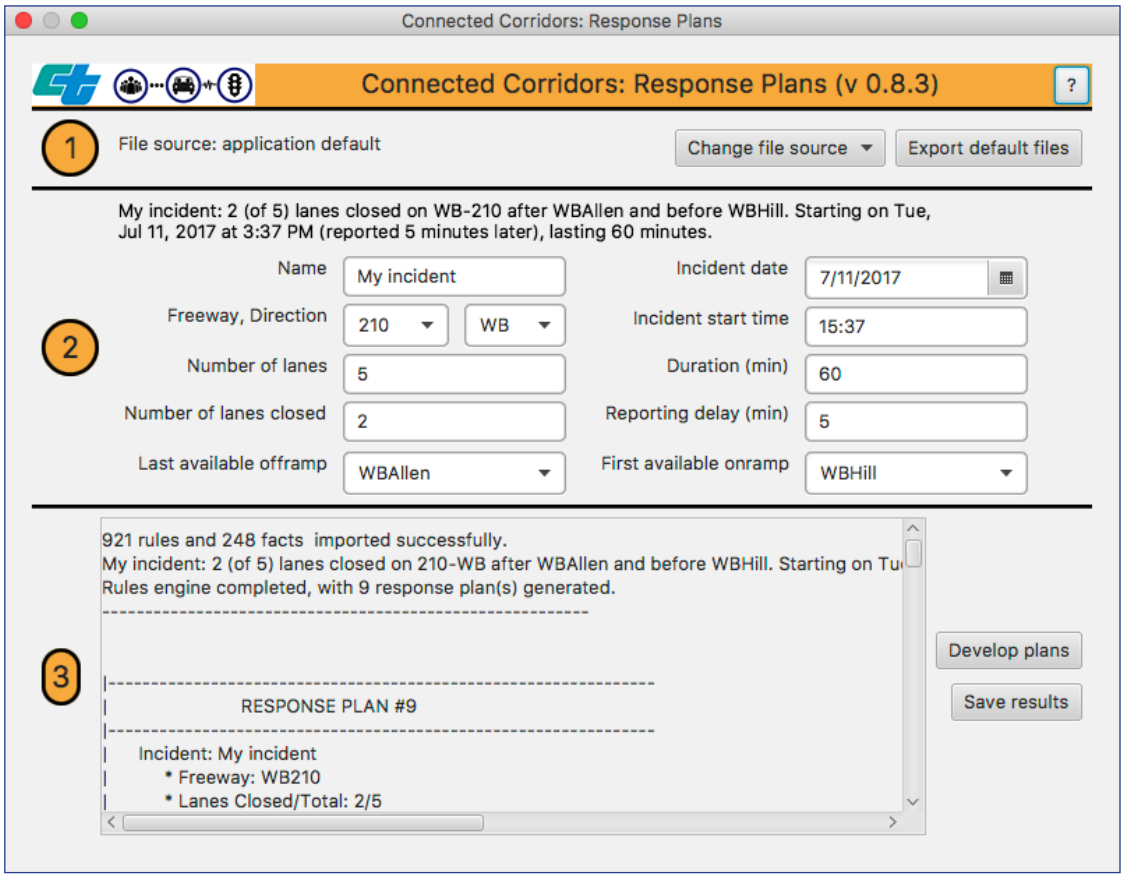
PATH Tool Developed to Evaluate Response Plans

The CC team has been steadily working on defining the response plan elements and rules needed for response plan generation. Greg Merritt and other team members at PATH have created a software application to assist stakeholders and engineers in capturing this information and then testing the generation of response plans for a given incident. All of the elements that make up a response plan are being added to the tool. These include signal timing plans, reroutes, changeable message sign information, agency notifications, and much more. In addition, the rules supporting which response plan elements can or should be used at a particular day and time are being determined and entered into the application. For example, a reroute that passes a school may not be a viable option during school hours; or if an incident takes place at 2am versus 2pm, different traffic management centers may need to be notified due to staffing.

To use the tool, incident information is entered into the user interface including location, date, time, number of lanes and lanes closed, duration, and so forth. Then the tool reviews the response plan elements and rules and uses them to generate response plans. This first version of the tool is being designed as a standalone desktop application. Later on, a very similar tool will be developed within the ICM system. This version of the tool will rank the response plans using rules or a traffic simulation model, and forward the plans for approval and implementation.

For the time being, the tool is being used to review, and refine, the response plans and rules with stakeholders. Greg has met with a number of agency stakeholders to discuss both the end user appearance of the tool and the response plans it generates. The team is currently focused on determining whether the response plans being generated by the tool are both complete and align with how stakeholders would want to respond to a given incident. Based on these reviews and our ongoing work, the rules and response plan elements are undergoing continual refinement. Early next year, stakeholders will be asked to formally approve the response plan elements and rules.

In addition to being valuable for the I-210 Project, the response plan generator tool will be made available to other Caltrans Districts and regional agencies for their use. This is a good example of how the Connected Corridors Program is paving the way for simpler ICM implementation across the state of California.



A screenshot of the tool the CC team is using to define and build response plans

CC Team Members Present at ITS CA Conference

In September, several members of the Connected Corridors team presented at ITS CA's annual meeting held in San Francisco. Greg Merritt presented on the use of the cloud at a technical session on the Internet of Things (IoT). Mort Fahrtash, Nick Compin, and Joe Butler were part of another technical session discussing Integrated Corridor Management (ICM) progress in California.

Greg's presentation was on the cloud and the various systems the Connected Corridors Project is developing and deploying in the Amazon cloud. Greg outlined the benefits of the cloud for ICM, including flexibility, scalability, cost-efficiency, security, and fault tolerance. He also discussed how transitioning from a traditional in-house server farm to a cloud-based computing platform is changing the team's perspectives on operations, deployment, maintenance, and security.

Mort is the newest member of the Connected Corridors management team. Mort is Districts 7's new District Traffic Management Office Chief and has also assumed the role of the Connected Corridors Project Manager for D7. Prior to his appointment at District 7, Mort was managing an ICM project in District 12, which he discussed in his presentation. The project is taking place on the North Orange County Triangle, which includes sections of Interstate 5, SR-91, and SR-57 in Anaheim. The project's vision is to "be a high performing, cooperatively managed transportation system that improves safety, promotes a multi-modal system, improves traveler conditions, provides robust traveler information, and reduces greenhouse gas emissions while reducing congestion related to events, incidents, and daily traffic." The project is being led by Caltrans, with support from local and regional stakeholders similar to the I-210 Project.

Nick discussed Caltrans efforts related to Transportation System Management and Operations (TSMO) and the Connected Corridors Program. He emphasized the importance of institutional, technical, and operational integration for TSMO and how Caltrans is making progress in each of these areas. Nick has been very involved in Caltrans initiative to implement TSMO statewide, including hosting corridor management workshops and corridor-level operations forums at Caltrans Districts. By the end of this year, all Caltrans Districts will have participated in an "Organizing for Corridor Management" workshop.

Last but not least, Joe presented on how the I-210 Project is reducing the cost and risk barriers associated with ICM. He provided details on the system interfaces the team is currently standardizing, the vendors that will be supporting these interfaces, and the documents and tools that either are, or will be made, publically available. He also discussed the team's efforts related to training, workforce development, and knowledge, skills, and abilities (KSA).

All of the Connected Corridor team member presentations from the conference can be accessed at ITS CA's website at: http://itscalifornia.org/17session-presentations

Additional information from Joe's presentation can also be found on our website at: http://ccdocs.berkeley.edu/

Cal Poly Pomona Developing Center-to-Center Communication System for Transit Stakeholders

Through LA Metro's Call for Projects funding, the Connected Corridors team is now working with researchers at Cal Poly Pomona to develop an Open Data System to enable communications between the Connected Corridors system and our transit stakeholders. The Open Data System (ODS) acts as a broker sending and receiving information from the Connected Corridors Data hub, to and from an individual agency's system. The information being transmitted includes incident details, response plans, and traveler information. The work is being led by Dr. Xudong Jia and Dr. Xinkai Wu.

Foothill Transit and Pasadena Transit will both utilize the ODS once it is functional. Cal Poly Pomona has already begun meeting with these agencies to discuss their requirements and individual communication protocols. The ODS will ensure that the data from Foothill Transit's Orbital System and Pasadena Transit's system can be translated into the Traffic Management Data Dictionary (TMDD) 3.03(d) protocol required by the Data Hub. The Data Hub will pass this information to the CC Decision Support system for use in creating incident response plans. Similar interfaces between the County's and cities' traffic control systems (TCS) and the CC system are in the early stages of development through their TCS providers including McCain, Transcore, and Kimley-Horn.

Dr. Jia emphasizes that unlike most current map applications that only push traffic information to the end user, the I-210 Project is a proactive program. "The DSS will be monitoring conditions and allocating additional resources to improve those conditions," says Dr. Jia. Resources, in the form of a response plan, include signal timing plans, ramp metering, detour signage, etc. "Traditional applications don't control the timing, we do. The Connected Corridors system will not only say 'go this route,' but here are additional resources to make this route better."

Separate from the Open Data System, the Cal Poly team is also working on two environmental stations for the corridor. The exact location of the stations has yet to be determined, but they will take advantage of existing call box infrastructure, thereby reducing their installation cost. The stations will measure air quality in their immediate area, helping researchers to better understand a road's (and vehicles) impact on air quality. Coupled with the data already being monitored through the I-210 Project, researchers have the potential to even see the air quality impact of an incident or re-route. The team's goal is to have five stations in the corridor, three on the freeway and two arterial stations.

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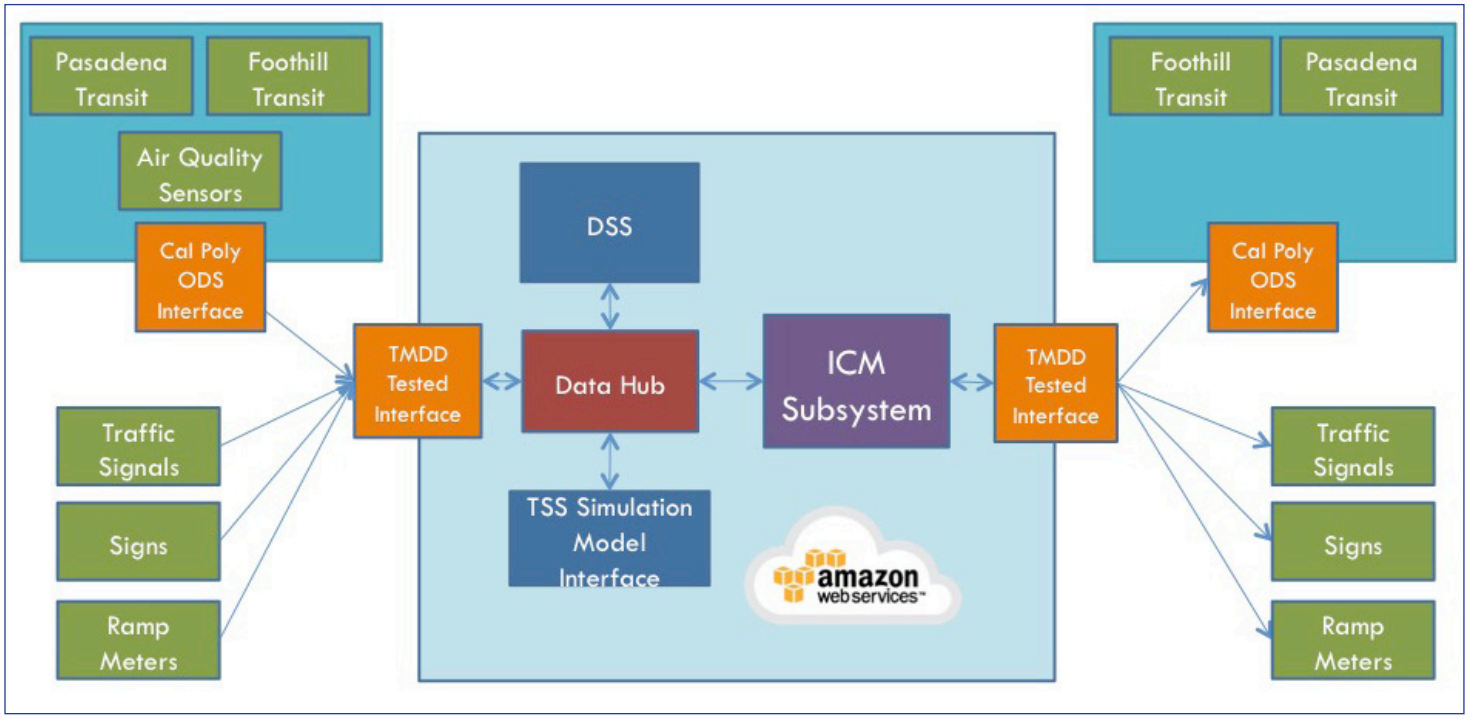

A simplified version of the ITS Architecture showing the connection with the Open Data System (ODS)

● Open Data Systems, continued from page 6

Allen Chen, Supervising Transportation Electrical Engineer for Caltrans District 7, is overseeing the Call for Projects work, including the Open Data System and environmental station development. "The Connected Corridor project is all about Active Traffic Management coordination with real time information, including traffic diversion and detour information, to all our transportation partners in the corridor. Information sharing is essential so traffic managers can make better decisions and respond when necessary to improve conditions and provide congestion relief. The traveling public will directly benefit from our efforts."

Q & A with Software Development Team

In this installment of our Question and Answer series, we hear from members of the Connected Corridors software development team. This team is responsible for the design of the entire Connected Corridors system, including certifying and implementing all standardized interfaces and the development and delivery of both the Data hub and the Decision Support System (DSS). The team is also responsible for the successful integration of over 20 separate data feeds and system components. Most of the system is being deployed and managed in the Amazon Cloud. Brian Peterson leads the development team, which currently has nine team members (including Brian): Faiza Atheeq, Shivani Bongani, Jeny Govindan, Gary Gremaux, Tom Kuhn, Cindy Li, Sean Morris, and Nate Titterton. While their work is often out of the public eye, it is the heart of the technical deliverables for the I-210 Project. We sat down with several team members to hear their thoughts on the program, its technical components, and how the use of the Amazon cloud affects the development process.

Tell us about how the team manages the work.

Nate: We break our work up into what we call sprints. Each sprint runs three weeks, which for me means we never get to walk. Each sprint has defined goals and we put all our goals for each person into a computer-based tracking system. For this sprint, we've broken ourselves into two teams, but this is not always the case. We each shift around based on what is needed, our area of expertise, and ultimately, we're all working together to accomplish the bigger tasks.

We also have daily scrums and a weekly demo which are part of how we bring everyone together and work to stay on track of our individual goals and sub-goals within each sprint.

Gary: We're all constantly learning, so an important part of our scrums and the demos is to learn from one another. Each one of us is focusing on different areas, but we're actively helping each other and learning through the scrums and demos.

How does the cloud change what the team is doing?

Brian: The cloud changes what is possible, how you think about and create a solution, and how the solution will be maintained going forward. It has not only architectural implications, but also presents opportunities for security, monitoring, maintenance, operations, and how to add additional corridors to an existing system. For example, if you think in terms of scalability, it allows you to scale the system by adding or removing available hardware within minutes for that quick burst you need when there is an incident. It also allows you to scale the system in the same sorts of ways when you want to add another corridor in a time scale of weeks or months. If you think in terms of deployment, operations, and security, it allows you many more opportunities for automation, which can be leveraged to improve the time to deploy, reduce the rote maintenance type of tasks, and allow operational resources to focus on the bigger picture items you want them to be able to concentrate on, such as security.

Cindy: From my perspective, moving this infrastructure to the cloud, is a "working or not working" decision. It's not because the cloud sounds nice and trendy, but it is the only way this will work. Once an incident happens, we can spin up dozens of servers immediately, run the estimation and response plan. Then, once it's done, we can shut them all down, so we don't have to pay for them to sit idle. This was a critical decision that was made in order for this to work.

How is this work going to improve the Pilot?

Shivani: The system will enable better decisions, more rapid decisions, it's also creating a foundation for other transportation management projects. The work we are doing is highly scalable. Once it works in this corridor, it can be used elsewhere in California.

Gary: The system that we're building is what is going

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to allow our stakeholders to make transportation decisions, implement response plans, and so forth. Gathering all the data and doing all the analysis is the essential work of the Pilot.

What has been the team's biggest accomplishment so far?

Cindy: This team has designed an architecture that's very flexible and decoupled to be able to support the dynamics of the data hub and the modeling system. It's highly decoupled, which means we can easily incorporate changes. For instance, if there's a component users decide not to use, we can plug in something else quickly without much impact on the rest of the components. This architecture will lay a strong foundation for the project moving forward.

Nate: The traffic estimation engine is a pretty big accomplishment. The estimation engine's job is to provide a very detailed view of the current corridor traffic, using a traffic model coupled with real time sensing information from the corridor. The software implementation of the estimation engine is quite advanced. It scales itself, so if you want to run something that requires more machine resources, it allocates those resources without a developer having to initiate another process.

What are you currently focused on?

Tom: My group is focusing on automating the infrastructure in the cloud. For cloud automation, we're working on making it possible to quickly start up a set of servers to run all the Data hub and DSS/modeling components. There is a lot of detail to capture – from the machine characteristics (how many CPUs, how much memory) to network security, to automating the installation and startup of all of the software components, both our own and the other packages we rely on like webservers, message brokers, and databases. Currently it takes more than 24 servers to run all the components in a complete stack for both the Data hub and DSS components. We currently have two independent stacks (for the Development and Test environments), hosted in the Amazon cloud, where we can access and control them remotely.

Cindy: Our group is focusing on building a control gateway for the datahub. This includes mechanisms for how we can turn on and off a data pipeline, and how we can find out the status of a pipeline. Right now, there is not a systematic way. Basically, a developer has to go to the server's command line window, type some bizarre commands to stop, start a pipeline, and so forth. The component we are building is called a command gateway and is essentially the control office which manages the data pipelines.

Jeny: I am currently working on testing the system as the team is developing it. There is an emphasis on automating as much of the testing as possible, so that testing can be easily repeated and improved with each new release. I have been successful with developing tools that can connect to each of the different software components, most importantly the messaging channels used to connect the different services. I am also developing automated methods to process the results and query the various databases involved. I'm in the process of articulating the test plan and verification plan as well, which will help to tie together and communicate the testing program. This is to ensure the software meets the needs of the stakeholders and to hand off the testing methods and automation scripts to Caltrans when the system is delivered.

For the I-210 Project as a whole, what is one thing you find really unique or interesting?

Gary: I think the cloud is really interesting. Also, there's all the communication and collaboration between agencies and cities. It's a huge puzzle and it's all coming together.

Shivani: As a technical person, I really like the diversity of the work. We are using a bunch of technologies, which are cutting edge and open source.

Cindy: This project, there's never a dull moment. Everything is a new adventure. Its not just a software project, there are all kinds of people involved, including scientists, researchers, software developers, government and private industry.

A very special thank you to the entire software development team for the great work they are doing.

Contacts

If you have questions about the status of the I-210 Pilot or any of the information discussed in this newsletter, please do not hesitate to contact us.

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About

Connected Corridors is a collaborative effort to research, develop, test, and deploy a framework for corridor transportation system management in California. Our aim is to fundamentally change the way the state manages its transportation challenges for years to come. Starting with a pilot on Interstate 210 in the San Gabriel Valley, the Connected Corridors program will expand to multiple corridors throughout California over the next ten years. As an Integrated Corridor Management (ICM) program, Connected Corridors looks at the entire multimodal transportation network and all opportunities to move people and goods in the most efficient manner possible.

CONNECTED is a biannual newsletter with updates and stories about the Connected Corridors program. For more information on the program or the newsletter, please visit our website at connected-corridors.berkeley.edu.