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Wireless traffic management network for downtown renewal

MIDLAND, TEXAS is located in the heart of the oil and gas rich Permian Basin. In 2005 the City began to experience exponential growth as the national and global demand for energy soared and exploration and production activates increased. The population of about 100,000 began growing 10% annually. In 2007 year over year traffic volume at major arterials in the City increased by 17% and traffic management became a top priority.

The City's existing traffic management system installed in the early 1990s was at end-of-life. It had been installed as two separate systems. Major arterials were managed by fixed time intervals for peak inbound and outbound traffic flows. The downtown system was controlled by a grid and changed traffic signals at fixed intervals set independently for inbound and outbound traffic, and by time of day. Replacement parts were scarce and operations and maintenance costs were increasing due to the need for more manual intervention. The decision to assess options and select an advanced traffic management system (ATMS) was initiated by Gary Saunders who heads the City Traffic Engineering Department.

Wireless is the solution

Saunders recommended the IP wireless ATMS proposed by Naztec, Inc. The solution used the Naztec model 980 controller and the web-based ATMS Central Software Suite running on a Cisco wireless network. In 2008 the traffic department began working with Naztec and Coleman Technologies Inc., a Cisco Gold partner, to handle the site survey, final design and implementation.

The re-vamped city-wide system began operation at the beginning of March this year using 180 Cisco 1524 wireless access points. Licensed frequencies are used to provide the backhaul for the 200Mbps network and provide two way communications with the Naztec controllers.

The system monitors, manages, and notifies the traffic department about the status of 119 networked traffic signals and 70 pedestrian crosswalk flashers. An additional 29 solar powered flashers will be added when the department identifies the best solution to power both the radios and the flashers. The system backbone runs to a new centralised Traffic Management Centre (TMC) that was implemented as part of the project.

Arterial management applications use the IP network to detect traffic flow and then take rapid pre-emptive action to mitigate

PHOTO: CISCO SYSTEMS

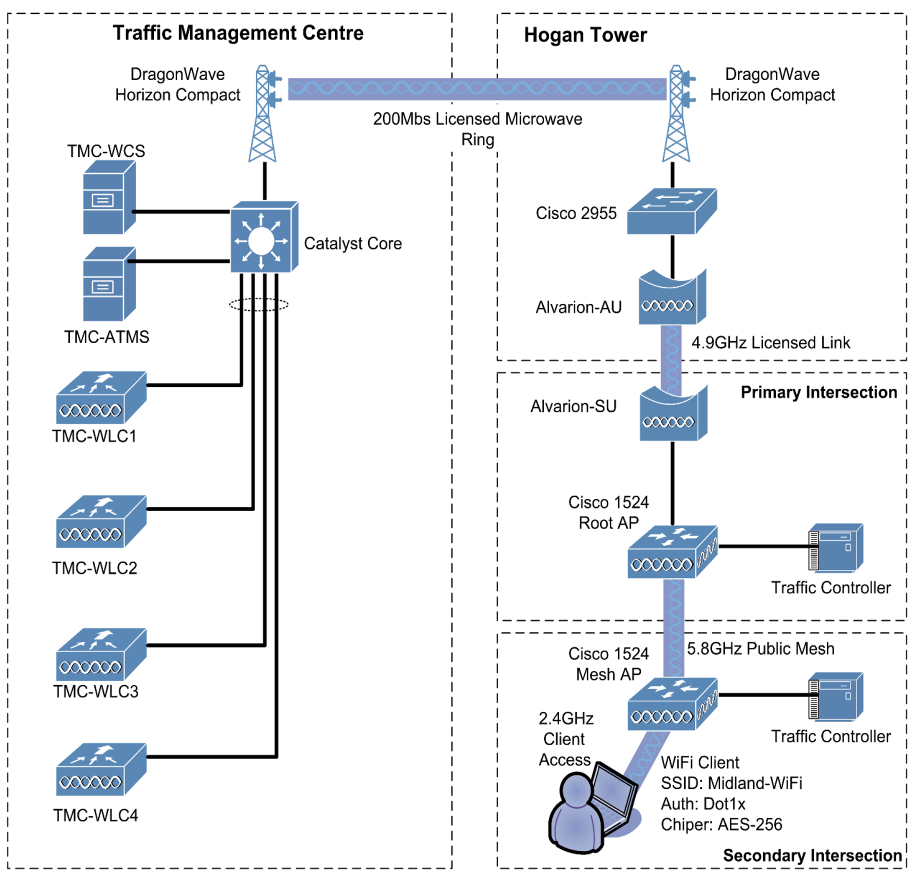
congestion. IP-connected controllers send immediate notification of signal malfunction and enable remote management to resolve signalling problems, optimise traffic flow by changing signal offsets and splits, and adjust the traffic signals for major events affecting traffic.

Secure monitoring and management can be done via web-enabled devices at the intersections and connected in what is effectively an extended wireless LAN. This permits traffic polices which can be programmed to respond to predefined conditions. For example, a vehicle threshold policy could be set for key intersections. When the count exceeds the threshold the system can recalculate signal splits and offsets and automatically apply them.

'By having the automated system analyze issues, I estimate that we will be able to reduce the amount of time spent on troubleshooting and problem resolution by at least 30%.

'By reducing manual intervention, we also reduce fuel costs for the City. Motorists will experience fewer delays, reducing carbon emissions and enabling drivers to gain better fuel mileage. Collectively these savings translate in to millions of dollars a year' says Gary Saunders, City of Midland transportation manager.

Mr Saunders estimates the following cost savings and benefits as a result of the new ATMS: 27% reduction in total delays per vehicle, 18% reduction in total stops per vehicle and 10% reduction in fuel consumption. This adds up to $1.2m annual savings on four major arterials alone with average vehicular volume. Following the first three months of operation, actual values appear to be in line with these estimates.



IP-video is the future

The next step will be to add wireless IP video cameras to the system. Five pan, tilt, zoom (PTZ) cameras are being tested to stream live video feeds from field locations back to the TMC. This will enable the department to monitor high accident intersections. Early accident detection enables quick information transfer to emergency dispatch and the rerouting of traffic on the fly. The department estimates that 70 cameras should provide full city-wide coverage for transportation-related services.

Other departmental needs for cameras are being identified. The police department needs to monitor security in public spaces and could use the video to integrate into applications such as license plate recognition. Addition of sensor based technology and analytics could alert cameras to hazardous material spills or fires and direct cameras in the impacted vicinity to provide visual support for response and remediation efforts.

'Based on my past experience with wireless systems, I didn't realise how fast information could really be transmitted. I assumed that the streaming video would hesitate, but in fact we can watch traffic as clearly as watching a DVD.

'It is an amazing thing when you invest in the right technology and you can actually see the limitless possibilities unfold in front of you' said Eric Johnson, assistant transportation manager, City of Midland

Strategic positioning

The decision has broad implications for the future of mobile applications for the City. The $1.9m investment will cover the network cost for the ATMS, but it also provides the wireless network as a platform for a growing array of emerging technologies that will benefit the entire city. Downtown revitalisation is seen as a key economic development initiative for the City and the installed network technology may have a role to play. As a result of the decision made by traffic engineering, the downtown area now has 95% wireless coverage at no additional cost. Free 802.11 WiFi access could be extended to outdoor spaces to increase the attraction of the downtown area as a destination.

The value proposition for the City is clear. Either pay for separate departmental networks or invest in a single, scalable, converged IP network. With the proliferation of mobile devices, the need for a secure, centrally managed, multiservice network is rapidly becoming a critical success factor. The Midland model offers a great example of a City that understands the strategic value of the IP network as a platform. **Barbara Walker**

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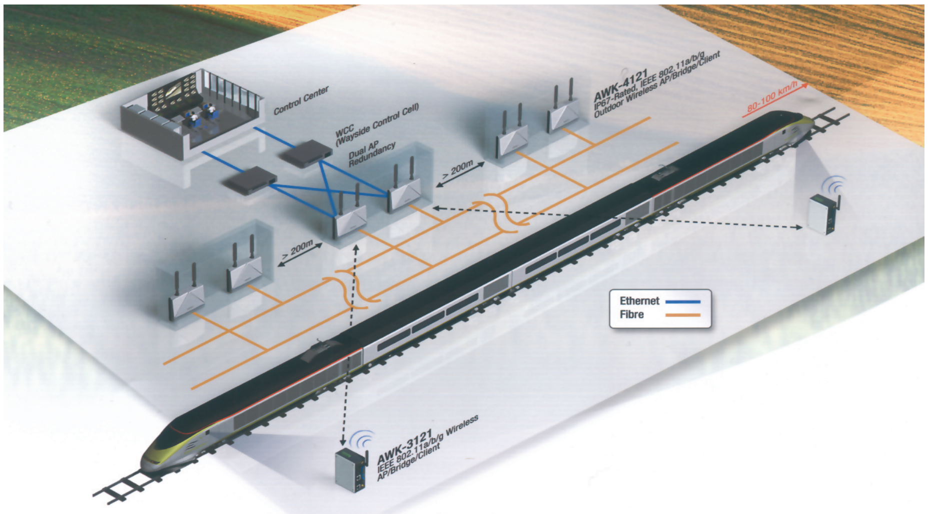

Fast wireless roaming assists railway control

The technology for client roaming across a WLAN is getting better. The handover time from AP to AP can be as short as 100ms under optimal conditions

EVERYTHING WORKS WELL as long as the train is standing still... The IEEE802.11b/g wireless LAN could provide a money-sensible method of exchanging data bursts with moving objects such as surface and underground railways – except that conventionally, it takes some three to five seconds to establish a network connection.

Network infrastructure company Moxa has done some original development work on the software mechanics of key exchange in its access points, the results of which promise to bring a more cellular style of roaming to wireless LAN access points. By re-organising the way that the security tokens are exchanged between a client and successive access points belonging to the same network, the handover time between access points can be as little as 100ms – provided that both the APs and the client incorporate Moxa's software tweak. Even where the link involves another company's AP and a TurboRoaming client – which is what the company calls its technology – the acquisition time can be reduced to around 500ms, it claims.

Of course this is not, and was never intended to be a technical development which could displace other cellular technologies: the 100m effective range for 802.11a/b/g for client-access point linkage still applies. However, it does permit a moving client to be part of a conventional network if only in brief bursts.

Translated into a railway application with a string of suitably equipped APs set out along the platform, high speed duplex data exchange can take place between the train and the trackside at speeds up to 100km/hour.

In practice

Communication Based Train Control (CBTC) is a an automated railway signalling system being deployed in modern metro systems around the world. It is designed to provide immediate status updates and control aspects of a railway system. Due to the mobile nature of the application, CBTC uses WLAN as its basis. Trains can update their status immediately to the control centre via WLAN and also receive commands from the control centre.

The application requirements include wireless communication capability at speeds up to 100km/hr, short system recovery time for seamless wireless connectivity, STP/RSTP protocol to resume communication when a wired or wireless link fails and EN50155 compliance for electronic equipment used on the rolling stock.

Solution description

The CBTC system should include access points (AP) placed about 200 metres apart from each other along the track. For network redundancy, two access points should be placed in the same place and all APs are connected to the control centre via fibre cables. Each train also contains two APs onboard: one at the head and the other at the tail end.

To ensure proper communication, the APs need to work properly up to at least 80 to 100km/hour. The roaming switch time must also be less than 500ms for this kind of application while the total delay from the train to the control centre must also be under two seconds. Vibration protection is also important. In metro systems, the EN50155 certification for railways may serve as a reference for this kind of application.

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