



CALTRANS D12 ITS 10 GB ETHERNET NETWORK

ABSTRACT

This document presents a brief overview of the current Caltrans D12 ITS Ethernet IP Network. It covers design topology, IP scheme, Redundancy, Protocols usage, and best design practices among other things.

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The California Department of Transportation District 12 (Caltrans D12) utilizes the latest in IP Ethernet switching technology. The current ITS IP Network is scalable and provides an end-to-end solution. The Core network is designed into a Layer-3 environment utilizing the best practice design: Core, Distribution, and Access layers. The network has provisions for redundancies and quality of service. The network is deployed around two-Dual Core Cisco 6506-E Switches, which connects to seven Cisco 4507R switch used for distribution layer and several hundred IE-3000 switches at the access layer. The Core to Distribution links are 10 GB/s links while the Distribution to Access links are 100 MB/s links with a future path to a 1GB/s access layer links.

The core network is designed using a hierarchical design model, which leverages a layered architecture comprised of three layers: An access layer, a distribution layer, and a core layer. The hierarchical network design model simplifies management of the network and allows for scalability, controlled growth and network resiliency. Each of the three layers has been implemented with the recommended best practices and with considerations for redundancy.

The TMC Core/Distribution network consists of a Dual-Core Cisco 6506E Layer-3 (L3) switches utilizing Supervisor 2T-10G modules running the EIGRP routing protocol. The primary Cisco network devices attached to the Dual-Core 6506E switch are single-homed to seven Cisco 4507R distribution switches. The core incorporates VLANs that are utilized for network management, servers, clients, decoding of video streams, traffic signals, traffic monitoring stations, ramp-metering service, and have additional IP addressing to accommodate future needs. The Distribution/Edge network consists of seven Cisco 4507R Layer-3 (L3) switches utilizing two Supervisor 8E-10GE modules running the EIGRP routing protocol. The 4507R distribution switches have an added layer of redundancy that distribute the connections to neighboring hubs in case of a supervisor module failure that connects the hub to the core. Two supervisor 8E-10GE modules increases the uptime for a 4507R by utilizing an Active / Standby method in the event of a supervisor module failure.

The TMC Edge network consists of daisy-chained Cisco IE-3000 (L2) switches with two Single-Mode Fiber connections. The edge groups are limited to a maximum of seven switches per chain to keep REP protocols costs and times low. The Cisco IE-3000 are attached to the distribution switches through 802.1Q (tagged VLAN) L2 links. The current design is based on a daisy chain of IE-3000 that is dual homed or singled homed depending on the local network topology and fiber availability.

The IP Scheme has been designed to allow for network growth well into the foreseeable future. The IP addressing hierarchy currently deployed for the Caltrans District 12 Network consists of a private addressing scheme as described by RFC 1918 "Address Allocation for Private Internets". The network takes advantage of route summarization based on the designed IP Schema. The Core can summarize all local as well as its Hub distribution routes via summarization to reduce bandwidth for routing updates, reduce memory utilization on the Core switch and improve reliability within the IP routing domain.

Multicasting has been implemented in the design of the Caltrans D12 IP Network. Rendezvous Points (RP) were configured for the Core and the Hubs. The RP were configured on the Hubs to support the need for multicast streams to be viewed directly from the Hub without the need for additional traffic to traverse from the Edge switch to the Core and back the Hub to view the multicast streams. The configuration of the standardized redundancy protocol Virtual Router Routing Protocol (VRRP) added some redundancy and failover design between two distribution switches for the edge switches that connect between two distribution switches. The Resilient Ethernet Protocol (REP) was used to replace the Spanning Tree Protocol (STP) in our Layer 2 network designs. REP offers faster convergence times, works on existing Cisco hardware, has predictable blocked ports, and is easier to configure.

Solarwinds ORION LAN Management Solution (LMS) is currently in use which provides management tools to simplify the configuration, administration, monitoring, and troubleshooting of the D12 ITS IP Field Network. The solution provides centralized management of hardware and software, configuration tools, and log monitoring. It also allows higher network response time and availability through monitoring and tracking and facilitates the monitoring of Bandwidth, port traffic management, analysis, and reporting through real-time device and link management. The Solarwinds Orion LMS server is installed inside the Network Operations Center (NOC) VMWare platform.