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The City of  
**SAN  
DIEGO**

San Diego's new mission-critical  
communications network  
transforms public safety  
and city services



An aerial photograph of San Diego, California, showing the city skyline, the San Diego Bay, and the waterfront. The image is used as a background for a text overlay. The text is white and semi-transparent, allowing the cityscape to be visible through it. The text describes a project by the City of San Diego to upgrade its critical communications infrastructure using IP/MPLS and packet microwave technology to create a next-generation public safety communications system.

The City of San Diego upgrades its critical communications infrastructure using IP/MPLS and packet microwave technology, creating a next-generation public safety communications system.





San Diego, California is the eighth-largest city in the United States, with 1.3 million residents and 11,500 municipal employees. In 2013, it faced a growing public safety communications challenge: an aging public safety microwave backhaul network with network equipment nearing end of life, and no easy path for scaling and incorporating new-generation technologies going forward. Nokia upgraded San Diego's critical communications infrastructure using Internet Protocol/Multi-protocol Label Switching (IP/MPLS) and packet microwave technology. The new network provides highly secure, resilient and reliable backhaul to support the new P25-based, next-generation public safety communications system with integrated voice and data capability, and is ready for future adoption of Long Term Evolution (LTE). The new IP/MPLS network not only strengthened the responsiveness

of public safety and other city services, but also significantly increased the city's overall network capacity. That allows the city to support a variety of additional municipal agencies and services—all with greatly simplified management and provision for higher reliability and cost efficiencies, and a highly scalable and reliable foundation for more advanced public safety communications capabilities in the future.

### Challenges

- Ageing IP and microwave backhaul networks with little upgrade capabilities
- Increasing volumes of public safety traffic incurred by IP-based video and data applications, requiring more network capacity
- Need to reduce TCO by retiring legacy network equipment and discontinuing commercial leased line services where possible
- Need for more flexibility in the deployment of new services to support more agency collaborations
- Wavench microwave solution to provide essential microwave connectivity
- Network Services Platform (NSP) for unified management of IP/MPLS and microwave layers

### The Benefits

- Advanced IP/MPLS shared network
- Deterministic multiclass QoS and low latency to ensure critical applications performance
- Multi-ring topology for a high level of redundancy
- Graceful migration of legacy applications to the new network
- Advanced MPLS recovery mechanisms such as fast re-route
- Reduced TCO with unified network management
- Readiness to upgrade to 10 Gb/s Ethernet link when required

### The Solution

- A shared IP/MPLS backhaul network
- 7705 SAR to facilitate legacy to advanced packet transformation
- 7210 SAS to extend the reach of Ethernet access
- 7750 SR to support core and headquarter sites





San Diego's backhaul network is facing enormous demands as more and bandwidth-intensive applications such as video are utilized for public safety and other municipal services.



## Challenges

A reliable mission-critical communications network is essential for protecting public safety while efficiently running city services. In fact, reliability is an essential public safety network design consideration. It must include resiliency in order to maximize network availability, and QoS to ensure that public safety traffic always gets through in case of network congestion. In the face of this imperative, increasing volumes of voice, video and data traffic are all placing substantial demands on aging networks, requiring new communication infrastructures.

Like any other municipality, the City of San Diego faces these issues, so in 2013 it partnered with Nokia to replace its existing public safety microwave radio backhaul network, which supported mission-critical voice and data on its P25 public safety communications. Managed by the city's Wireless Services Division, major users include police, fire, border patrol, water, waste water management, the library system, lifeguards and the city's business operations. Applications in the network include mission critical voice and video to support first responders and other departments, including SCADA, and provide connectivity between the city's facilities.

These applications and other currently unplanned or unforeseen future services will require vastly larger link capacity. San Diego's solution needed to evolve from supporting a microwave

link and 1 Gb/s fiber link today to a 10 Gb/s fiber link in time, while preserving as much existing nodal infrastructure and network configurations as possible. It also required common operational procedures for legacy time-division multiplexing (TDM), Ethernet and IP-based services to attain optimized operation efficiency, along with a consistent and full end-to-end packet approach instead of hybrid TDM/packet microwave.

QoS policy would need to classify critical traffic into high-priority class to ensure that it gets through with low latency, even in the case of a major catastrophe, to ensure fast response time for critical applications in the case of a major catastrophe. For example, it would need to prioritize emergency response and command center traffic.

Additionally, the network would need to provide high resilience to re-route traffic from failure in 50ms or less. It must demonstrate stable, reliable performance, and the capability to support Internet Protocol version 6 (IPv6) and IP multicast when necessary.



San Diego's new backhaul network provides unprecedented agility, efficiency and resiliency for mission-critical communications.

# Nokia was able to supply a premier end-to-end public safety backhaul solution to address San Diego's mission-critical requirements.

## Why Nokia?

San Diego partnered with Nokia as its communications transformation partner largely because of our ability to offer a proven backhaul network solution under a unified network services platform. Nokia's solution would simplify overall network operations and reliably transport safety-critical and best-effort traffic for all city departments, with deterministic QoS. San Diego recognized that we could provide an unparalleled suite of products, solutions and professional services, and by supplying the entire solution, would be able to meet all safety and

security requirements. They also value Nokia as a solutions partner who understands their unique requirements.

In addition to supplying and deploying the infrastructure itself, including on-tower installation and provisioning, we also provided key professional services such as network design and on-site engineering support.

## The solution

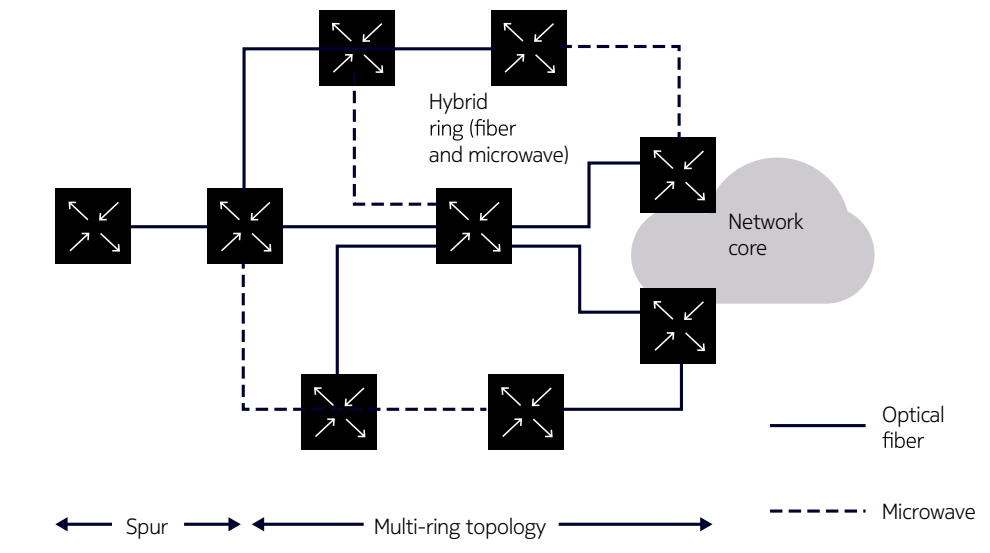
Rising to the challenges, we deployed a new shared IP/MPLS backhaul network. It met all of San Diego's communications requirements with a suite of Nokia products designed for mission-critical networks. With IP/MPLS

VPNs, traffic from different agencies and departments sharing the network are completely segregated to ensure that they do not cause unintended interactions and disruptions.

Capitalizing on IP/MPLS's capability to ride over any transport medium transparently, the network topology design strategy was to use whatever transmission assets available, including microwave and dark fiber, to form interconnected rings. In this design, the operation procedures are common, whether the services are running over fiber, microwave or both.

The multi-ring topology ensures superior redundancy in the event of

# City of San Diego network architecture



attacks or failures from weather, fires, earthquakes, cyberattacks and other emergencies, preserving essential communications for response, recovery and business continuity. In case of network failure, MPLS's recovery mechanism, such as fast re-route, will be invoked to restore the traffic. The solution's IP/MPLS VPN services capability also allows the network to be shared among different agencies, departments and user groups while keeping their traffic segregated.

Products chosen for the new network included the 7705 Service Aggregation Router (SAR) to facilitate legacy to packet migration in both fixed and

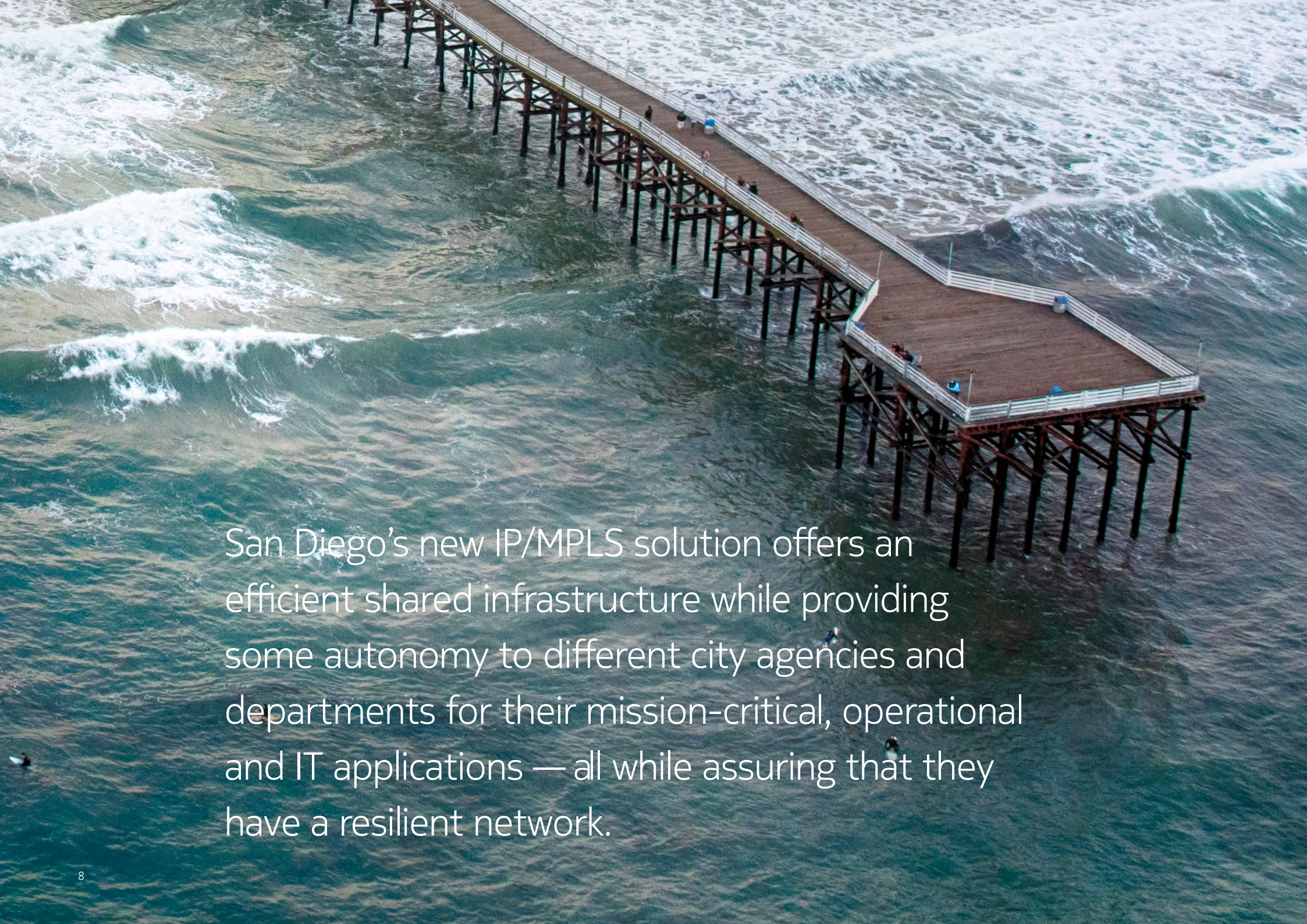
mobile environments; the 7210 Service Access Switch (SAS) for extending the Ethernet access; and 7750 Service Routers (SRs) to support large locations such as command centers. The 7750 SRs also are ready to evolve to support 40 Gb/s and 100 Gb/s Ethernet to form a high capacity core when necessary.

In addition to the P25 radio system, applications on the network include other city department applications such as SCADA for water utility and waste water, plus other critical public safety applications.

Nokia's Wavence microwave transmission supports a consistent provisioning and management

paradigm across the IP portfolio, including cross-domain management with packet microwave. It allows network users to have different level of access privileges, depending on their needs and expertise level, for example, "super user" privileges to IT personnel for a defined set of nodes. It also delivers real-time visualization, surveillance and troubleshooting for the IP/MPLS network and services, accelerating service-problem resolution. Furthermore, the 5650 CPAM delivers IP/MPLS route and path analytics to help the City simplify IP/MPLS control plane management and carry out what-if failure scenario planning.



An aerial photograph of a long wooden pier extending from a sandy beach into the ocean. The pier is constructed of dark wood with a light-colored wooden deck and white railings. It has a long straight section that ends in a larger, rectangular platform. Several people are visible walking along the pier. The ocean is a deep blue-green color, and white-capped waves are breaking against the base of the pier. The sky is not visible in the frame.

San Diego's new IP/MPLS solution offers an efficient shared infrastructure while providing some autonomy to different city agencies and departments for their mission-critical, operational and IT applications — all while assuring that they have a resilient network.



## The benefits

San Diego's new network can evolve to support future data traffic at 10 Gb/s and beyond when necessary, providing its public safety operations and the city with the capacity to run advanced applications. It allows older applications to migrate off existing legacy network, attaining operation cost savings. It enables unified management across IP/MPLS and microwave layers, integrated operational efficiency, comprehensive monitoring and an industry-leading set of network and services management tools for end-to-end visibility, fault detection/correction and service provisioning. It also assures high QoS for real-time agency applications, which now can be distributed to any point on the network with unparalleled reliability. The IP/MPLS-based ring architecture provides multiple points of entry, thereby shortening the fiber distances for connecting remote locations while allowing unprecedented flexibility and resiliency in routing network services.

The new network can deliver circuit emulation services, Layer 2 and Layer 3 VPNs. It meets the performance requirements of all applications, supports advanced MPLS capabilities such as virtual private LAN service (VPLS) and IP virtual private networks (IP VPNs), and provides cost-effective support of the city's existing traffic until it is migrated to the new IP-based network. All of this allows the city to take its operations to the next level

of efficiency and safety while handling more traffic, resulting in an overall lower TCO.

Compared to San Diego's previous solution, this IP/MPLS network is far more agile, which makes it more resilient. It allows the city to use shared infrastructure while providing some autonomy to its business units for their mission-critical and central services—all while assuring that they have a resilient network.

## Prepared for today and tomorrow

By flexibly using microwave and optical transport, San Diego's new IP/MPLS network is providing high-speed, high-capacity data connections between all of its municipal facilities. The new network enables enhanced voice and data communications for first responders such as police and fire departments, and supports other applications, including SCADA and business operations.

Completion of this project highlights Nokia's continuing focus on delivering mission-critical networks for markets beyond traditional communications service providers. Public safety in particular remains a high priority for San Diego, as well as for other national and regional governments seeking to modernize their aging communications infrastructures for first responders, an area where we are particularly well positioned.





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