DELL'ORO GROUP

White Paper | June 2021

5G Service Providers and Public Cloud Service Providers: **ideal partners**

by Dave Bolan, Research Director
Mobile Core Network and Multi-Access Edge Computing

Introduction

This whitepaper will explore several reasons why 5G Communication Service Providers (CSPs) and Public Cloud Service Providers (SPs) would make ideal business partners. In the coming 5G wireless era, both entities have the opportunity to increase revenues by partnering together by bringing new solutions to the marketplace at an accelerated pace. At the same time, as 5G networks moves into the cloud era, it becomes viable for Public Cloud SPs to host the 5G CSPs networks, increasing revenue for the Public Cloud SPs while extending many benefit to the 5G CSP beyond the obvious, lowering costs – making ideal partners. This is not a theoretical idea, but one that is already bearing fruit with early adopters carving out commercial contracts. This market opportunity is in the budding stage that could mushroom, benefiting customers, 5G CSPs, and Public Cloud SPs.

This whitepaper is a high-level outlook covering the following topics:

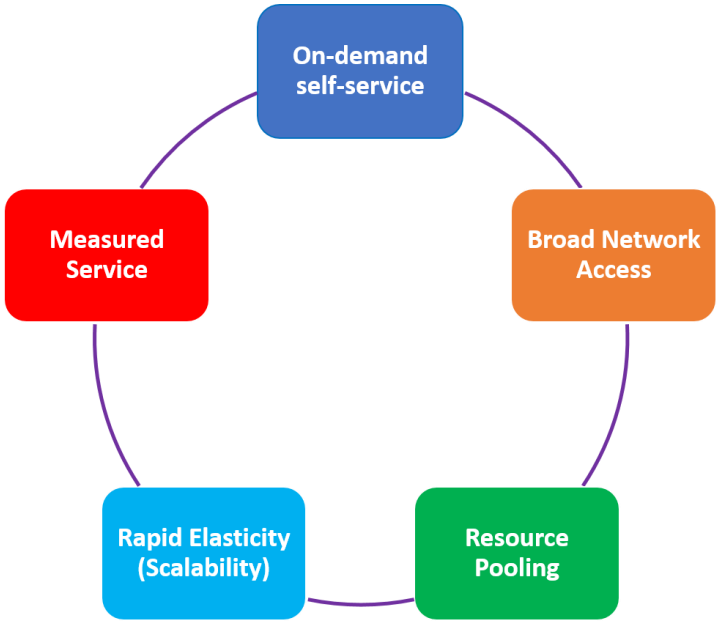
Defining Cloud Computing

Cloud Computing has become a mainstream technology for personal and business use. Simply defined, cloud computing is the accessing of cloud computing resources on-demand via the Internet.

Cloud computing resources are primarily networks, servers, storage, applications, and services that have global connectivity. Other resources include database management, software services, and analytics and intelligence.

The minimum requirements of cloud computing comprise five definitive characteristics:

Figure 1: Cloud Computing Requirements[1]



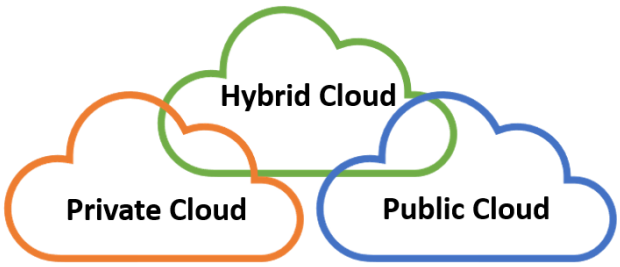
Cloud computing resources must be:

- available 24/7 with self-provisioning
- available from a wide range of locations using standard protocols
- shared amongst a variety of customers
- able to be rapidly scaled up and down as demand requires, and
- able to provide information regarding resource usage to support the requirements of the customer.

[1] "Evaluation of Cloud Computing Services Based on NIST SP 800-145," NIST Special Publication 500-322, February 2018

There are three basic deployment models of cloud computing that are fairly self-explanatory:

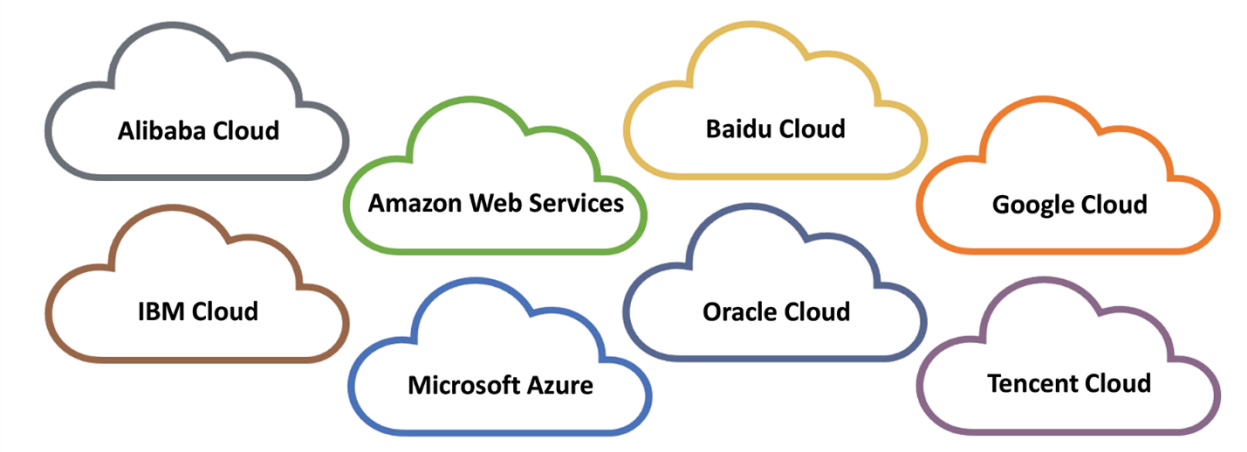
Figure 2: Cloud Computing Deployment Models



Public Clouds provides cloud computing to unrelated customers that use the shared cloud service and the underlying resources. Private Clouds are for one organization only, which can use the cloud service and the underlying resources. Hybrid Clouds are a combination of clouds that enable application portability across multiple clouds—that is being able to leverage an application in your organization's private cloud or working remotely and leveraging the same application through the public cloud.

> *To keep up with the demand for new service offerings and businesses, top Public Cloud SPs in the world today are investing heavily in their Data Center capacity and capital expenditures are estimated to grow at an 11% CAGR (2021 – 2025)*[2]

Figure 3: Top Public Cloud SPs



[2] Data Center Capex Five Year Forecast Report 2021 – 2025, Dell'Oro Group, January 2021

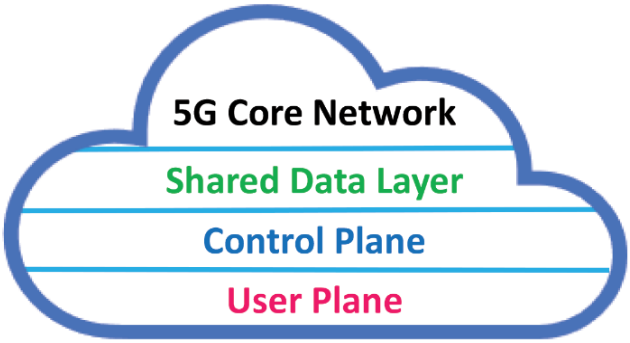
5G Networks Moving to the Cloud and Edge

As we enter into the 5G era, the 5G Network, unlike previous generation mobile networks, has been designed from the ground up to be ready to run in the cloud at what is known as web-scale. Web-scale refers to a flexible service for robustness that can scale and add new services quickly, like a Public Cloud SP network.

The first step in the design process of the 5G Core Network was disaggregating the hardware from the software. This allowed the software to run on standardized computing hardware.

The next step was partitioning the software into three domains: a shared data layer (storage resources for subscription and policy data), a control plane (computing resources for the control logic), and a user plane (computing resources for user data). With these steps complete, 5G CSPs can now build a robust web-scale network with the same advantages as the Public Cloud.

Figure 4: 5G Core Networks Designed for the Cloud

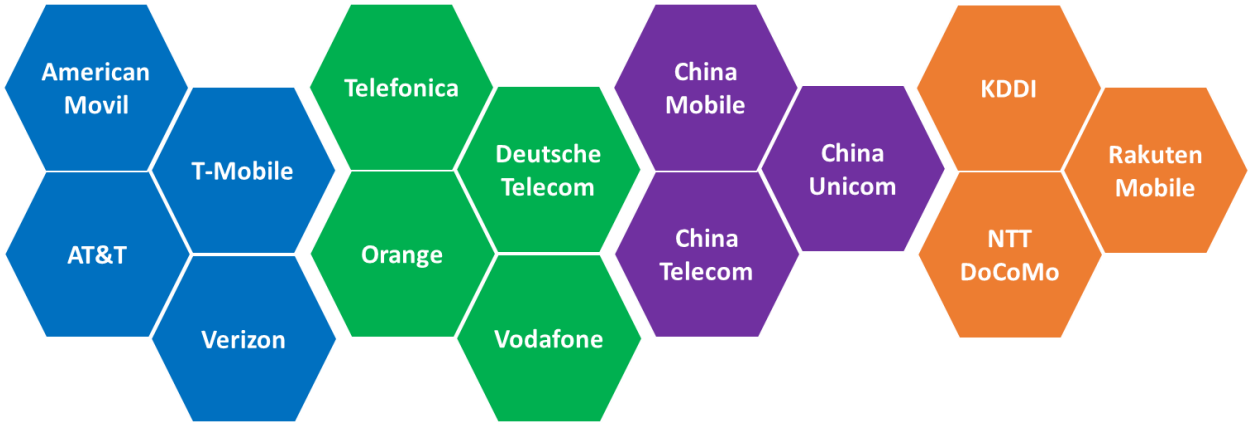


One of the new business opportunities that 5G networks can develop is accessing more applications from wireless devices and sensors; namely, the Internet of Things (IoT), especially for what has been dubbed Industry 4.0. The IoT is a fast growing business projected to have a 23% CAGR over the next five years (2021 – 2026)[3].

[3] Ericsson Mobility Report, Ericsson, November 2020

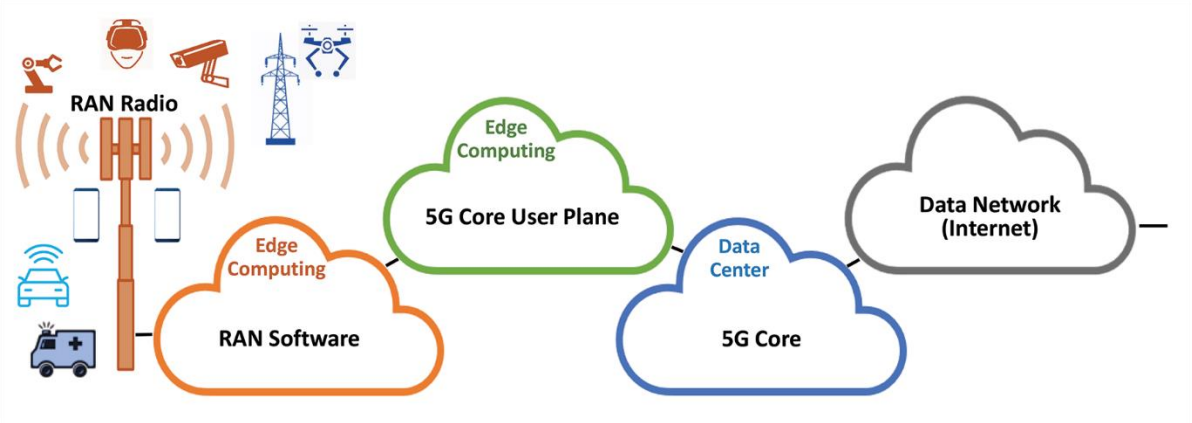
Many CSPs already provide cloud computing services for IoT devices via their 2G/3G/4G networks and are now laying the foundation to address these new applications in 5G networks.

Figure 5: Top CSPs[4]



New Industrial IoT applications are envisioned for latency-sensitive communications (i.e., real-time or near real-time communications) that conventional cellular networks with centralized data computing resources cannot relay quickly enough. 5G CSPs need to extend their IoT services to enable latency-sensitive communications closer to the IoT devices. Proximity to the IoT devices is known as the Edge of the network, or simply Edge Computing. This means additional computing power may be located between the RAN Radio and the 5G CSP's 5G Core Data Center, which could be located on the user premises or nearby. A 5G CSP Network architecture is designed for Edge Computing.

Figure 6: 5G CSP Network Architecture



[4] Telecom Capex Report, Dell'Oro Group, 2H20

Edge Computing is achieved by distributing the User Plane of the 5G Core and its associated computing resources to the Edge and RAN Software and its associated computing resources to Edge closer to the RAN For latency-sensitive applications, Edge Computing will process data inputs from the users at the Edge and return the results back to the end user without sending the data all the way back to the 5G Core; this provides real-time and near real-time communication.

The Edge can be located inside the 5G CSP network and support enterprises that need wide-area coverage for such applications as drone video inspection, smart grids, vehicle-to-everything (V2X), ambulances equipped with remote diagnostics, and other mission critical communications. The Edge can also be located on the premises of enterprises that have more latency-sensitive communications—such as automated guided vehicles (AGV), augmented reality/virtual reality (AR/VR), machine/computer vision inspection, and synchronized robotics with extreme positioning accuracy on a production line—providing real-time communication.

THIS TREND IN THE "CLOUDIFICATION" OF 5G CORE AND 5G EDGE COMPUTING IS EXPECTED TO GROW AT AN EXPLOSIVE 141% CAGR OVER THE NEXT FIVE YEARS (2021 – 2025)[5]. AS 5G NETWORKS CONTINUE TO BE DEPLOYED AROUND THE WORLD.

Following suit with the 5G Core, 5G CSPs are just beginning to disaggregate the hardware and software of the Radio Access Network (RAN). Applying this concept to the RAN is new for 5G CSPs, but the trend has begun, and we have identified 20 potential RAN Software vendors that are targeting this opportunity[6] in the hopes of capitalizing on RAN Software spending that is anticipated to grow at a 63% CAGR (2021 – 2025)[7]. These RAN sites may become additional Edge sites for 5G Core User Plane Edge Computing as well.

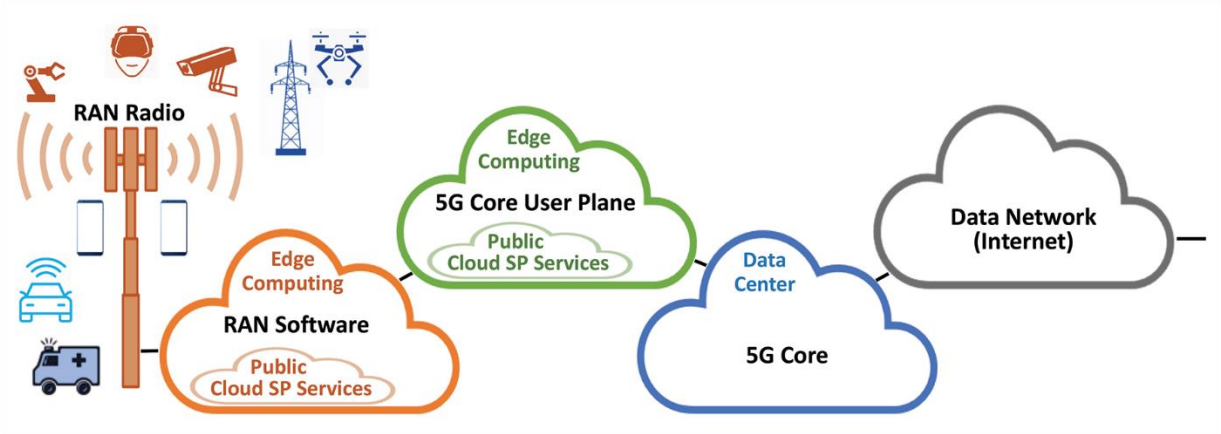
[5] Advanced Research Report Multi-Access Edge Computing Report 2021 – 2025, Dell'Oro Group, January 2021
[6] Advanced Research Report, Open RAN Market Forecast, Dell'Oro Group, January 2021
[7] Mobile RAN Five Year Forecast 2021 – 2025, Dell'Oro Group, January 2021

Integration of Public Cloud SP Services into 5G CSP Networks

Public Cloud SPs offer many services to enterprises, including IoT services. Many Public Cloud SPs recognize the role that 5G will play in the future and see the need to extend services—especially latency-sensitive applications—to 5G end users and IoT devices.

As a result, Public Cloud SPs have begun forging relationships with 5G CSPs, integrating their services into the Edge of the 5G Network. This allows Public Cloud SPs to bring services to the Edge such as Artificial Intelligence/Machine Learning (AI/ML) computing power, which allow industries to make real-time decisions using data and video analytics. This is a win-win for both entities: the 5G CSP can offer additional applications at the Edge, and the Public Cloud SP can extend its services for new latency-sensitive applications.

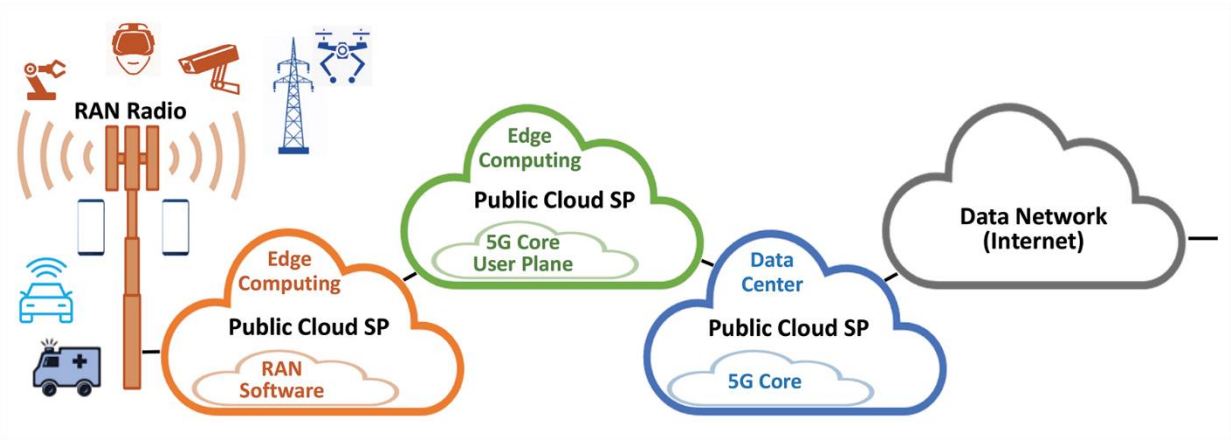
Figure 7: Integration of Public Cloud SP Services into 5G CSP Networks



Public Cloud SPs Hosting 5G CSP Networks

Another attractive business opportunity for Public Cloud SPs is hosting the 5G Network software for the 5G CSPs. Since the 5G Networks are designed for the cloud, they are perfectly suited for integration into a Public Cloud SP's network. Since the 5G Networks are designed for the cloud, they are perfectly suited for integration into a Public Cloud SP's network.

Figure 8: Public Cloud SPs Hosting 5G CSP Networks



This presents a new architectural choice for a 5G CSP, meaning that 5G CSPs currently have three primary choices for computing platforms and two supplier choices for 5G Core and Edge software.

Figure 9: 5G Core and Edge Vendor Choices for 5G CSPs

Computing Platform Choices	Software Supplier Choices
1. 5G Core Vendor 2. COTS Vendor 3. Public Cloud SP	1. 5G Core Vendor 2. Public Cloud SP

For the computing platform, choice number 1 has been the traditional choice for most 5G CSPs. Choice number 2 is a recently new option, in which a 5G CSP decides on the computing platform vendor independently of the software vendor; this is known as commercial off the shelf (COTS) computing platform. Choice number 3 is the new choice—a 5G CSP selects the Public Cloud SP's

computing platform to host the 5G Core and Edge software. 5G Core and Edge software can be supplied by some of the Public Cloud SPs as well as by the traditional 5G vendors.

The RAN Software computing platform choices are basically the same as those for 5G Core, and there are two choices for the RAN Software supplier: a 5G radio vendor or a RAN software supplier that does not offer a Radio.

Figure 10: RAN Software Vendor Choices for 5G CSPs

Computing Platform Choices	Software Supplier Choices
1. 5G Radio Vendor 2. COTS Vendor 3. Public Cloud SP	1. 5G Radio Vendor 2. 5G RAN Software Vendor

Benefits of Public Cloud SPs Hosting 5G CSP Networks

5G CSPs can reap many benefits by selecting a Public Cloud SP to host the 5G Network. Public Cloud SPs have already proven themselves quite capable of meeting the demanding requirements of enterprises, which are choosing Public Cloud SPs for their networks for the same reasons that the 5G CSPs should consider.

Figure 11: Public Cloud Computing Advantages

Costs	Opex as part of a service versus capex + opex (upgrades and energy costs)
Speed	Self-service provisioning in minutes
Scalability	Able to scale resources up and down with a subscription and on a global scale
Performance	Regularly upgraded to the latest generation of computing hardware
Productivity	Elimination of datacenter management by the 5G CSP
Productivity	Data back-up, disaster recovery, and business continuity is part of the service
Security and Trust	– Governance/Cloud Compliance - security, privacy, and compliance to meet regulatory requirements and policy objectives. – Confidential Computing/Data Privacy/Encryption – Network Security

Security and Trust

Every generation of wireless standards is more secure than the previous, and 5G is no exception, given its new security enhancements. The same is true for the Public Cloud; where as with all clouds, security involves constant and ongoing work. Security improvements are seen year over year. Public Cloud SPs provide enterprises with a security toolkit to customize the level of security, tailor it to the enterprises' needs, and provide tools to manage and monitor security.

Public Cloud SPs have earned the trust of thousands of enterprises in millions of locations. For industries that do not want to leave anything to chance, the RAN and Edge Computing can reside on-premises, and the enterprises' data never has to traverse the public networks. In addition to enabling latency-sensitive applications, Edge Computing is also a security enhancement for organizations that need to retain data sovereignty, which is one reason that the enterprises have a keen interest in Edge Computing.

Network Management and Orchestration

5G and Public Clouds are becoming increasingly complex, with more customers in more locations and millions of 5G IoT devices expected. 5G is designed to manage up to one million IoT devices per square kilometer. Edge Computing sites residing on-premises at millions of enterprises adds another layer of complexity. Automated Network Management and Orchestration tools have been developed to make it easy for enterprises to self-provision and auto monitor all of these endpoints with AI/ML. The Public Cloud's skill and expertise in AI/ML makes this possible.

Summary

This has been a high level overview of how 5G CSPs and Public Cloud SPs make ideal partners. The market opportunity looks very rewarding for companies that come up with the right solutions the quickest at the right price. The market outlook is bright with projected CAGRs for IoT devices at 23%, Edge servers and software at 141%, and RAN software at 63%.

- By integrating Public Cloud Services into the Edge of a 5G CSP's network, enterprises win with more solutions available to them sooner than later, while generating more revenues for both partners to share, making it a win-win-win scenario.
- By integrating the 5G Network into the Public Cloud, 5G CSPs gain the same benefits many enterprises have experienced migrating to the Public Cloud. And Public Cloud SPs generate more revenuers, another win-win scenario.

5G CSP and Public Cloud SP collaborations can capitalize on the enterprise market opportunity for latency-sensitive applications that will be mutually beneficial to all parties, the 5G CSP, the Public Cloud SP, and the enterprise.

Author:

Dave Bolan joined Dell'Oro Group in 2017 and is currently responsible for the Mobile Core Network market research, as well as our Advanced Research report for Multi-Access Edge Computing market research programs. He previously covered the Carrier IP Telephony, and Wireless Packet Core markets for Dell'Oro Group. Mr. Bolan has written articles in industry media such as RCR Wireless and Pipeline Mangazine. Mr. Bolan's research and analysis has been widely cited in leading trade and business publications. Mr. Bolan is a frequent speaker at industry conferences and events, including CTIA Wireless conference, NetEvents Global Summit, SDN NFV World Congress, and Telecom TV.

Email: dave@delloro.com

About Dell'Oro Group

Founded in 1995 with headquarters in the heart of Silicon Valley, Dell'Oro Group is an independent market research firm that specializes in strategic competitive analysis in the telecommunications, networks, and data center IT markets. Our firm provides world-class market information with in-depth quantitative data and qualitative analysis to facilitate critical, fact-based business decisions.

About Dell'Oro Group Research

To effectively make strategic decisions about the future of your firm, you need more than a qualitative discussion – you also need data that accurately shows the direction of market movement. As such, Dell'Oro Group provides detailed quantitative information on revenues, port and/or unit shipments, and average selling prices – in-depth market information to enable you to keep abreast of current market conditions and take advantage of future market trends. Visit us at https://www.delloro.com.

Dell'Oro Group

230 Redwood Shore Parkway
Redwood City, CA 94605 USA

Tel: +1 650.622.9400
Email: dgsales@delloro.com

Website: www.delloro.com