The Thinking Networks Revolution:
A “Digital Lifestyle” Call to Action for Communications Service Providers
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Introduction

The convergence of universal mobile broadband access, virtually unlimited content, and smart mobile devices has unleashed a seemingly insatiable consumer demand for more content, applications, and services. That escalating demand is impacting nearly every aspect of the industry, ushering in a radical transformation in revenue streams, business models, and value chains. As a result, operators find themselves at a critical juncture. The stakes have never been higher and timing never more critical. To capture and monetize the mobile data opportunity, service providers must act quickly to transform the way they approach their business models and their networks, transitioning from being “network and device providers” to “digital lifestyle providers.” Underpinning this shift is the need to evolve existing network architectures to more flexible, software-defined thinking networks that can manage dynamic applications, foster innovation, and respond in real time to rapidly changing network events and service demands.
Creating New Revenue

To date, mobile operator revenue streams have been dominated by three main waves: voice revenue derived from basic voice communication and mobility, messaging revenue generated by peer-to-peer short message service (SMS), and access revenue driven largely by data demand. Each revenue wave has followed a standard adoption growth curve. When penetration hits 70 to 90 percent of the subscriber base, revenues peak, and then begin to decline. The rate at which these revenue curves peak and decline is dependent on a number of factors, including competitive pressures, regional economics, and usage models.¹

Figure 1. Service provider revenue growth curves

Voice revenue is already in decline in most developed markets. By 2013, it is predicted that voice revenue globally will fall below the 60 percent threshold.² The messaging and access waves have helped offset the loss of voice revenue. Messaging revenue is expected to increase globally at a compound annual growth rate (CAGR) of 3 percent over the next five years.³ However, new Internet Protocol (IP) messaging services such as WhatsApp and iMessage are attracting consumer attention, particularly smartphone owners. This shift resulted in US$22 billion in lost messaging revenue in 2012. Between 2012 and 2020, it is projected that operators will experience US$479 billion in cumulative lost revenues to alternative messaging providers.⁴

Access revenue, the third wave, is in a growth phase globally. However, the margin pressure on this revenue is the greatest because capacity demand is doubling every year in most major markets—driving up the costs to realize this revenue wave. Revenue growth is predicted to continue for the next three to five years before it, too, reaches its peak. At that point, all existing revenue waves will be in decline.⁵

² Ibid.
Clearly, operators need to look toward a new revenue wave to compensate for the inevitable decline in voice, messaging, and access. The fourth revenue wave—digital lifestyle service—is underway. It consists of the “mobilization” of various existing services—commerce, payments, health, entertainment, and advertising—and the convergence of mobile communications, entertainment, and social media that will create a new “mobile social ecosystem.”

Facing New Competition

As the nature of communications changes, competition, business models, and value chains are also evolving. With the previous three revenue waves, consumer services, infrastructure, and value chains were generally dominated by and controlled by the service provider. As a result, the competitive playing field was largely limited to other operators.

This new mobile social ecosystem brings with it a new breed of competitors that understands the data-savvy consumer. These so-called over-the-top (OTT) companies are well funded; are not saddled with legacy infrastructure and operations; and offer innovative, valuable services. They include internet-era application providers, media and content companies, and even established corporations that offer consumer-friendly applications for value, such as anytime account access, discounts, and loyalty programs. Subscriber consumption of their content and services is responsible for the bulk of the data traffic being generated on mobile networks; however, mobile operators realize little to none of the revenue being generated by these services. This leaves operators in the difficult position of providing the costly resources to drive bandwidth-intensive services, but playing a smaller role in the application and device revenue chain.

These new competitors are successfully decoupling applications from the underlying infrastructure. They are amassing large volumes of valuable subscriber profile and payment information that can be used to create highly personalized subscriber experiences, sophisticated service packages, and advertising. Moreover, they are building direct commercial relationships with subscribers. As a result, operators are losing their brand relevance in the mobile social ecosystem. The top-four global brands—Google, Apple, Microsoft, and IBM—are not service providers; they are technology providers. In this intensely competitive landscape, brand is a powerful strategic weapon that can be leveraged to foster customer loyalty and generate significant revenue through the creation of an ecosystem that is valuable to its consumers.
Operators cannot block this trend, but, if they design their networks properly, they can leverage them to create new business relationships and models. To solidify their stake in the mobile social ecosystem, operators must shift their business strategy and move beyond providing access to mobile data services. They must focus squarely on creating value in their subscribers’ minds by offering innovative service plans, adding value to these third-party applications, and develop new revenue sources such as loyalty programs and mobile advertising. Operators that are successful with these initiatives will strengthen their own brands with their subscribers.

**Leveraging Valuable Assets**

Operators hold a trove of assets that can enhance applications—resources that can be parlayed into new service models and fresh revenue streams. They own the networks that carry content to virtually every connected device and the relationships with the millions of subscribers who depend on them for always-on connectivity. Providers are sitting on a cache of real-time subscriber and network data that gives them the opportunity to gain unique analytic insight that few others can rival. Moreover, by protecting their subscribers’ personal data and information, they have established a trust factor with their consumers.

The challenge is to intelligently leverage those subscriber and network assets by combining them in new and analytically sophisticated ways to create a more valuable, localized, and relevant subscriber experience. Recent research indicates that subscribers are willing to pay at least US$3 more per month for individual services such as social networking, cloud services, Voice over IP, and video. And when those services are bundled, consumers are willing to pay an extra US$6 (or more) per month.\(^7\) Ernst & Young (now known as EY) notes that “repurposing customer data in new ways can enable operators to improve their market positioning, through advantages such as better business intelligence—for example, anticipating market and customer changes before competitors—and reusing network data for collaborative partners and sector verticals.”\(^8\)

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\(^7\) Signals Research Group, “Mobile Broadband Pricing and Bundling—The Voice of the Consumer,” 2013.

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Critical Juncture

Operators cannot afford to be late to the game. Mobile device and competitive application providers are already capturing sizable portions of their markets and customers. If operators hope to take advantage of market disruptions and capitalize on the digital lifestyle service revenue wave, the time to act is now. They must move quickly to update their networks to more highly adaptable and flexible thinking networks. Those that delay “might find themselves consumed by the powerful forces of the competitive markets and some relegated to the dustbin of mobile history.”9

How operators react to and maneuver in the new mobile social ecosystem will define their success or failure over the next decade. “They need to adapt their business models to a wider ecosystem and make firm decisions about which revenue sources they are going to target within that broader environment.”10 Will they follow the utility service path, supplying the network infrastructure for third-party application and service providers? Will they serve as enablers, providing a robust network, APIs, and data that power the most useful and popular consumer applications and services? Or, will they retool their business models and open their network for innovation to become digital lifestyle providers, leveraging the mobile social ecosystem, social media, entertainment, rewards programs, and mobile commerce partners?

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Evolving to Thinking Networks

Existing networks were not built to handle dynamic applications, foster innovation, and respond quickly to rapidly changing markets to meet the demands of the connected world. To support the digital lifestyle, the network must provide more than a connection. It must have an analytical view of the relationship between all the services it carries—the characteristics of each in addition to the impact of one service on another. For example, if demand for a service surges, the network must understand how that surge can impact other services and ensure that their service quality is not degraded. To reinvent themselves as digital lifestyle providers, operators will need to evolve their networks into highly efficient software-defined thinking networks.

The thinking networks vision embodies an architectural and operational evolution of network capabilities. It creates a more efficient and flexible network architecture that responds dynamically to changing subscriber and service needs. Thinking networks intelligently orchestrate the interaction between services and network elements to make real-time decisions on who, what, when, where, and how resources are allocated. They ensure that subscribers receive the appropriate quality of service (QoS) and quality of experience (QoE) based on their subscription entitlement, device type, and application requirements. This is accomplished on demand without having to overprovision each network domain.

Centralized management, virtualized application software, and the programmable nature of thinking networks enable faster, more responsive service deployment. Operators can create new services on the fly. Furthermore, they can develop new and innovative business models and relationships with third parties in real time without having to redesign their network.

Thinking networks bring architectural agility to mobile data networks, which are essential to enabling the new business models and services necessary for operators to become digital lifestyle providers. The creation of software-defined thinking networks will be an evolutionary process—a transition built on four overlapping phases.
Phase 1: New Diameter Network

The new Diameter network is the foundation for thinking networks. In this phase, an independent, intelligent control layer is created to orchestrate Diameter-based communication among gateways, policy servers, charging systems, subscriber profile databases, Session Initiation Protocol (SIP) application servers, and mobility and session management functions. This phase places operators in the position to scale the network for growth and to monetize mobile data.

The following Oracle Communications products meet the requirements of the most critical new Diameter network elements:

- Diameter Signaling Router, the central nervous system of the new Diameter network, provides the scalability, reliability, and flexibility in the core network to manage mobile data and signaling growth.
- Policy Server, the network’s brain, provides the real-time logic and rules that enable new business models and revenue streams.
- Subscriber Profile Repository, the network’s memory, personalizes Policy Server’s real-time rules based on a subscriber’s profile, state, and usage data.

Creating a scalable Diameter network is critical to a successful mobile data business model because “mobile networks, especially those powered by LTE [Long Term Evolution] gear, will be bombarded with control traffic that will eventually overwhelm the limited routing capabilities of Diameter-based equipment, such as policy servers, online charging systems and subscriber data repositories.”

new Diameter network will continue to be critical because the industry is in the early days of Diameter signaling growth. As service providers evolve to become digital lifestyle providers, the amount of Diameter traffic being managed will escalate as they expose policy, charging, analytic, and subscriber data to enhance third-party applications and mobile advertising, machine-to-machine (M2M) services, and mobile commerce services. Given that Diameter signaling traffic is expected to grow at a CAGR of 252 percent between 2011 and 2016, managing the pending Diameter signaling growth is a top priority for mobile operators.\footnote{Oracle, “LTE Diameter Signaling Index 2012: Forecast Report and Analysis 2011–2016,” (white paper) updated September 2013.}

With the new Diameter network in place, operators can leverage data in subscriber databases, which are accessible by policy servers, Diameter routers, and other equipment. Moreover, they can begin to monetize the mobile internet with basic use cases such as tiered services, shared data plans, day passes, turbo boosts, and third-party subsidized data access.\footnote{Oracle, “The New Diameter Network,” (white paper) updated 2013.}
Phase 2: Network Virtualization

In the second phase of network evolution, the intelligent new Diameter network layer moves to a virtualized state. This represents a fundamental shift in the way operators improve network scalability and flexibility. In the network virtualization phase, operators leverage robust virtualization and software-defined networking (SDN) technologies to deliver dynamic scalability in terms of sessions, transactions, and throughput, thereby effectively creating a private cloud for the network. This is accomplished with industry standard hardware supported by the virtualization middleware layer or hypervisor. This phase is a critical step toward enabling flexible network streams for different types of services. It also helps operators reduce capital and operational expenditures by creating more flexible network architecture and deployment options. For example, operators no longer need to build excess core network capacity to address peak usage, because virtual resources can be temporarily reallocated to different functions based on changing traffic levels.

Figure 5. Network virtualization phase

This phase comprises four main components:

- The network virtualization platform provides the common hypervisor for the new Diameter network components using industry standard hardware.
- The virtualization function dynamically adds/removes memory, compute, and storage resources to the available hardware pool.
• The orchestration function provides dynamic allocation of new Diameter network computer resources as needed and tells the virtualization function and flow management function to instantiate additional Diameter resources. For example, if the load on a Diameter signaling router (DSR) in a particular location recedes and there is a surge in the need for Policy Server resources, server blades can be reallocated to additional Policy Server instances. This can be done with stateful binding to maintain sessions and context for the newly instantiated resources.

• The flow management function uses SDN technologies to dynamically manipulate traffic flows entering or leaving the cloud. For example, when a network with one active DSR experiences a signaling traffic surge, additional server blades with DSR instances can be added to manage it. The orchestration function instructs the flow management function to direct signaling flows to the newly instantiated Diameter resources in the cloud.

Phase 3: Mobile Social

The flexibility, capacity, and control provided in the network virtualization phase enable operators to extend their business models beyond access services. With the transition to the mobile social phase, mobile operators leverage integrated network and subscriber intelligence to provide valuable opt-in, mobile advertising, and other personalized offers to competitive application and content providers. This paves the way for them to become digital lifestyle providers. In this phase, operators do not just passively facilitate the flow of services between the subscriber and competitive providers. They play an active “push” role in determining what, when, where, and how services are offered to a particular subscriber based on many factors, including specific usage behavior, preferences, customer demographics and segmentation, and service agreements. Operators make those determinations by collecting and analyzing the vast amount of dynamic subscriber and network data that is generated every second in their networks, in addition to data from other sources within their business such as customer relationship management and billing systems. In many cases, this data is unique to network operators and extremely valuable to advertisers and content providers jockeying for consumers’ attention. Today, however, this information is often trapped within the network, and operators lack the tools to effectively monetize it.

In this phase, policy’s role extends beyond the boundaries of the core network to subscriber devices, M2M devices, cloud providers, and service delivery and competitive provider platforms. It acts as the network’s brain, orchestrating the subscriber experience, by leveraging network, subscriber, device, and application awareness, together with Diameter signaling routing. It enables operators to dynamically control the when, where, and how of service delivery. For example, it might not be appropriate for an operator to deliver an ad during business hours. Using knowledge of the subscriber’s opt-in preferences, location, and daily behavior, the operator can ensure that such content is only delivered during “off hours.”
Further, to optimize the subscriber experience, operators can leverage policy to match the type of service—video versus voice versus text—with the best available access technology. For instance, an operator can choose to defer the delivery of a particular service until a suitable access technology is available rather than risk an unpleasant usage experience by delivering it on suboptimal access. With the advanced policy capability of the mobile social phase, operators can harness knowledge of the subscriber’s device capabilities to optimize service presentation and interaction at the device itself. And, with the application management function, they can ensure a secure interconnection to alternative value providers and ad networks, which is fundamental to service personalization.

Figure 6. Personalized, targeted ads

At this stage of network evolution, operators are building marketing brand loyalty as an integral part of the mobile social ecosystem by enabling new business models such as the following:

- Opt-in advertisements, offers, and new service recommendations that are personalized to the individual and contextually relevant
- Subsidized mobile data access sponsored by ads or third-party application and content providers
- Integrated loyalty programs within a community of e-commerce and merchant partners
- Aggregated analytic data about uptake and usage of competitive services
- Secure identity management for single login to third-party services
- Simple, efficient, and secure mobile payment transaction services
- Consumer and enterprise cloud services, including policy as a service, identity as a service, and charging as a service
The mobile social phase builds on the new Diameter network and network virtualization phases with the following key components:

- The subscriber behavior analytic function provides the tools to unlock a trove of subscriber data. It enables operators to collect large volumes of subscriber and relevant network data via a highly scalable, high-throughput database based on the latest advances in big data technology. This function can accept real-time feeds from multiple network sources without any service impacts and then combine that with data from the rest of the business to enrich the analytic process. It encompasses analytic capabilities to determine subscriber behaviors, norms, preferences, and connections.

- The service delivery platform (SDP) interfaces with a subscriber behavior analytic repository, enabling operator-controlled or third-party services to securely retrieve subscriber intelligence via industry standard APIs. It also provides a mechanism by which third-party information requests can be verified against subscriber privacy preferences, enabling operators to safely and securely share subscriber data while protecting subscriber privacy.

- Using the subscriber behavior analytic function, operators can access subscriber intelligence, where permitted, without impacting ongoing subscriber behavior data collection operations. It has a low enough latency to support services that interact directly with consumers such as real-time bidding in display advertising.

- A mobile policy gateway extends policy directly to devices, enabling operators to manage mobile and Wi-Fi network selection based on preferential network access, subscriber tier or type, device type, application usage, or network conditions. The gateway also reduces signaling from chatty applications to improve the subscriber experience and secure devices and personal information by blocking malware and fraudulent activity. This is critical for new services such as mobile commerce.

- The traffic detection function characterizes media flows on select, high-value services at a more granular level than is available with today’s deep packet inspection (DPI) and video optimization functions. This capability enables superior personalization of application-based services.
Phase 4: Thinking Networks

The endgame of this evolutionary process is the creation of highly evolved, software-defined thinking networks. Like the human mind, these networks think for themselves. They process new information with what they already know, morphing and gaining more intelligence as time, events, and content are added from a multitude of sources. Thinking networks self-organize, self-optimize, and self-determine responses to unprecedented and unpredictable events. They anticipate subscribers’ behaviors and future preference patterns. Operators are able to understand their subscribers’ digital lifestyles, including where they work or travel, what devices they use, and what they like and dislike. Armed with this level of subscriber knowledge, they are able to craft a highly personalized and relevant subscriber experience that matches each subscriber’s needs. Moreover, operators can apply that data to new services and content in real time.

The foundation of this thinking networks model is the new Diameter network. It embodies the critical intelligence and control assets to enable service providers to manage their business independent of the underlying network technology. This approach simplifies the network architecture by eliminating redundant control elements.

The flexibility of thinking networks supports different streams for “best effort” internet, subsidized data, M2M, and virtualized network services using policy-directed SDN control and advanced network event reporting capabilities. Network control expands beyond bandwidth, applications, time, and speed. It includes signaling, compute resources, devices, and IP flows, enabling operators to monetize end-to-end QoE. At this stage, the network provides the flexibility and innovation that are essential to enabling the new business models and services that are the hallmarks of digital lifestyle providers.

Figure 8. Thinking networks phase
The thinking networks phase includes the following:

- The network event detection function “listens” and reports on network events to the policy-directed SDN control function. Network events include radio access network (RAN) congestion, degradation in data session setup times, excessive invocation of policies by the policy server, excessive number of failed Diameter endpoints, and requirements for special handling of high-value data sessions by the policy server. Examples of event detection include event records, analytics, and alarms from the policy server; Diameter message information; alarms from a DSR; congestion feeds from RAN probes; and overload alarms from traffic detection functions. Alerts can be sent to an advanced analytic platform to provide rich segmentation and insight into customer and network behavior to inform the policy-directed SDN control function and design and implement new service plans.

- The policy-directed SDN control function receives alerts or triggers from the network event detection function. It evaluates the network situation and makes decisions based on this evaluation, along with subscriber intelligence from the subscriber behavior analytic function and business logic from the operator, using a sophisticated, rule-based policy engine. It directs the definition of new QoS rules based on IP flow conditions. It can also selectively manage high-value IP flows that are associated with subscriber sessions of interest following industry standards. For example, the policy-directed SDN control function can direct:
  
  - A subscriber’s IP flow toward a video optimization platform to optimize the subscriber’s viewing experience based on the subscriber’s device type
  
  - A specific set of IP flows requiring DPI services toward a DPI platform rather than requiring all IP flows to pass through the DPI, which significantly improves the efficiency of the DPI because it no longer needs to process all IP traffic
  
  - IP flows in the Diameter signaling network to route traffic around congested areas of the network based on real-time conditions and signaling loads

**Conclusion**

There is a consumer-driven transformation underway in the telecom landscape, and its impact is being felt in nearly every aspect of the industry—revenue streams, business models, and value chains. For operators, the stakes have never been higher and timing never more critical. To secure their claim in the digital lifestyle ecosystem and capitalize on the fourth revenue wave, operators must move quickly to transform their business models and their networks.

Equipped with thinking networks, operators place themselves squarely at the center of subscriber interaction as digital lifestyle companies and ecosystem providers. The thinking networks vision opens the door to unlimited options for partnerships and services with third parties, including application and content providers, mobile advertisers, mobile payment providers, M2M providers, and cloud service providers. Thinking networks provide the flexibility to create dynamic applications, foster innovation, and respond quickly to rapidly changing markets to meet the demands of the connected world.
## Appendix: Acronyms and Initialisms Used in This Document

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<tr>
<th>Acronym</th>
<th>Description</th>
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<tbody>
<tr>
<td>CAGR</td>
<td>compound annual growth rate</td>
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<td>DPI</td>
<td>deep packet inspection</td>
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<td>DSR</td>
<td>Diameter Signaling Router</td>
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<td>ICL</td>
<td>independent control layer</td>
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<td>IP</td>
<td>Internet Protocol</td>
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<td>LTE</td>
<td>Long Term Evolution</td>
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<td>M2M</td>
<td>machine-to-machine</td>
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<td>MPG</td>
<td>mobile policy gateway</td>
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<td>QoE</td>
<td>quality of experience</td>
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<td>QoS</td>
<td>quality of service</td>
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<td>RAN</td>
<td>radio access network</td>
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<td>SDN</td>
<td>software-defined networking</td>
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<td>SMS</td>
<td>short message service</td>
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<td>VoIP</td>
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Hardware and Software, Engineered to Work Together