Big Data & Advanced Analytics in Telecom: A Multi-Billion-Dollar Revenue Opportunity

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Abstract

Big data today is a reality. Communications service providers that want to be innovative and maximize their revenue potential must have the right solution in place so that they can harness the volume, variety and velocity of data coming into their organization and leverage actionable insight from that data.

However, most service providers across the globe suffer from real-time decision-making challenges. Most operational decisions are either made manually, which tends to be subjective, sub-optimal and not necessarily compliant with corporate policies, or they're hardcoded inside the business/operations support system (BSS/OSS) application, which means they are not dynamic and cannot keep up with changing business environments. To solve this problem, service providers need real-time actionable insight and a decision-making capability that can help improve and streamline their business processes to not only help them achieve their holistic end goal of profitable growth, but also to help achieve secondary goals around customer experience and network efficiency, thereby reducing customer churn.

Today's phenomenal growth of data requires that service providers not only understand big data to decipher the information that counts, but also – more importantly – the possibilities of what they can do with it using big data analytics. Service providers are sitting on terabytes of data that are stored in siloes and scattered across the organization. In order to exploit the full potential of this stored data, service providers must have solutions that can help them correlate, process and decipher nuggets of actionable information. This is not possible without big data and advanced analytics. For simpler and faster processing of only relevant data, service providers need an advanced analytics driven big data solution that will help them to achieve timely and accurate insights using data mining and predictive analytics, text mining, forecasting and optimization capability to continuously drive innovation and help service providers make the best possible decisions.

Executive Summary

The world of communications has seen unprecedented data growth in the last few years. The advent of smartphones, mobile broadband, peer-to-peer traffic, growth in mobile data volumes, social media chatter and the increase in video-based services have all contributed to the data volume. Smartphones like the Apple iPhone, Android, Samsung Galaxy and others have vastly improved the Web surfing experience and increased consumption of media and content-based services. The result is a significant increase in data usage, as well as explosive growth in bandwidth consumption. *Heavy Reading*'s research believes that what we are witnessing is only the beginning and just the tip of the iceberg.

The Internet has changed how we communicate and consume services. The explosion of data will be primarily driven by consumer demand for low-latency services that are more video intensive, integrated and interactive. Quite simply, an increase in network performance (accompanied by the availability of devices, services and applications to take advantage of that performance) will result in dramatic growth in data traffic.

Let us take a quick look at the magnitude of this data increase problem in the last few years, based on facts *Heavy Reading* has gathered during operator interviews. Some of the numbers that have been mentioned are truly mind-boggling:

- Data network traffic from smartphones will grow more than 50-fold by 2016.
- Telefónica O2 says its data traffic is doubling every six to eight months.
- Sky TV says about 80 percent of its video content is consumed over Wi-Fi.
- AT&T has stated that only 3 percent of its users consume 30 percent of its network capacity.

Service providers do not have a dearth of subscriber data; they collect usage transactions, network performance data, cell-site data, device information and other information spread across network and back office systems. Despite this treasure trove of information on customer behavior, most operators do not have the real-time, end-to-end view of their subscribers that can help maximize their revenue potential from each subscriber. The reasons for this are manifold:

1. Most of the data is collected in silos by various departments, spread across the organization. Correlating a 360-degree view from fragments of customer data is a complex endeavor that consumes significant time and effort.

2. The quality of data is suspect and needs significant massaging, de-duplication and cleansing before it can be leveraged effectively.

3. There are significant political and organizational barriers that impede a free flow of information across departments and business units.

As operators try to become more than just bit pipe providers, their ability to leverage and exploit customer data becomes a key competitive advantage. What strategies can they pursue to shore up their capabilities to monitor, manage and monetize customer data effectively? This sponsored report examines scenarios and best practices that demonstrate the value of big data and advanced analytics in telecom. This white paper forecasts the global market for big data and advanced analytics – based on primary research, global operator interviews, investment flow parameters, etc. – explores how operators are using big data and briefly discusses Huawei's big data solution.
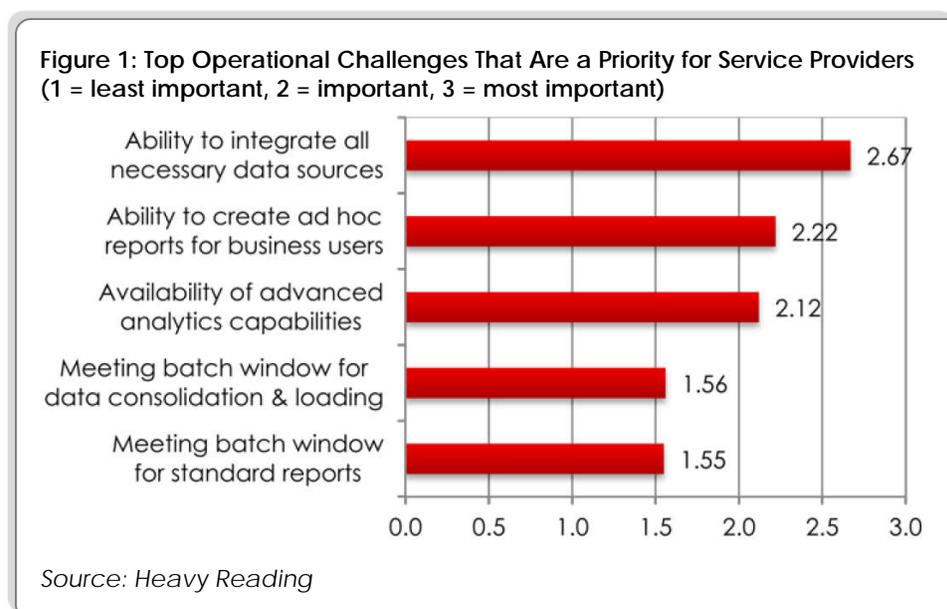
How Big Data Differs From Legacy Analytics

Heavy Reading believes that customer centricity and profitability hinges on three key pillars: efficiency, insight and performance. Profitability, customer churn reduction and increase in wallet share hinges upon obtaining a coherent, current and actionable view of a service provider's entire business. In a world where more and more customers interact online via Facebook, Twitter, blogs, etc., and talk about their experiences and issues online, service providers must have a proactive social strategy through collecting data and analyzing the data to take action on customer retention and offer attractive services.

However, dealing with social media means dealing with unstructured data, which is complex as it does not always fit into neat tables of columns and rows. The advent of these new data types that can be both structured and unstructured means they must be pre-processed to yield insight into a business or condition. Data from Twitter feeds, blogs, call detail reports, network data, video cameras and equipment sensors is not stored directly in a data warehouse until it is pre-processed to correlate and normalize the data to detect basic trends and associations. It is a cost-effective mechanism to structure the unstructured data part, load that data into data warehouses for comparison and then use that data with other collected data to run advanced analytics processes on it.

There is a need for solutions that can combine customer usage and subscription data with insight into the network, cost, customer mood and customer preference data to trigger specific actions, which helps enhance customer experience.

Service providers have no dearth of data at their disposal, but they are missing actionable insights from that data. The fact that data passes through the network does not mean that actionable, correlated information is available to the company. Service providers must find efficient ways to bring together, normalize and correlate all data sources, which poses a serious challenge. As shown in **Figure 1**, *Heavy Reading*'s survey identifies integration of data sources as a primary operational challenge for service providers.

Figure 1: Top Operational Challenges That Are a Priority for Service Providers
(1 = least important, 2 = important, 3 = most important)

Source: Heavy Reading

A big data advanced analytics solution that effectively utilizes structured and unstructured data to improve decision-making will be the "silver bullet" that service providers need to alleviate their business problems. Big data is definitely an industry-wide buzzword, and there are several competing definitions circulating in the market.

> Heavy Reading *defines big data and advanced analytics as the utilization of hardware and software solutions designed to process large volumes of data (in the range of hundreds of terabytes) to unearth actionable insight. Big data is a combination of both structured and unstructured data coming from text, social media, video, etc. As such, real-time streaming technology and complex event processing technologies are part and parcel of big data solutions.*

Figure 2 illustrates the key differences between the realities of yesterday's analytics infrastructure and our expectations for today's big data analytics infrastructure.

Figure 2: Legacy Analytics vs. Big Data Analytics Infrastructure

	LEGACY ANALYTICS	BIG DATA ANALYTICS
Storage Cost	High	Low
Analytics	Offline	Real-time
Utilizing Hadoop	No	Yes
Data Loading Speed	Low	High
Data Loading Time	Long	Average 50%-60% faster
Data Discovery	Minimal	Critical
Data Variety	Structured	Unstructured
Volume	Gigabyte, terabyte	Petabyte, exabyte, zettabyte
Velocity	Batch	Real-time
Administration Time	Long	Average 60% faster
Complex Query Response Time	Hours/days	Minutes
Data Compression Technique	Not matured	Average 40%-60% more data compression
Support Cost	High	Low

Source: Heavy Reading

Figure 2 highlights how using big data and advanced analytics can provide measurable return on investment (ROI) benefits for service providers. A big data analytics infrastructure is not a replacement for the traditional analytics infrastructure; rather, it is an "add-on" to fill in the "in-between" gaps and create data collections that can provide "richer information." As such, information is requested and consumed either to make better decisions or to create new products or applications, and the overall infrastructure evolves to better serve the demand. This evolution creates an organic relationship between service provider's business, network and IT "territories," gradually effacing the infamous "silos."

Key benefits that service providers will obtain from a savings and operational efficiency standpoint are:

- Reduction in data compression, maintenance cost and support cost
- Increase in data loading speed
- Reduction in administration cost
- Reduced time to run queries and real-time response for *ad hoc* queries by hundreds of concurrent users
- Easy implementation of any data model from any data source with no changes needed and no additional response time with data growth
- Saving in storage space because of advanced compression techniques
- Utilization of complementary technologies such as Hadoop and Map-Reduce with existing RDBMS and data warehouse technologies
- Leverage commodity hardware

Advanced Analytics & Big Data Create Value

Service providers that are trying to compete in the cutthroat world of telecom services – where more and more subscribers rely on over-the-top (OTT) players as providers of value-added services – are focused on increasing revenue, reducing churn, reducing opex and enhancing the customer experience as key business objectives. **Figure 3** illustrates the top business objectives cited by C-level service provider executives in a recent *Heavy Reading* survey of 60 operators worldwide. We asked CSP respondents to choose on a scale of 1 to 5, where 5 is "most important" 4 is "important", 3 is "somewhat important", 2 is "low importance" and 1 is "not important at all," their top business objectives in 2012 and 2014.

Figure 3: Leading Service Provider Business Objectives in 2012 & 2014
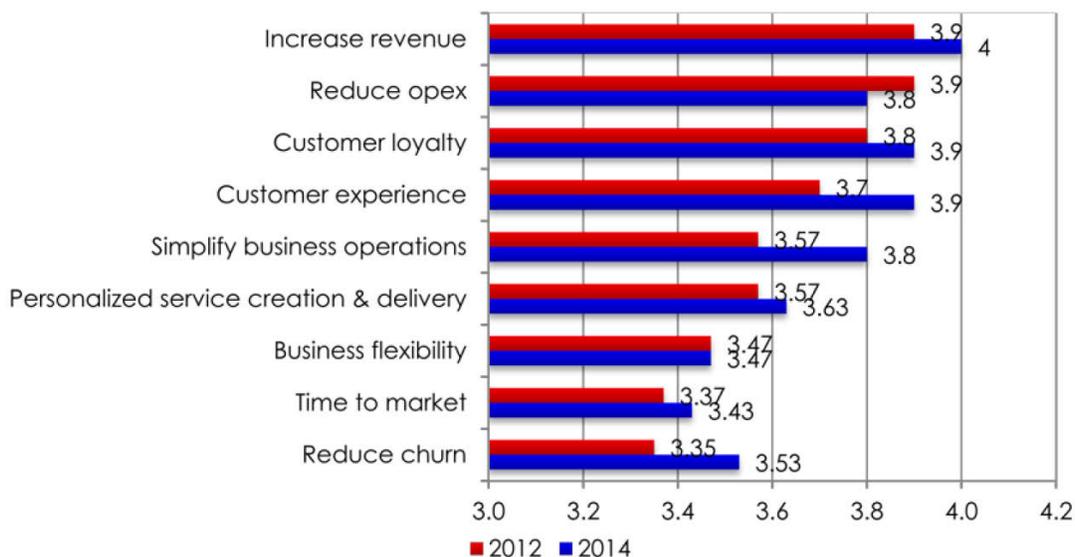
Source: Heavy Reading

Simplifying business operations is a big endeavor for operators that have organizational and IT implications. Operators are trying to be operationally lean and are in the process of simplifying their business operations by adapting best practice methodology, becoming more collaborative and breaking their silos in order to reduce opex and become more competitive.

Service providers are looking for the next big thing to differentiate themselves from their competitors. When every operator has similar networks and services, they can only separate themselves from the pack by offering a superior customer experience. The company that manages to do so can be more efficient, more proactive and ultimately more innovative than its competitors. Service providers' customer experience strategy must be transformative and should be able to anticipate, contextualize and preempt customer complaints and queries, as well as effectively address subscribers' challenges.

Operators believe that big data and advanced analytics will play a critical role in helping them meet their business objectives. In the same survey, respondents

indicate critical use case scenarios in the context of big data and advanced analytics where they are investing now and where they plan to invest in the next three years. **Figure 4** illustrates key findings from that survey.

Figure 4: Service Provider Plans to Invest in Big Data & Advanced Analytics

Use Case	Now	In 3 years
Customer profitability analysis	65%	72%
Revenue assurance & fraud	65%	72%
Dynamic profiling & enhanced customer segmentation	62%	65%
Network dynamic congestion control	60%	68%
Targeted offer & campaign management	58%	65%
Preemptive service assurance	55%	70%
Preemptive customer care	52%	67%
Package design for specific OTT	47%	55%
Churn prediction & SNA	45%	65%
Location-based services & personalized advertising	44%	51%
Accurate capacity planning	41%	60%
Cell-site optimization	40%	71%
Multi SIM prediction	32%	45%
Data exposure & API enablement	30%	45%
Intelligent network planning	27%	55%
Subscriber-centric wireless offload	20%	65%

■ Now   ■ In 3 years

Source: Heavy Reading

Operators face an uphill challenge when they need to deliver new, compelling, revenue generating services without overloading their networks and keeping their running costs under control. The market demands a new set of data management and analysis capabilities that can help service providers make accurate decisions by taking into account customer, network context and other critical aspects of their businesses. Most of these decisions must be made in real time, placing additional pressure on the operators. Real-time predictive analytics can help leverage the data that resides in their multitude systems, make it immediately accessible and help correlate that data to generate insight that can help them drive their businesses forward.

Figure 5 looks at the market potential of use cases and how we believe these markets will grow in the future. The figure lays out the basis on which we will discuss scenarios and size the big data and analytics market opportunity in telecom.

Figure 5: Key Business Application Categories in Telecom Big Data Analytics

	BIG DATA ANALYTICS
Real-Time Analysis & Decision-Making	Network dynamic congestion control Data interactive exploration Location-based services & personalized advertising Cybercop
Precise Marketing	Offer optimization Churn identification Churn prediction & SNA Package design for specific OTT
Operation Efficiency	Preemptive customer care (IVR) Network ROI analysis intelligent network planning Subscriber-centric wireless offload Cell-site optimization
Innovative Business Model	Data exposure & API enablement Payment data for increased sales Match demand and offering nearby
Customer Experience Enhancement	Dynamic profiling and enhanced customer segmentation Clickstream analysis Detailed weblog inquiry

Source: Heavy Reading

Let us look at how operators identified use cases in the previous section maps to big data and analytics-related initiatives that relate to specific constituents within operators, applies to specific business application category and their related scenarios and use cases.

Innovative Business Models

Potential Benefits: The strategic use of big data and advanced analytics could bring major benefits to service providers. Service providers talked about increasing their revenue anywhere between 12-15 percent by specifically investing in selective innovation. The benefits are not restricted to just financial benefits, but have also allowed service providers to diversify their revenue streams. This will help position service providers to engage with third parties and OTT players in a win-win equitable revenue arrangement situation.

Recommendations: Innovation is a continuous process, so service providers must evaluate their strategies based on the underlying fabric of their big data and advanced analytics infrastructure. To continue their momentum, service providers

need to capture, centralize and distribute customer interaction events. They must start with creating a flexible big data and advanced analytics architecture that can wrap base services with value-added components and incubate attractive and personalized services, either organically or with third parties.

Data Exposure & API Enablement

Application programming interface (API) enablement allows operators' networks to be more programmable and better support the development of services for both internal operations and external developer. With a well-constructed API, developers either inside or outside a company can craft a program that brings in customers via a new application. API management is becoming a major big data initiative for many operators as it leverages the insight that resides within the data and can provide service providers and their enterprise customers with details on what applications are used, how they are used and who is using them. Another critical aspect is API exposure, where service providers can expose anonymous customer information with customer label for third parties to use in real time.

Using Payment Data for Increasing Sales

Service providers can work with business customers, such as retail chains, to enable near field communication (NFC) payments. Service providers can collect and analyze customer payment and transaction data, and then send out personalized e-coupons and promotions to customers based on their preferences, which helps increase frequency of customer visits and acts as a revenue generating catalyst.

Match Demand & Offering Nearby

By encouraging users to express their demands and offerings in the mobile, service providers could match the demands and offerings in nearby areas, especially around malls, shopping centers, supermarkets, etc. Service providers can share that information with merchants in order to match a wish list of subscribers with merchant offerings. This can help merchants sell unused products, push specific campaigns to specific sub-segments of users and create a more robust and efficient market place both for buyers and merchants.

Precise Marketing

Potential Benefits: The strategic use of big data and advanced analytics will help service providers sharpen their campaign management and pre-emptive churn avoidance mechanism effectively. Our research points to the fact that campaign effectiveness of service providers have increased from 15-25 percent, and churn prevention has helped reduce churn 8-12 percent by strategic utilization of big data and advanced initiatives.

Recommendations: Leveraging customer data and their transaction data to precisely target and cross-sell or upsell offers to customers and persuade appropriate influencers and their social circle is crucial for service providers, which are all focused on minimizing churn. Social network analysis (SNA) and other advanced analytics techniques provides more targeted upsell opportunities and tracks customers and their social circle and community, taking the guess work out of how to avoid customer churn.

Offer Optimization

Using advanced analytics for advanced offer management enables service providers to confirm which service bundles and promotions are successful and to offer management capability based on data such as subscriber network usage, traffic-based promotion, loyalty points, event-based promotion and rules-based promotion. And identifying and offering innovative promotions, such as offers for early adopters, cross-product promotions and loyalty points, will be critical in driving value-added services adoption, which will be provided either by the service provider itself or by partnering with OTT players.

Churn Identification, Prediction, Prevention & SNA

Segmenting customers for more accurate marketing campaigns is part of the overall objective of increased customer satisfaction to prevent customers from churning. The key to a big data driven advanced analytics solution providing optimal churn prevention will be its ability to provide preventive churn actions in real time. So, for example, a customer complaint or service quality problem would trigger a very targeted and customized offer that is more attractive to a subscriber, greatly decreasing the propensity of this subscriber churning. Strategic utilization of big data and advanced analytics enables service providers to shift their business intelligence focus from looking back at old records to looking forward with current data in a predictive and preventative fashion to determine things such as "What behaviors will trigger churn events?" and "What actions are most likely to prevent a churn event?"

Other use cases for real-time churn-preclude actions include:

- **Multi-SIM prediction:** Preventing subscribers from buying SIM cards from other service providers by offering them more appealing rates or product bundles – proactive roaming offerings based on travel patterns.

- **Rotational churn identification:** Identifying and preventing mobile subscribers that disconnect and reconnect their service in order to take advantage of promotions that only apply to new customers.

- **Churn location:** Identifying and sending more appealing offers or even contacting subscribers located in areas that have a higher churn rate.

- **Leveraging SNA:** SNA dives into the billions of daily data transactions (by utilizing an algorithm using nodes and ties) and identifies and helps segment influencers and patterns among social calling circles of friends and families. Combining this information with the data from the network, for example the CDR and CRM systems, service providers can process that data in both a defensive and offensive manner to help with overall customer experience enhancement, churn reduction and revenue growth.

Package Design for Specific OTT

The essence of this use case is to enable a two-sided business model for service providers. They can either promote the use of strategic partner applications with sponsored access funded by OTT content partners or include certain OTT applications as part of their data plans (e.g., unlimited Facebook, unlimited YouTube, etc.). A service provider can partner with a streaming music provider to offer subscribers free access to the site. The OTT content provider, in return for being exposed to the service provider's broad customer base, would sponsor or fund the

access either by subsidizing the cost directly, sharing the cost with the service provider or by opting in their customers to view targeted ads.

Operational Efficiency

Potential Benefits: Opex remains stubbornly high for most service providers, and it typically consumes 30-40 percent of revenue. Network operations account for about 45 percent of this expenditure. The expansion of network footprints due to organic and inorganic growth has resulted in poor capacity utilization. Strategic utilization of big data and advanced analytics can increase operational efficiency and significantly reduce opex to the order of 10-15 percent, as highlighted by our research.

Recommendations: Next-generation customer care, planning, etc., strategies must be transformative, and service providers need solution infrastructure that can anticipate, contextualize, pre-empt customer complaint and help plan initiatives by being able to effectively address big data challenges. Harnessing big data effectively and utilizing it to provide actionable insight will be a critical attribute for service provider success.

Preemptive Customer Care

In order to deliver on pre-emptive customer care in the communications industry, operators must create a robust repository of error fixes, enable pro-active resolution of issues by guiding contact center agents continuously to reduce average handling time (AHT) and have a continuous contextual intelligence update that effectively maintains an up-to-date context map of each customer. The only way operators can provide a world-class customer experience is by continuously monitoring subscriber activities to identify and rectify issues and improve issue prediction based on industry best practices.

Intelligent Network Planning

Service providers need network planning solutions that are embedded with advanced analytics to federate and correlate information from multiple network data repositories, as well as sales forecasting systems, such as CRM. This will provide operators with:

- The ability to plan, predict and optimize their investment in network build and rollout, identify potential stress points
- Prioritized and optimal network investment plan based on service forecast demands
- The ability to anticipate and implement necessary network change just ahead of the demand curve

Service provider network planning systems must be advanced analytics-driven and work closely with their OSS systems, such as network inventory solutions, service activation solutions, network discovery information, etc., and via service modeling and correlation of utilized resources, which need to help in accurate operational planning by predicting network resource exhaustion in a timely manner. These systems must drive capacity optimization and provide network planners with the ability to create "what if" scenarios based on past utilization trends, subscriber information, sales forecasts and service consumption trends.

Cell-Site Optimization

4G networks are intended to be increasingly self-optimizing, with cells automatically managing how they interact with one another (adjusting their power to minimize interference, while maximizing bandwidth and coverage), managing their power consumption and how they load balance traffic and handover traffic between cells. They will be able to do this much more effectively if they can augment the network performance with contextual information, which includes subscriber information such as user experience in specific areas, how that user experience varies according to the different types of services they might use and typical patterns of user behavior throughout the day.

Subscriber-Centric Wireless Offload

Analytics capable of combining data from remote cell site monitoring solutions (across various generations of network), DPI systems, customer usage systems, backhaul network management systems and subscriber data repositories can be used in real time to push different types of traffic belonging to different types of customers to different cells, depending upon their subscription levels, the applications they are using and according to the traffic loading on different cells of different types. In the context of 4G, where Wi-Fi offload is a common phenomenon, contextual intelligence can, in the case of congestion, correlate customer information with their lifetime value, spending pattern, type of services they are running, service-level agreements (SLAs) attached to that particular customer, etc., and intelligently decide which subscribers should be offloaded on Wi-Fi.

Real-Time Analysis & Decision-Making

Potential Benefits: Software vendors must provide service providers integrated big data and advanced analytics driven solutions that will not only meet their real-time transaction needs, but also provide real-time intelligence, enabling the service providers to maximize revenue potential from a short window of opportunity. Our research has shown that operators have been able to reduce fraud and revenue leakage by 15-20 percent, as well as increase revenue potential by 5-10 percent, by strategic utilization of advanced analytics-driven solution.

Recommendations: The big data and advanced analytics-driven infrastructure will need to process complex events in real time and provide the users of the system the best actions to take based on those events. This directly enables service providers to lower risks and provide excellent experience to their customers. It should be able to process and correlate event stream processing, as well as use advanced analytics modeling techniques to gain the best insight into their customer behavior.

Congestion Control

RAN congestion has emerged as a major problem for mobile operators. Solutions that incorporate subscriber information with their services and location information can provide visibility at individual sub-cell level and provide priority to certain subscribers based on their tiers, etc., when they are moving across certain cells that are suffering from congestion issues. Since congestion events are often fleeting, making use of historical information about congestion from OSS systems to pre-empt similar problems and deploying RAN congestion only in those areas

where congestion is anticipated is a key area where operators are planning to utilize big data and analytics solution.

Enable Location-Based & Personalized Advertising

One significant advantage of big data and analytics is that it provides location-based data that enables providers and site owners to better target users in the form of geo-fencing or location-based advertising. In this scenario, a subscriber enters a certain geographic zone and may receive a non-chargeable, timely SMS or relevant banner to his/her the social media with an advertisement or promotion (based on their customer behavior and preference) from a local merchant.

Data Interactive Exploration

Having an analytics infrastructure that provides dynamic dashboard and reporting capability for different stakeholders within the organization can bring major benefits for operators. Different stakeholders have different needs within the organization, which means different views are needed. For example, from a CFO's perspective, being able to accurately calculate financial impact based on network utilization and to plan for all future capex is important. This implies that to support the CFO's decision-making, they need dashboard and reports that can provide them with accurate information on network growth, help with pricing and planning major bids, and ensure that network build costs and budgets are accurate. CMOs, for example, have critical reporting requirements. It is critical for CMOs and product marketing directors to have accurate and up-to-date information that enables them to launch, extend or modify campaigns.

Cybercop

Strengthening network security and reducing profitless resource consumption is at the top of most service providers' requirements. Operators can utilize a big data-driven advanced analytics infrastructure to identify in real time malicious calls, applications, etc., and prevent them from wreaking havoc on their operations. Big data-driven analytics solutions must help detect abnormal subscriber consumption, fraud cases and help save operators from bad debt concerns. Detecting abnormal subscriber consumption, cybersecurity threats and changes in subscriber behavior or traffic flows are critical areas in which pattern matching can be used. Pattern matching can be effectively utilized by service providers to match customer events and note major variances in patterns to raise fraud alerts and drive processes to block transactions or implement some revenue assurance fix processes.

Customer Experience Enhancement

Potential Benefits: Today the customer care experience for consumers is disjointed, reactive and not personalized. Service providers interested in managing the customer experience more effectively need to collect as much customer experience-related data as possible. They must be able to analyze this information to understand the customer experience and especially to detect unexpected and unpredictable events that might pose either an opportunity – for example, to enhance or enrich the customer experience – or a threat.

Recommendations: A unified approach to customer experience – across all organizations – is the need of the hour. It is in the best interests of service providers

to look for unified solutions, as siloed solutions can only paint a partial picture of customer experience, resulting in suboptimal results. Service providers have traditionally operated with a complex, disparate set of silos, including CRM, billing, inventory, provisioning and fulfillment, service management systems, network management systems and the different generations of network architecture – each holding different types of data, in different formats and with different business goals. This must change if service providers are to truly deliver a superior customer experience.

Dynamic Profiling & Segmentation

Predictive analytics can use dynamic profiling to analyze incoming data sources as varied as customer care, product/service/device portfolios, cost and billing, and network service quality to segment customers by (for example) their:

- Usage (e.g., voice, data, SMS usage, times of day)
- Interests (e.g., gaming, music or video downloads, time spent on social media portals)
- Location (e.g., area code)
- Socioeconomic class (e.g., prefers the newest, high-end devices)
- Influence in their network (e.g., what type of influence they are within their own contextual cluster, such as their family, business community or peers)
- Propensity to churn (e.g., predictive modeling)
- Relationship with off-net users (e.g., makes frequent calls to those using a different service provider)

For service providers, being able to segment the customer is crucial for retention and customer satisfaction. For example, a provider must be able to identify the heads of household and keep them as satisfied customers, because, if this type of influencer churns, they may take with them five devices and the services that support them. By properly identifying and predicting the proper needs of these influencers, a service provider can offer them more attractive services, helping to retain them as a customer and enhance their customer satisfaction and loyalty.

Clickstream Analysis

In a nutshell, clickstream analysis is the process of collecting, analyzing and reporting aggregate data about the pages visitors visit and the route they choose when clicking or navigating through a site. A clickstream is a list of all the pages viewed by a visitor, presented in the order the pages were viewed, also defined as the "succession of mouse clicks" that each visitor makes. This analysis at what point in their ecommerce experience that the user has abandoned the transaction, percentage conversion rate and other hidden nuggets that provides tremendous information on user behavior.

Detailed Weblog Inquiry

End users and operations team members can query the detailed consumed lists of usage in real time. The only way this is possible is by adopting big data techniques in the context of storage and handling of transaction data in real time and making the data available to end users.

Investment Priorities for Big Data & Analytics

Heavy Reading's study of big data technology usage in telecom indicates widespread adoption of big data and analytics in the telecom industry. Our primary research conducted with major global operators suggests a fast growing multi-billion market potential that will provide opportunities for both hardware and software vendors. Some of the key findings from our forecast include:

Heavy Reading expects the big data technology and services market to grow from $1.95 billion in 2013 to $9.83 billion in 2020, as shown in Figure 6. This represents a total compound annual growth rate (CAGR) of 26 percent. Breakout CAGR growth between software, hardware and services are: software will grow at 29.3 percent CAGR; hardware will grow at 22.8 percent CAGR; and services will grow at 26.8 percent CAGR.

Figure 6: Big Data & Analytics Market in Telecom
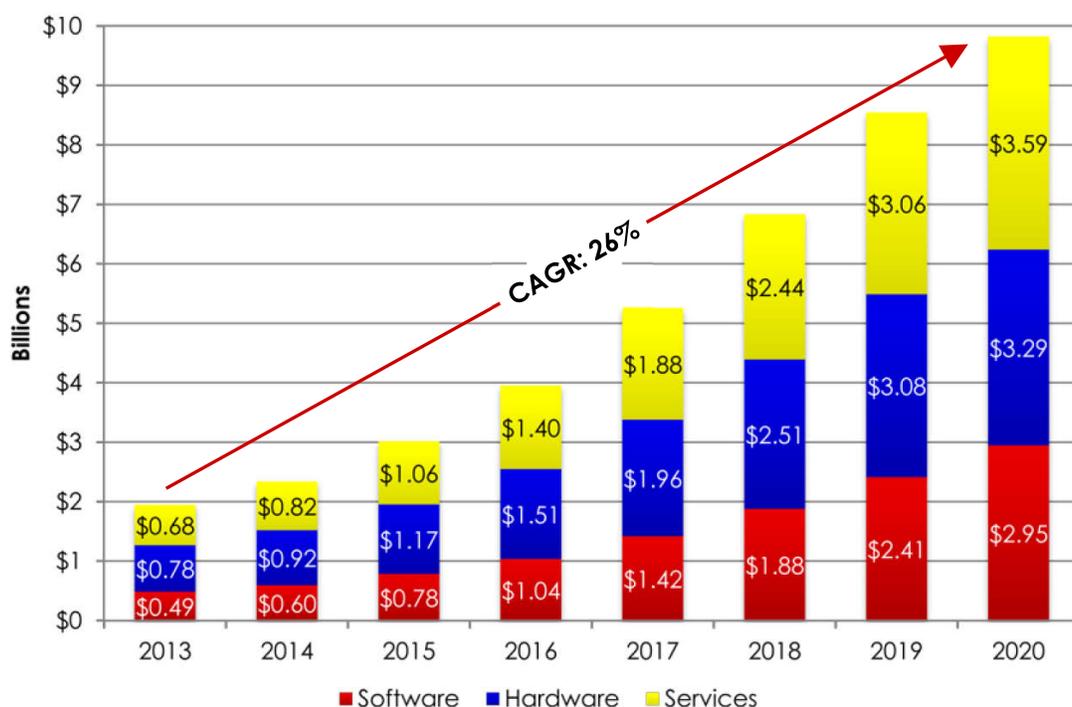
Source: Heavy Reading

Of the five identified business application categories, we believe customer experience enhancement will grow the most, from $546 million in 2013 to $3.57 billion in 2020, at 30.8 percent CAGR, shown in Figure 7. Precise marketing category will increase from $273 million in 2013 to $1.6 billion in 2020, at 28.5 percent CAGR. Operational efficiency improvement will increase from $449 million in 2013 to $1.7 billion in 2020, at 23 percent CAGR, followed by the innovative business model category, which we predict will grow from $332 million in 2013 to $1.3 billion, at 22.4 percent CAGR between 2013 and 2020, and real-time analysis and decision-making from $351 million in 2013 to $1.4 billion in 2020, at 21.9 percent CAGR.

Figure 7: Big Data Analytics Market Size by Business Category
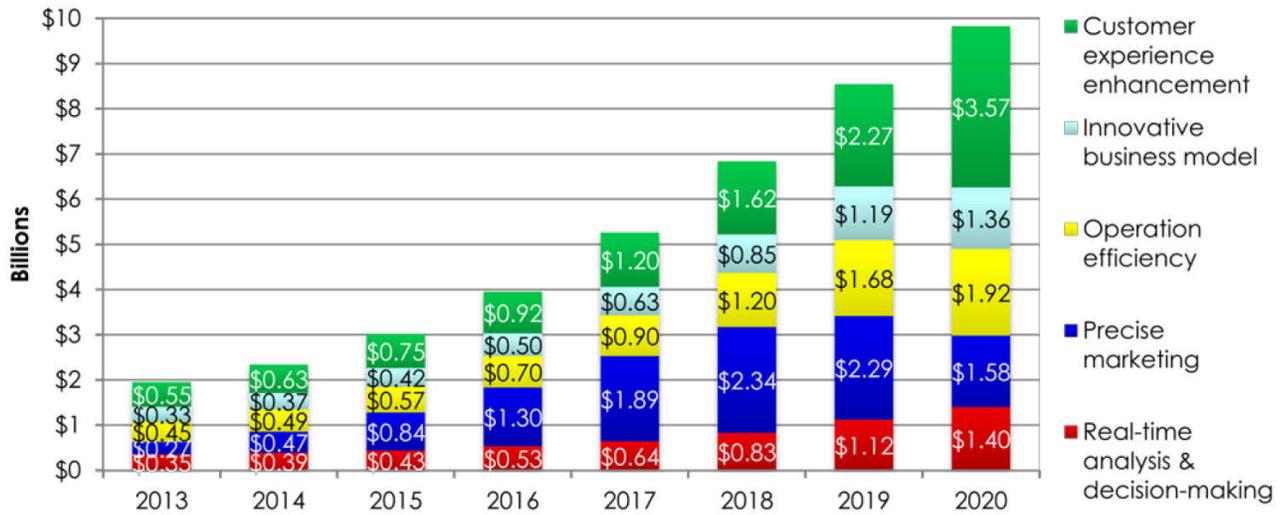
Source: Heavy Reading

North America continues to be the biggest spender on big data and advanced analytics, as shown in Figure 8. We expect spending in this region to grow from $936 million in 2013 to $4.37 billion in 2020 (24.6 percent CAGR). EMEA is next, with a spending of $565.5 million in 2013, estimated to grow to $2.97 billion in 2020 (28 percent CAGR). Asia/Pacific follows with $292.5 million in 2013, growing to $1.6 billion in 2020 (26.8 percent CAGR). Central/Latin America accounted for $156 million in 2013, which will grow to $874.7 million in 2020 (27.9 percent CAGR).

Figure 8: Big Data Analytics Market Size in Telecom by Region

Source: Heavy Reading

Big Data Best Practices for Service Providers

There are numerous ways in which service providers across the globe are utilizing big data in order to increase their revenue and become more effective. In this section we will take a look at few such examples.

Figure 9: Examples of Big Data Analytics in Telecom

Source: Heavy Reading
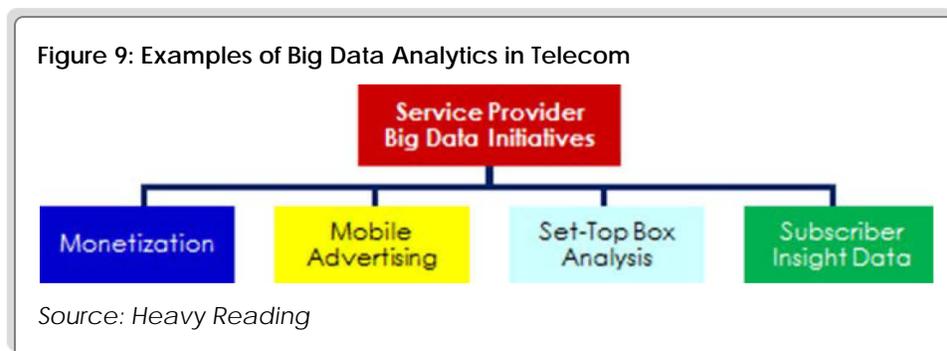
Monetization

Service providers are monetizing the big data on their networks by providing analytic insights that make offerings more effective.

Telefónica O2 has been progressive the last few years, having had an active channel sales function in O2 Media, and has launched Telefónica Dynamic Insights, which is a new global business unit dedicated to identifying and finding potential opportunities for creating value from "big data." The offering provides companies and public sector organizations with analytical insights in order to enable them to become more effective. Its first product, "Smart Steps," fully anonymizes and aggregates mobile network data to enable customers to measure, compare and understand what factors influence the number of people visiting a location at any time. The insights are designed to help retailers tailor local offerings for existing stores and determine the best locations and most appropriate formats for new stores. Several retailers are helping with product development by providing user feedback. Telefónica says Smart Steps also helps town councils measure how many more people visit their street after the introduction of free car parking, farmers markets or late night shopping.

Subscriber Insight Data

Service providers are looking to sell their copious amounts of customer data to third-party marketing companies as an alternative means of revenue.

Tier 1 operators are looking to the sale of their big data as a means of monetization. **AT&T** plans to profit from the subscriber data it holds in its back-office systems. The carrier has announced its intention to update its customer privacy policy so that it can aggregate customer data that can then be sold to advertisers and marketing firms. The operator also says it may begin selling anonymous information about its customers' wireless and Wi-Fi locations, U-verse usage, website browsing, mobile application usage and "other information" to other businesses. The carrier claims it will protect its customers' privacy by providing the data in aggregate form so it cannot be used to identify an individual. AT&T also announced that its customers can opt in or out of the program, and that the operator is updating its

privacy policies. Opt-ins are the terms and conditions that can allow for data gathered to be used by third parties.

AT&T is not the first operator to sell anonymous information about its customers' location and behavior. **Verizon Wireless** launched its Precision Market Insights business last year, which also anonymizes and sells customer location and usage information. Verizon works with media owners, sponsors, advertisers, venue owners and retailers. In the Precision Market Insights literature, Verizon says it uses a base derived from a sample of the 86+ million Verizon Wireless customers. Data is collected by daypart and anonymized for the protection of subscribers. Verizon's analytics engine then extrapolates a sample, so that it has a full view of a national population segment to provide insights from unique compilations generated from many resources, including location, demographic and usage data. Verizon uses data collected from subscribers that have "opted in" to its Verizon Selects pro-gram, which allows access to micro-segments of the market that are made available in the precision range of data services. Verizon Selects enables location, Web browsing habits and mobile application usage data, as well as other data, including customer demographic and interests, to create specific insights.

Mobile Advertising

Service providers are partnering or acquiring vendors that specialize in mobile advertising in order to improve their advertising platform and leverage its big data.

In order to leverage big data this last year, **SingTel** acquired Amobee, a mobile advertising platform. The operator believes the acquisition enables it to help brands better reach their target audience and deliver more relevant offers, rewards and promotions to customers. SingTel sees the Amobee platform as a means to provide differentiated solutions across smartphones and feature phones, giving SingTel retail customers a better return on their marketing spend. SingTel feels it will bring better value to customers as they are in control of the promotional message they receive. Likewise for retailers, SingTel says it will be able to reach out to customers that are interested in their products and minimize waste of ad spend. SingTel's targeted advertising is based on several mobile advertising opportunities for SingTel's partners, which includes context aware advertising based on adver-tisements embedded within consumer mobile applications targeted SMS/MMS adverting, location based advertising and vouchers.

Set-Top Box Analysis

The cable industry is sitting on a mountain of big data in the form of customer and network information and data from STBs and other client devices, such as tablets.

Cable operators are focusing on how big data can affect the bottom line, from marketing and advertising opportunities, to content licensing negotiations, to customer churn and network planning strategies. What companies can do with detailed audience metrics from TV set-top data, tablet data, etc., is a hot topic both inside and outside the cable industry. Viewership data promises new revenue streams from targeted ad sales and the development of customized and person-alized content services. Because of its potential value, more companies are diving into the set-top analytics business and developing new solutions for the cable market. However, while cable enthusiasm is running high, there's still the tricky issue of consumer privacy: Strict regulations govern what information cable companies can track, and how they can manipulate user data to make more money.

Vendor Profile: Huawei's Big Data Solution

Operators' ability to leverage all the information at their disposal will be limited without an overarching big data and advanced analytics system that can provide access to relevant data, enable analysis of that data and provide actionable reports and insight to end users.

Such a system must help service providers go beyond building a consolidated view of subscribers from different data sources and have the ability to convert those decisions and real-time insight into pre-defined measurable actions. This will drive profitability of service providers by helping them to launch more personalized services and targeted promotions, thereby increasing the success rate of their campaigns and promotions dramatically. What service providers need today is a nimble solution that can react in real time, have advanced analytic capabilities and enable them to:

- Create innovative new business models

- Maximize the value of network resources

- Act on deeper subscriber and network insights in real time

- Simplify and personalize the subscriber experience

Huawei's big data solution closely mirrors today's communication market requirement. The architecture of the vendor's big data solution is illustrated in **Figure 10**.

Figure 10: Huawei's Big Data Solution
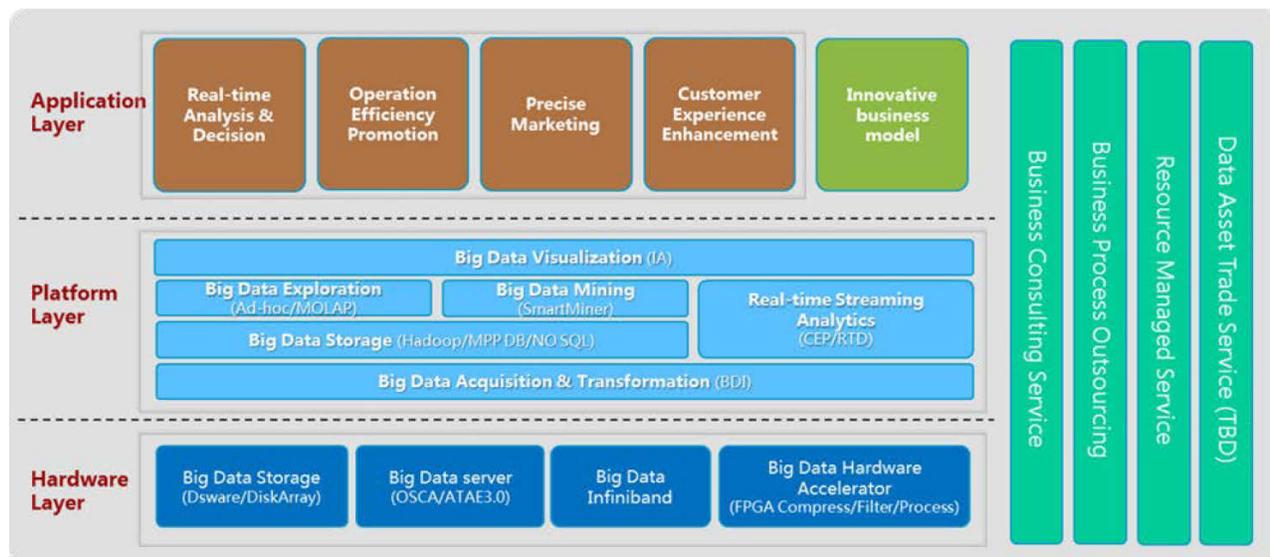
Source: Huawei

Conclusions

Converting the deluge of information into actionable real-time information is an arduous task that service providers must tackle if they want to have a user-defined Telco IT architecture to dynamically meet their business objectives that centers on accurate network planning, providing pre-emptive service assurance and delivering superior customer experience. Real-time analytics will play a key role in the success of operators as they will not only provide operators with real-time intelligence, but also help them to maximize their revenue potential from a short window of opportunity.

The challenges of taming big data in order to achieve actionable insight lies in the operator's ability to collect all data generated and analyze those data collected cost effectively. Unstructured, non-standard, incomplete and inaccurate data makes the task all the more complex. Overall, the complexity surrounding big data is that it is expensive to manage and difficult to extract value out of it. However, big data used effectively has the potential to revolutionize the way telecom operators build, run and market their services.

Service providers can use advanced analytics to effectively manage and monetize their big data. They can use advanced analytics for more innovative business models that can offer more targeted campaigns based on specific customer segmentations, as well as location. These more personalized offerings not only increase revenue, but ultimately reduce churn. Service providers can use advanced analytics for pre-emptive service assurance and customer care by correlating the information about the customer from various systems, which can trigger certain actions to prevent problems before they occur.

Strategic big data and advanced analytics implementation can enable operators to do all of the above. In the future, big data and advanced analytics implementation will become a fundamental pillar of service and network strategy, and operators must start planning for them now.

Appendix A: About the Author

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Banerjee focuses on service provider IT, including all aspects of telecom software research. He examines the breadth of software used by communications service providers in customer, business, service and infrastructure management. His area of focus includes all aspects of BSS, OSS, SDP, digital commerce, revenue assurance, service assurance and elements that span both the infrastructure and network software markets, such as data warehousing, analytics and business intelligence.

Prior to joining *Heavy Reading*, Banerjee was the VP of Next Generation Software Systems at Yankee Group, leading and overseeing all aspects of their telecom software research. He also worked for the billing and customer care division at Lucent Technologies, and subsequently the global software and services group at CSG Systems. He has worked for utility companies in Asia and Europe in a number of business development and technology functions.

Banerjee speaks regularly at leading communications industry events. He holds a B.E. in electronics and communications from Manipal Institute of Technology in India and an M.S. in computer information systems from Bentley College, as well as an M.B.A. from the University of Glasgow Business School. He is based in the U.K. and can be reached at ari.banerjee@ubm.com.