Big data analytics for communications service providers

IBM

Contents

There is a lot of buzz around "big data"—and rightly so.
Organizations that are capturing and analyzing large amounts
of data in real time or near–real time are creating significant
competitive advantages for themselves, their customers and
business partners.[1]

Communications service providers (CSPs) are no exception. CSPs
that can ingest and analyze network, location and customer data
in real time or near–real time have much to gain. They will be
able to quickly introduce new capabilities such as location-based
services, intelligent marketing campaigns, next best actions for
sales and service, social media insights, network intelligence and
fraud detection to significantly increase revenues and reduce costs.

This paper defines what big data analytics mean to CSPs, provides
an overview of their most valuable uses in telecommunications,
outlines what organizations must look for as they adopt new
big data analytic solutions and discusses how IBM can help.

Unique big data requirements for communications service providers

By leveraging large amounts of data in real time or near–real
time, CSPs can gain new insights and make predictions that
help them introduce new ways of doing business internally and
externally. However, to deliver the benefits that big data offers,
they will need to deploy new tools and adopt new methods
to manage the unique volume, velocity, variety and veracity
requirements of big data:

- **Volume:** Traditional software wasn't built to ingest and
analyze the billions of call detail records, 60 terabytes of
location data and 20-30 terabytes of Twitter data or more that
CSPs generate or must sort through daily. With traditional
approaches, it usually takes hours to capture data into a data
warehouse or data mart before it can be analyzed to develop
models, findings and predictions. Performing context-based
analysis on large volumes of data in minutes or seconds, based
on a consumer's activity over the last several minutes, requires
new big data analytic solutions.
- **Velocity:** Most data warehouse platforms today perform
historical analysis on yesterday's data, which is useful, but
does not enable the real-time analytics that companies need
to instantly analyze large amounts of information produced
at high velocity. This analysis requires the ability to rapidly
ingest and analyze data with solutions that can provide
context-based analysis in real time.
- **Variety:** In the past, most data was structured and was stored
in relational tables that could be easily analyzed and processed.
Today, large amounts of unstructured data are being created
in blogs, tweets, video, audio, email, click streams, posts on
Facebook, LinkedIn or company or consumer forums, notes
within customer service or sales applications and so on. This
new data must be rapidly analyzed to determine its positive or
negative sentiment, and then presented in a structured format
that can be used to gain insights and build predictive models.
All of these activities must happen in real time or near–real
time, which is more than traditional approaches can handle.

- **Veracity:** The ability to quickly identify, track and govern data that may be deceptive, inaccurate or based on outdated information is not supported by traditional techniques. These capabilities require new technologies that are able to, for example, detect when "customer" posts are actually from a competitor and then account for that data differently than actual customer sentiment.

Service providers have much to gain from deploying big data analytic solutions that can manage the volume, velocity, variety and veracity of big data, and quickly turn data into information to derive valuable insights that benefit their businesses. Big data analytic solutions won't replace the data warehouse, data mining and analytics investments companies already have in place. They will build on top of this core analytics infrastructure to enable companies to ingest and analyze data in new ways.

Benefits of big data analytics for communications service providers

Once a big data analytic solution is in place, CSPs can more easily introduce new capabilities that will increase revenue and customer satisfaction, and reduce costs (see Figure 1). These capabilities include:

1. Location-based services
2. Intelligent marketing campaigns
3. Next best sales and service actions
4. Social media monitoring and insights
5. Network intelligence
6. High-velocity fraud detection

Industry imperatives	Deliver smarter services that generate new sources of revenue	Transform operations to achieve business and service excellence	Build smarter networks
Executive stakeholders	Chief marketing officer	Chief operating officer	Chief network officer
Big data business scenarios	• Location-based services • Intelligent campaigns • Social media insights	• Fraud detection • Next best action	• Network intelligence

Figure 1. Key big data business scenarios for communications service providers.

The following is an overview of these new capabilities and the benefits they offer to CSPs and their customers and partners.

Location-based services
Service providers that can accurately determine a customer's location in real time will then be able to deliver relevant and timely promotional offers and other services to them, based on their location, while respecting their privacy preferences. There are three kinds of location data accessible to CSPs: passive mobile positioning data, call detail records and global positioning system (GPS) data.

Mobile positioning data is gathered periodically when a phone is powered on, regardless of whether calls are being placed or received. Call detail records are generated each time a call is placed and contain information such as who made the call, who received the call, and the start and end time of the call. GPS location data is available from customers who have smartphones and have turned on GPS tracking. GPS provides a higher degree of accuracy data by delivering coordinates that are within a few feet of a person's actual location.

If CSPs are equipped to collect and analyze real-time location data, it can be used for activities such as detecting fraud, improving network quality, establishing client location profiles and offering intelligent marketing campaigns. Location data can also be sold to third parties such as cities or marketers for their own use. For example, a city could buy anonymized location data and use it to identify areas where drivers are regularly reducing their speed when no known traffic conditions are occurring, which may indicate areas where potholes or other road hazards exist. Service providers could also sell the location data of subscribers who have opted-in to retailers who could then, for example, offer these customers promotional coupons based on their proximity to a company's stores.

Capturing and using location data requires sophisticated solutions that are capable of handling large volumes of data at high velocity. When location data is tied to individual subscribers, other technical challenges are introduced as CSPs need to give subscribers a way to opt-in to share their location data and to specify the types of offers they want to receive. Since many CSPs have tens of millions or hundreds of millions of subscribers, managing and honoring consumer preferences can be an extremely complex task.

Intelligent marketing campaigns
Big data analytic solutions enable CSPs to better understand their customers and develop subscriber profiles that can be used to create more intelligent marketing campaigns. For example, after analyzing a person's location data and correlating it with other business location data, a provider may determine that a subscriber is an office worker who spends weekdays traveling between their home and office on a particular route, sometimes stops for coffee on the way to work or at a restaurant or grocery store on their way home, and frequents a mall or other shopping locations on the weekend. This information can be stored in a subscriber profile that is then accessed by CSPs for promotional purposes.

Intelligent marketing campaigns utilize big data analytics to improve the results of marketing promotions, increase revenue and help to prevent customer churn. In seconds, a subscriber's usage profile, billing data and past responses to offers can be analyzed to create targeted promotions that customers are more likely to accept. The following examples illustrate the types of intelligent campaigns that big data analytic solutions enable:

• Coupons can be issued to consumers based on their profile, such as offering a dinner coupon at the end of a workday for a restaurant along an office worker's route home, or a coupon offered to a customer standing in front of a coffeehouse or clothing store that they are known to frequent.

- Promotions to prepaid phone customers that encourage them to reload and help prevent customer churn. For example, if a consumer's balance is running low on their phone, they are near a recharge location, and they have recently made a lot of calls to Malaysia, a provider could offer them a coupon to recharge their phone for $30 within the next few hours and get 10 free calling minutes to Malaysia.
- Marketing programs that help to ensure customer retention when subscribers are having service problems, such as when someone has experienced many dropped calls over the last two days. In this example, the subscriber's phone usage could be automatically analyzed to determine what free add-on offer they are most likely to value. The provider could then instruct a customer service representative to call the subscriber and offer them the free add-on. The goal would be to improve customer satisfaction by demonstrating that the provider values the customer's business.

The technical challenges of delivering these types of intelligent marketing campaigns include the need to rapidly process and analyze high volumes of location data, and automatically combine it with a deliverable, such as analyzing a prepaid subscriber's balance and usage information to issue a targeted promotional offer in real time.

Next best sales and service actions

The ability to respond to customers with next best actions in a sales or customer service situation while balancing customer needs and company priorities can increase revenue, profits and customer satisfaction, and reduce customer churn. Next best action responses are most effective when they take into account recent customer interactions across all sales and service channels and automatically determine and enable next best actions for each customer, such as offering them a new service, an upgrade for an existing service or a service call to address a specific issue.

Some examples of next best actions include:

- Automatically authorizing a call center representative, who is speaking to a customer known to be having problems with their service, to present the customer with an offer that compensates them for their trouble and helps retain them as a customer. Examples of an offer could include a month of free service, a free device upgrade six months ahead of schedule and so on.
- Identifying on-the-fly a specific customer who is currently visiting the company's website and is interested in a firewall solution. This discovery is based on recent web activity or customer records that show they called in or visited a store looking for information about firewalls. The knowledge is used to automatically personalize the customer's web experience by prominently featuring firewall products.

The ability to automatically determine and present next best actions can be technically challenging. Large volumes of structured and unstructured data related to a customer's interaction with the provider, such as service calls, prior calls to a call center, store visits and so on, must be analyzed and enhanced with customer, product and service sentiment that is gathered from blogs, forums and other social media. All of this information must then be combined with a real-time analysis of the customer's current activity to determine what next best actions may best satisfy them and are most aligned with the company's business priorities. A 360-degree view of the client base is also required.

Social media monitoring and insights

Service providers can leverage big data analytic solutions to quickly track and analyze customer responses and sentiments from social media sources such as Twitter, Facebook, LinkedIn and YouTube, message boards and other online locations where consumers chat and post opinions, as well as the company's customer service call notes and email exchanges with customers. This capability helps CSPs more quickly evaluate how new advertising campaigns, products and services are resonating; determine the geography and demographics of consumers who are reacting positively, negatively or not at all; and leverage that information to help increase sales or reduce negative reactions.

Traditionally, CSPs monitor and analyze this data manually in house or outsource the task to a third party. Both options are expensive and do not provide them with actionable information quickly. Companies can use big data analytic solutions to create a centralized command center where social media and other unstructured content for the entire company can be rapidly collected, tracked and analyzed in hours instead of days. Closer monitoring and analysis of customer sentiments can help to improve results for CSPs in many ways, including:

1. **Ad effectiveness:** When a new advertising campaign is released into the marketplace, if companies are able to quickly evaluate qualitative consumer responses in real time to determine how the campaign is resonating and with whom, they can quickly tune their campaigns to maximize return on investment.

2. **Brand and reputation sentiment:** The ability to track whether a company is perceived as honest, innovative and having great products and services; identify which demographic or geographic groups like or dislike them and define the size and characteristics of those groups; and respond to negative comments in a timely fashion allows CSPs to better protect their brand and reputation.

3. **Pre-sale product and service buzz:** The ability to better determine consumer response to upcoming products and services, such as how many consumers are waiting for the release and which groups of consumers are most interested, enables CSPs to quickly adjust marketing programs or forecasts based on this additional information.

4. **Post-sales satisfaction:** Evaluating how consumers are responding to new offerings in the marketplace in real time, such as high-speed Internet services or digital phone lines for small businesses or a new type of smartphone for consumers, helps companies rate post-sales service and satisfaction, and make adjustments to forecasts, marketing strategies or business processes as required.

CSPs will benefit from centralizing and standardizing the monitoring and analysis of social media and other unstructured data. It will enable them to quickly detect qualitative consumer sentiments and gain timely insights that will increase revenues, reduce costs and protect their brand, while ensuring that customer data is protected and that they are in compliance with privacy regulations.

Network intelligence

An important concern of all CSPs is how to increase customer satisfaction and reduce customer churn by improving network quality. Providers can use big analytic solutions to easily identify problems, perform real-time troubleshooting and quickly fix network performance issues, which will improve network quality and lower operating costs. Some examples of common network problems include areas that suddenly experience a significant number of dropped calls as a result of a failure in tower equipment, or locations that regularly experience dropped calls at a certain time of day due to increased data usage resulting from population surges, such as in a downtown area where a sports stadium is located.

Real-time analytics can provide CSPs with the intelligence they need to rapidly identify and troubleshoot issues. They can then make adjustments to optimize network operation such as, in the case of the stadium, reorienting the antenna on a cell tower to give more coverage to the area when a game is being played.

The technical challenges of using real-time data to improve network quality include analyzing high-velocity streams of call detail records to detect critical network events as they happen, storing and analyzing years of call, switch, billing and network event data, and providing immediate access to the types of retrospective analytics needed to improve network performance, plan for additional network capacity and reduce customer churn.

Another challenge is how to optimize existing LTE network investments. CSPs are investing heavily in advanced 4G networks to meet the growing demand for mobile content accessed from smart devices. At the same time, they must ensure existing 2.5/3G networks are providing a consistent quality of experience, particularly as over-the-top (OTT) content players with innovative, feature-rich services continue to impact traditional voice and text services.

By analyzing data across the network, CSPs can identify where high-value customers use mobile services, what devices they use and the different types of applications and services they access. Identifying the device and usage patterns of different customer segments enables network-planning teams to identify where it makes sense to roll out new LTE technology infrastructure. With the right data in front of them, CSPs can prioritize their LTE investments around location as well as customers and their usage patterns, maximizing revenue opportunities, the return on investment and ongoing profitability.

High-velocity fraud detection

A number of fraudulent activities can impact CSPs. In the past, many of these activities were impossible to resolve quickly. Big data analytics allow telecommunication companies to detect and analyze high-velocity fraud activities in real time and take immediate action. Examples of how big data analytics can help to reduce high-velocity fraud include:

• Calls made from the same number within a short period of time from two different locations—such as Los Angeles and Chicago—indicate that one of the calls was most likely made from a phone with a cloned SIM card. The system can detect two separate calls from the same phone number happening in two locations, invoke necessary security measures (such as shutting off the SIM card most likely to be fraudulent to stop further activity) and then begin a more thorough fraud investigation.
• Use of a smartphone or another device, such as a laptop or tablet, as an unauthorized wireless hotspot to connect multiple users. This type of activity generates large volumes of data transmission and results in lost revenue for the provider. The system can identify the fraudulent or unintended usage that is violating a subscriber's wireless service agreement and the company's customer service team can then contact the subscriber to ask them to cease this type of activity or upgrade their contract.

With big data analytic solutions, CSPs can identify potential fraudulent activities as they happen, score them and rate the probability that they are fraudulent. This information can then be turned over to a fraud analyst to take further action, or to a customer service representative to contact the subscriber to correct unauthorized actions. The technical challenges for real-time fraud detection include the need to ingest and analyze large volumes of high-velocity data from all geographies and subscribers, and identify and prevent unauthorized use.

Essential technologies to enable big data analytics

Before CSPs begin big data analytics projects, they need to ensure that the solutions they select can support the volume, velocity, variety and veracity demands of big data and the analytics that will be required to gain insights, make predictions and realize benefits.
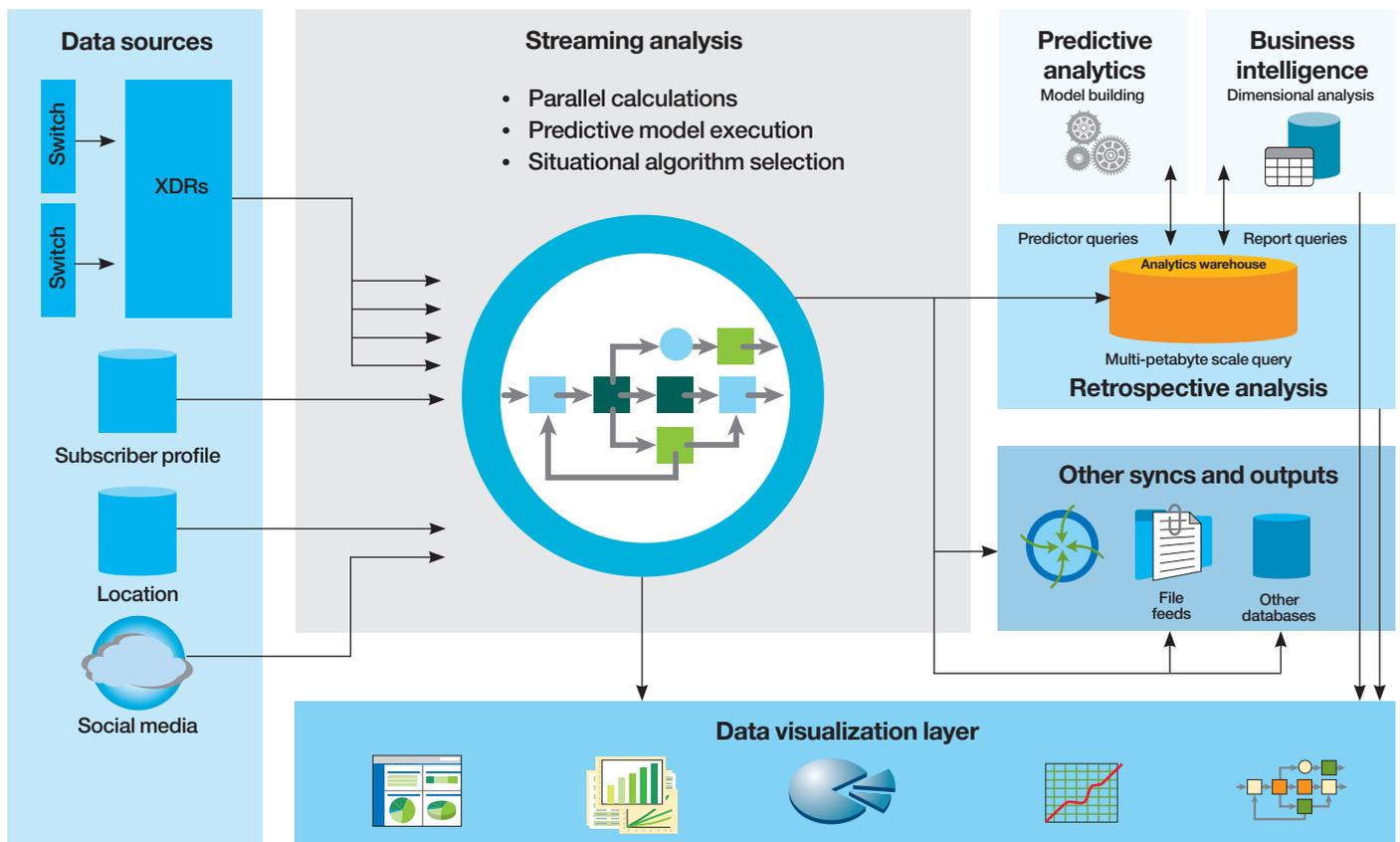

Data sources

Switch

Switch

XDRs

Subscriber profile

Location

Social media

Streaming analysis

- Parallel calculations
- Predictive model execution
- Situational algorithm selection

Predictive analytics
Model building

Business intelligence
Dimensional analysis

Predictor queries   Report queries

Analytics warehouse

Multi-petabyte scale query

Retrospective analysis

Other syncs and outputs

File feeds

Other databases

Data visualization layer

Figure 2. A variety of technologies combine to govern and analyze big data in fast-moving industries like telecommunications.

The rigorous demands of big data require solutions that support a range of advanced capabilities (see Figure 2), including:

- Rapidly processing and analyzing parallel streams of data.
- Delivering greater levels of precision with algorithms that leverage location data.
- Performing retrospective analysis on a wide variety of data to enhance subscriber and network intelligence.
- Predictive analytics and modeling to improve outcomes and detect problems before they occur.
- Building cognitive and machine-learning analytics.
- Visualizing data to make it easier to understand the information and insights that big data analytics are providing.

The following sections cover each of these requirements in more detail.

Streaming analysis

Real-time analytics require the ability to process and analyze parallel streams of data as they come in from the network, before they are ever stored in a database. Streams processing offers CSPs new opportunities to generate revenue from their existing subscriber base, and quickly respond to network quality issues.

For example, with streams processing, as subscribers make calls, download data or ringtones, and purchase movies or songs, CSPs can combine this real-time data with billing, account status and other information and present targeted offers based on subscriber-specific information. Streams processing can also help CSPs quickly detect network performance problems and immediately analyze additional data about the location where the problems are occurring to determine the best course of action.

Parallel streams processing is required for these types of actions; they cannot be accomplished with traditional solutions that take too long to ingest and analyze the large volumes of data coming in at high velocity. By the time traditional solutions have captured and analyzed the data, the subscriber has already left the area where the promotional offer could be issued or a large number of subscribers have been impacted by poor network performance.

Real-time location algorithms

Today, most location data comes from mobile positioning data and call detail records. To increase their accuracy, algorithms can be applied to these types of location data. For example, if a subscriber is connected to three towers, then information from those three towers can be analyzed and algorithms applied to triangulate the data and get more precise location information.

Retrospective analytics

CSPs can learn much about their subscribers and networks by analyzing large quantities of historical information. Here are a few examples of how retrospective analytics can improve subscriber and network intelligence:

- **Subscriber intelligence:** More precise information about subscriber preferences and behaviors can be determined by analyzing historical location data and then correlating it with business locations to provide more details about a subscriber's actual past locations. This data can be used to create customer micro-segments such as office workers, traveling salespeople, coffee drinkers, movie fans, shoppers and so on.

For example, if someone is usually at home and often goes to a coffeehouse at some time during the day, but occasionally goes to the airport and is in another city for a few days, then they would most likely fit into the traveling salesperson segment. If someone travels from home to a commercial location every morning and then is at home most evenings, except when they stop at a mall, grocery store or restaurant on the way home, then they are most likely an office worker. Subscribers who are often in a coffeehouse are likely to be coffee drinkers, those who are often in movie theaters are likely movie fans, and those who are in malls are either shoppers or window shoppers.

- **Network intelligence:** By reviewing past network event data, providers can identify the geographic areas, times of day, and specific days of the week, month or year when network performance is poor. For example, in Los Angeles near the intersection of Wilshire and Westwood boulevards, one of the most highly traveled areas in the city, calls are being dropped consistently between 5 p.m. and 7 p.m. on weeknights, but there isn't a problem on Saturdays or Sundays. With this knowledge, the provider can assess how to address the issue—most likely by either increasing the capacity of cell towers that are located near the intersection or by changing the orientation of their antennas to provide greater coverage during peak traffic periods.

Service providers may already have retrospective analytic solutions in place, but these systems may not be capable of quickly analyzing large volumes of data coming in at high velocity or delivering analytics in the time required.

Predictive analytics

Statistical models created from retrospective data, real-time data or both can help CSPs better understand, analyze and predict the likelihood or propensity of an event occurring in the future. A predictive model correlates a number of independent variables to predict the probability of outcomes, monitors predictions and outcomes, and modifies the model in real time to improve results.

For example, information about whether a subscriber acted on a promotional offer that was made to them in the past can be used to predict the likelihood that they will act on a future offer. Based on this assessment, a decision can be made about whether to issue an offer and what offer to present them with at their current location. Or by analyzing statistics about past churn rates and failed calls, the service threshold level at subscribers' homes or offices that are likely to result in a customer switching subscribers can be determined. When that threshold has been reached, a provider will want to take immediate action to improve service to prevent losing them.

In addition to the capabilities above, predictive analytics must be able to tie back into a company's operational management applications so that operational alerts can be issued when algorithms and predictive models detect patterns in data that indicate current or pending device or network failure of an upstream device or network element.

Data visualization

A data visualization layer enables users to make better decisions by providing them with a view of consolidated information from transactional systems, such as order management, customer relationship management and billing, and insights from retrospective and predictive analytics. For example, while they are speaking to a subscriber by phone, a CSP call center representative can see a complete 360-degree view of a customer's information, review recommended next best actions and make offers on the fly. Effective data visualization capabilities allow CSPs to reduce average call handling times for thousands of call center representatives to improve productivity, reduce costs and increase customer satisfaction.

Big data analytic solutions can help service providers drive outstanding business results, but many companies are struggling with when and how to begin their journey. IBM recommends a phased approach that enables rapid deployment and reduces risk.

IBM addresses the requirements

As telecommunication companies look for ways to get started or advance their big data analytics initiatives, IBM suggests a simple five-step approach:

1. **Focus on the biggest and highest-value opportunities.** Identify one area that is most important to your business and will enable you to deploy rapidly. Don't try to tackle everything at once, as you will learn from your first area of focus and can then improve your approach and processes as you expand.

2. **Start with questions, not with data.** Organizations tend to get caught up in looking only at what they can do with the information they have, which can limit your thinking and your approach.

3. **Embed insights into actions to deliver value across your organization.** Analytics for the sake of analytics is not helpful. Analytics will only be meaningful if you use the insights you gain to deliver value.

4. **Keep existing capabilities while adding new ones.** Don't think of your project or initiative as a starting point, but as a way to integrate new and expanded capabilities into your organization.
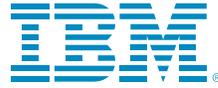
5. **Use an information agenda strategy to align your information and business objectives.** This approach will allow you to refine scope, evaluate core capabilities and competencies and determine how the proposed initiatives can be extended across the business. Always stay focused on delivering business value even early in the lifecycle.

Many of the leading CSPs worldwide use IBM® technologies to help them make better decisions and improve business outcomes. IBM provides a full range of big data analytics products and services to help telecommunications companies increase revenue, improve customer service quality, and reduce costs and customer churn.

Whichever route you choose to get started, the important thing is that you do. The gap is widening between CSPs that use big data analytics and those that do not. Make sure you don't get left behind.

For more information

To learn more about how IBM can help CSPs and other telecommunication organizations develop a big data strategy, visit **ibm.com**/software/data/bigdata/industry-telco.html

[1] "Analytics: The new path to value," a joint study by MIT Sloan Management Review and IBM Institute for Business Value. © Massachusetts Institute of Technology 2010.

Please Recycle

IMW14651-USEN-01