CLOUDERA

Digital Transformation in Telecommunications

TOP 5 DATA AND ANALYTICS USE CASES

The New Telecommunications Economy

The **Telecommunications** industry is experiencing transformation at a staggering pace. Powered by an increasingly hyper-connected world, generating massive amounts of data, telecommunication companies are reinventing themselves as technology and digital service providers for the connected modern era. Today's "buy now" economy has changed consumer expectations. Streaming video now accounts for two-thirds (63%) of all mobile data traffic.[1] This has forever changed the competitive landscape. Massive amounts of structured and unstructured data are generated every day, and emerging technologies such as 5G and IoT have created opportunities never before imagined.

The convergence of these technology trends holds great promise for communication service providers (CSPs) looking to move beyond connectivity to drive true business value for consumers and enterprises. By harnessing and analyzing the data that they capture, CSPs can monetize 5G and meet the needs of a changing industry with technology that enables smart cities, self-driving cars, connected homes, connected factories, and more.

The Role of Analytics in Telecommunications

Communication service providers are among the world's biggest aggregators of consumer data and work under the most uncertain regulatory and market conditions. CSPs today generate and have access to vast amounts of valuable data including everything from detailed customer profiles, content preferences, and usage patterns to device, network, location, sensor, and application usage data.

Given the access to unprecedented volumes and varieties of data, analytics and machine learning will play a key role in CSP digital transformation. Whether used to analyze churn, conduct targeted marketing, identify fraud, optimize networks, or launch compelling new revenue engines, data—and the intelligence from that data—have the potential to fundamentally redefine the telecommunications space.

[1] Cisco, "Cisco Visual Networking Index: Global Mobile Data Traffic Forecast Update," 2017-2022.

Service providers today are capitalizing on all of this data at their disposal
to effectively:

- Enhance the end-to-end customer experience

- Create real-time targeted marketing and promotions

- Optimize network performance and investments

- Enable predictive maintenance to proactively fix issues

- Reduce the risk of fraud and cybersecurity

- Monetize 5G

- Capitalize on new business and digital services opportunities

What CSP's need today is the ability to ingest, process, store, and analyze any type of data, regardless of where it lands—at the edge, in the data center, in any public cloud, or in a hybrid cloud. They need to be able to drive insights and use cases not only from data at rest, but also from data in motion and streaming data sources in real time. Machine learning, advanced analytics, and AI will enable you to identify patterns in petabytes of data, detect anomalies, and predict potential outcomes for your business.

With greater visibility and insights at the point of decision, CSPs can use the data they generate every day to drive down operational costs, deliver a more compelling and personalized customer experience, and help drive new revenue streams.

Telecom operators can **reduce costs by**

30 to 40%
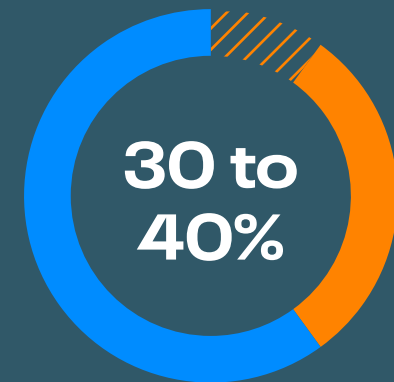
and **increase cash flow margins**

25 to 40%

using machine learning and applied analytics[2]

[2] McKinsey, "A Future for Mobile Operators: The Keys to Successful Reinvention," February 2017.

5G – The Next Frontier for CSPs

Telcos are pumping in over 1.5 trillion dollars into rolling out 5G, and are focused on monetizing these investments by rolling out new services and use cases.

Although 5G could theoretically achieve speeds greater than 20GB per second, ultimately, it is not just about faster speeds. 5G offers enterprises super low latency and, crucially, ultra-high reliability, and security to enable more real-time mission-critical applications. Things like autonomous driving, remote health monitoring or surgeries, smart grids, and factories—all of these require high reliability and low latency to be powered well. This is really the next big opportunity for Telcos.

The Economic Impact of 5G

Over the next decade, the rollout of 5G networks will have massive impact on the global economy. A broad range of industries across healthcare, transportation, and retail stand to gain from increased productivity, new products and services, optimization of service delivery, and data driven decision making.

By 2035, 5G will contribute:

$13.2T

in global economic value

$2.1T

in GDP growth

– IHS Markit, The 5G Economy

5G Enables Innovation and Transformation Opportunities

Mobile Broadband and Fixed Wireless Access

CSPs will offer faster speed, lower latency and greater capacity to enable on-the-go, ultra-high-definition videos, virtual reality and other advanced applications. And, 5G paves the way for mobile technology to intersect with fixed-line services, whereby CSPs deliver 5G fixed wireless access connections replacing wired internet services.

IoT

The advent of 5G will unlock the potential of the IoT by improving the connection density—enabling more connections at once (up to 1 million per square kilometer) at very low power, to enable IoT use cases, creating additional revenues for CSPs.

Mission Critical Applications

This presents the biggest opportunity for CSPs. 5G's high reliability and ultra-low latency connectivity with strong security and availability will allow wireless technology to provide an ultra-reliable connection for critical applications such as autonomous vehicles and remote operation of complex automation equipment where failure is not an option.

5G Industry Application Examples

Healthcare
> Remote health monitoring
> Remote surgeries

Manufacturing
> Smart factories
> Connected machinery

Automotive
> Autonomous vehicle
> Driver assistance

Utilities
> Smart grids

Ultimately, 5G and IoT are going to drive an explosion in data and the success of these initiatives will depend on the ability to ingest, process, analyze, and act on massive volumes of streaming data.

Top Analytics Use Cases in Telecommunications

Today's leading communications service providers rely on data, analytics, machine learning, and AI technologies to drive digital transformation—converting raw data into actionable insights. Here are the top five use case domains that have the greatest impact for CSPs.

1. IoT and Digital Services

With mobile devices and sensors becoming increasingly connected to the digital world, the Internet of Things (IoT) is having a profound effect on the way we live, the way we work, and how we get value from technology. With the emergence of 5G, Telcos will play a key role in connecting people to their data, creating value from data generated by mobile devices, wearables, sensors, connected cars, and many other devices. As the connectivity layer for IoT, CSPs consequently become part of the IoT ecosystem, enabling them to play an active role in the digital sphere by providing solutions for IoT analytics, data monetization, and more.

IoT Analytics

According to industry sources, the number of connected devices representing the IoT ecosystem is expected to reach 25 billion by 2025, generating more than 1.4 billion 5G connections by 2025.[3] As data volumes from IoT are expected to increase at an accelerated pace, CSPs, due to their inherent proximity to data generated, can play a dominant role. Beyond managing the connectivity requirements for billions of connected devices, CSP's are ideally positioned to provide end-to-end IoT solutions to collect streaming data while processing, storing, analyzing, and serving that data and resulting intelligence back to their customers.

Similarly, CSPs can add location-based and geo-spatial elements to the streaming data to provide enriched and valuable insights to enterprise verticals. And since most of the streaming data from sensors needs to be encrypted before it can be transferred across a wide area network, CSPs are well positioned to integrate and aggregate data while also providing security and analytics.

With the rapid evolution of 5G and enabling technologies, CSPs are driving the evolution of key IoT solutions and use cases across diverse verticals including smart factories, industrial IoT, e-health, telematics, connected utilities, and consumer IoT. The demand for data management and analytics services will only continue to grow as these offerings mature.

[3] GSMA Intelligence, 2018.

The number of connected devices representing the IoT ecosystem is expected to reach

25B

by 2025.

– GSMA Intelligence

Data Monetization

In the IoT ecosystem, CSPs have a unique advantage in that they have access to wide varieties and ever-increasing sources of data, like subscriber demographics, network usage, device usage, application usage, and subscriber preferences. Given the data at their disposal, CSPs are able to begin mining, modeling, aggregating, and anonymizing these data sets to create powerful analytics that can be of significant value.

By combining customer location information with customer demographics and preferences, CSPs can provide data analytics as a service (DAaaS) to key customer-facing verticals like retail, financial services, advertising, healthcare, and public services. These verticals have found a wide variety of applications and use cases for data-centric analytics including:

- Customer footfall analytics which helps retail chains decipher who is visiting their stores and when
- Traffic patterns and bottlenecks, helping logistics companies fine-tune their delivery processes
- Targeted campaign and advertising data for advertising agencies targeting specific micro segments

A number of leading service providers across the globe are already capitalizing on these opportunities and have created specific business entities that focus on delivering analytics services and monetizing data assets.

Of course, data security and privacy issues are at play. Carefully navigating data privacy issues and anonymizing customer data to ensure confidential information is not disclosed is an essential part of data monetization. If executed correctly, CSPs can effectively monetize customer data and provide relevant, valuable insights without compromising subscriber privacy.

CSPs are starting to mine, model, aggregate, and anonymize data sets to create powerful analytics that can be of significant value.

2. Customer Experience Analytics

For today's CSPs, improving and optimizing the customer experience is key to maintaining market differentiation and improving the lifetime value of the customer. By bringing together the right data sets, they can stitch together a true 360-degree view of their customers along their journey and across all of the diverse interaction channels, products, lines of business, and more.

CSPs can now bring together diverse types of data including customer profiles and usage data, network performance metrics, location data, and social media streams to enable targeted marketing, develop personalized offers and recommendations, and predict and prevent churn.

This analysis enables CSPs to discover new ways to increase customer retention, improve the effectiveness of marketing and promotions, enhance the end-to-end customer experience, and become a trusted partner to the customer.

Churn Analytics

Customer churn continues to be one of the most important concerns for communication service providers across the globe. Research by Tefficient shows that the average service provider in mature markets spends 15-20% of service revenues on customer acquisition and retention activities.[4] With its direct effect on revenue, churn continues to be a key area of focus for service providers and offers ripe opportunity for data analysis.

Reducing churn involves developing ways to better understand, monitor, and predict customer behavior. Identifying customers who are most likely to defect and finding factors that increase churn will enable you to take the necessary steps to retain their most valuable customers.

Cutting-edge analytics will let operators apply advanced algorithms to vast troves of data to predict the most vulnerable set of customers. Churn prediction models will also allow CSPs to identify the key factors contributing to churn and then launch retention campaigns that identify and then address at-risk customers via outbound channels.

For example, CSPs can proactively reach out to high-value customers who have experienced a series of service quality issues or who shared a negative sentiment on social media. And then address those issues and offer discounts or service credits to prevent customers from defecting.

[4] Telecoms.com, "Churn Is Breaking the Telecoms Market: Here's How to Fix It," September 2018.
[5] McKinsey, "Reducing Churn in Telecom Through Advanced Analytics," December 2017.

Telecommunication companies that implement a comprehensive, analytics-based approach can **reduce their churn by as much as 15%.**[5]

Targeted Marketing

Traditionally, marketers use data to create ads and campaigns that are targeted to broad demographics. With the limited effectiveness of this approach, personalization is becoming a core strategy for many marketers. With detailed customer profiles, CSPs can develop targeted micro-segments of their consumer base and create personalized offer recommendations. This helps improve the effectiveness of campaigns while also improving the ways customers receive and interact with the organization through those campaigns. Using analytics and intelligence from data collected, CSPs can personalize the next best offers, optimize campaigns, and create location-based promotions—proactively presenting the right offer at the right time, in the right context, to the right customer to improve conversion rates.

Using data analytics, some CSPs have been able to drive significant improvements such as an uplift of one percent of revenues just by optimizing their campaigns targeted to subscribers.

"Delivering the right offer at the right time to the right customer."

3. Network Optimization

Keeping up with the explosive growth in mobile and IoT data requires that CSPs continue to invest heavily in their networks, requiring as much as 30-40% of their capital and operating budgets every year. However, effectively predicting and managing the traffic that moves through the network is a challenging endeavor. Optimizing the network requires a complex analysis of usage, mobility patterns, network logs, hardware bottlenecks, peak loads, and other granular details that will enable CSPs to optimize network utilization and traffic.

Network capacity is a highly valuable resource and CSPs are using advanced analytics and machine learning to effectively monitor and manage network capacity, build predictive capacity models, and prioritize and plan network expansion decisions.

The network continues to be the biggest cost center for CSPs, consuming **30 to**

40%

of their capital and operating budgets.

Real-time Network Analytics

The need to reduce costs and streamline operations, while meeting rising customer demands, is driving CSPs to find new and better ways to optimize the network. Real-time network analysis plays a key role in understanding where problems and bottlenecks exist and how to optimize your network for peak performance.

With data collected from the network, CSPs can build **real-time capacity heat maps** that continually monitor the quality of the user experience. This allows engineers to effectively monitor any drop in service performance at a specific location and determine a proactive resolution.

Real-time data synthesis and analysis will enables CSPs to optimize the network to better predict loads and outages, understand bottlenecks, and provide faster download speeds. With this data, CSPs can proactively address network performance, capacity optimization, and network infrastructure management.

Dynamic Network Provisioning

In today's digital era, ensuring optimal network performance can mean the difference between meeting the rising demands of customers and losing out to the competition. With its inability to scale and associated high costs, manual provisioning is a thing of the past. Technologies like machine learning now enable networks to be more dynamic, flexible, and customizable.

Using advanced analytics, CSPs can use network and device data to predict and dynamically provision network capacity. This **"zero touch" provisioning** requires a move from traditional, hardware-driven networks to software-defined networks. By transitioning to a software-defined approach, CSPs can effectively automate traffic management, improve bandwidth engineering, and better tailor the network to customer needs on demand.

4. Operational Analytics

Ensuring peak operational performance for CSPs is key to reducing costs and growing revenues. Key day-to-day operational data sources offer insights into many areas of the organization including revenue assurance, fraud, cybersecurity, financial forecasting, and equipment maintenance.

Cybersecurity

Communication service providers have become a target of cyber-attacks because of their role in building, controlling, and operating infrastructure that is widely used to transmit large volumes of sensitive data. As device proliferation continues, **cybersecurity** takes center stage and they must race to ensure their networks and associated systems are secure from malicious attacks.

The solution to this challenge lies in analyzing and securing network traffic and end points within this connected ecosystem. CSPs can analyze their data and use it as a weapon against network intrusions. However, due to the sheer cost and complexity, legacy event detection technologies are unable to collect and analyze the many data sources necessary for identifying and responding to advanced threats. Security professionals need to be able to access and analyze an avalanche of data (including network logs, events, packets, flow data, asset data, and configuration data) in real time to mitigate risk, detect incidents, and respond to breaches.

Big data analytics platforms, coupled with machine learning and AI capabilities, enable CSPs to collect and analyze log data, find anomalies that alert unusual activity, and create an event for the security analyst. Data hubs can provide a cost-effective platform for real-time data ingestion, storage, processing, and offer advanced analytics capabilities to support deep packet analysis, behavior analytics, profiling, and threat modeling.

Fraud Analytics

More than any other industry, telecommunications is experiencing a rise in fraud. With new technologies comes a new breed of fraud tactics. Telecommunications fraud takes the form of schemes to defraud the service providers themselves, attempts to defraud subscribers, and fraud conducted over the phone through the network.

Criminals are increasingly adopting hyperscale techniques to perpetrate fraud quickly and more efficiently than ever before. A cyber-fraud gang can set up, go to work, and disappear in 24 hours or less, often before an operator even knows the attack is happening. With roaming and subscription fraud, premium rate service fraud, and domestic and international revenue share fraud, modern, sophisticated attacks mutate, evolve, and arbitrage faster than analysts can write rules to detect and protect against them.

With the significant financial losses that fraud creates, detecting and preventing fraud is crucial. Leading CSPs are turning to cutting-edge analytics, machine learning, and AI technologies to analyze large amounts of real-time data, **detect fraud in real time,** minimize false positives, and identify both new (unknown) and old (known) types of fraud.

These next-generation data analytics solutions enable CSPs to analyze their network and events to conduct anomaly detection in real time and discover 250% to 350% more fraud while generating 20 to 30 times fewer false positives. Machine learning algorithms and natural language processing enhance the data to enable the dynamic fraud detection that protects the business.

Mobile and fixed-line carriers lose

$29B

per year to fraud. This amounts to 1.2% of revenues.[5]

CSPs can discover up to

350%

more fraud using analytics and machine learning.

[5] Communications Fraud Control Association, Global Fraud Loss Survey, 2017.

5. Connected Ecosystems

Our society is more connected than ever. New technologies enable us to connect everything from cars and refrigerators to light bulbs and doorbells to the internet. Powered by 5G, this connectivity extends beyond personal smart homes and enables a complete ecosystem of connectivity among communities, the **government**, commerce, **hospitals**, and neighboring cities. Communication service providers play a key role in enabling these connected ecosystems.

Smart Cities

A smart city is an urban area that uses sensor data to develop efficiencies, improve sustainability, create economic development, and enhance quality of life. Rapid urbanization has led to the development of smart city technologies that have evolved from discrete products to a sizable market opportunity. CSPs are uniquely positioned to drive the smart city revolution by offering connectivity and value-added solutions for governments and cities across the globe.

A big data analytics platform enables the smart city by collecting and processing IoT sensor data in real time and applying artificial intelligence to improve the lives of citizens and visitors. Smart cities put data and digital technology to work to create smart energy, smart transportation, smart infrastructure, and smart mobility of data throughout the city and between cities.

Connected Vehicles

Today's auto **manufacturers** are collaborating with CSPs across the globe using connectivity and the power of IoT to create connected cars of the future. These connected cars are intelligent machines that can communicate with other vehicles and connected infrastructure while optimizing their own operation and maintenance to enable comfort and convenience for drivers and passengers.

Data, analytics, artificial intelligence, and machine learning technologies form the backbone and foundational platform for the development of these connected and self-driving cars. For example, some of the leading automotive manufacturers use a big data platform to effectively ingest, process, store, and analyze diverse data sets from connected cars. Data types include sensor data (i.e., vehicle acceleration and angle of incline), camera images, LIDAR, GPS, weather, image metadata, and more. The platform also helps auto manufacturers use this data to accelerate the development and testing of self-driving technology.

Connected Marketplaces

Online retail is at an inflection point and is experiencing major shifts in technology and business models. With the impact of mobility and the role of digital channels, retailers are creating connected marketplaces that enable personalized buying experiences. Connected marketplaces have shifted from traditional e-commerce platforms like eBay to hypermarkets, assistive selling, and omnichannel capabilities. Communication service providers play a role in enabling the connected marketplace by providing the network through which market automation, omnichannel selling, cognitive learning, and assistive selling take place. The data platform empowers these capabilities by delivering artificial intelligence and machine learning technologies to communication service providers.

Telecommunication Analytics in Action

Today a number of service providers across the globe are leveraging Cloudera's data management platform to gain a 360-degree view of their customers, reduce churn, improve network performance and drive innovation.

10 of the **world's top 10** communication service providers run on Cloudera.
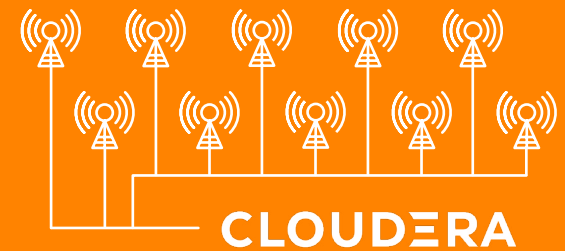
CLOUDERA

Case Study:
Leading North American CSP

Data plays a key role in enabling the growth of one of the nation's largest communication service providers. Cloudera helped the company create a big data center of excellence that spans across its wireless, wireline, cable, satellite, and all global lines of business to develop an infrastructure built on data.

With more than **200 data-intensive applications** and use cases from the Cloudera platform, the company is now able to make analytics-driven decisions around the 360-degree customer view, context-aware marketing promotions, network analytics, network decommissioning, fleet predictive maintenance, cybersecurity, fraud, and more.

They deployed a data lake for capturing and analyzing all sources of customer interactions across multi-channels and were able to to deploy a **360 customer household view** with inferred demographics for household members that had devices without separate accounts set up.

On the network side, they are ingesting over 30 billion data points every hour to optimize the network and customer experience. For example, they built a **tower outage and network analyzer** to identify and prioritize the tower repairs that can provide the biggest impact to customer satisfaction.

They are also ingesting network and traffic data to identify and manage the **decommissioning** of RAN circuits and network equipment without any customer impact, which resulted in **millions of dollars** of savings in network costs.

59%

"Our big data solution for managing the quality of service and customer interactions has helped to drive a 59% improvement in the customer experience."

–Sr. Vice President of Big Data

"Big data is being adopted across our entire organization, including training, so that every employee will be skilled in big data analytics."

–Sr. Vice President of Big Data

Case Study: British Telecom

For **British Telecom (BT)**, one of the largest telecommunications providers in the world, the key to achieving sustainable, profitable growth in today's competitive landscape is its ability to broaden and deepen customer relationships. BT engaged with Cloudera to optimize their ETL operations for the enterprise side of the business. BT was able to increase data velocity by up to **15x,** giving them the means to process five times more data in one third of the time. The transition provided substantial cost savings, delivering an ROI of 200-250% in one year.

In addition, BT uses Cloudera to bring together network and performance data for deeper analysis of the network, minimizing wasted truck rolls. By remotely identifying network performance issues, BT sends fewer technicians to the field, generating savings of millions of dollars.

To better understand the performance of their services, BT also uses the platform to collect data from more than **10 million smart hubs** and smart devices in consumers' homes. The data allows them to predict and proactively fix customer problems, preventing customers from experiencing potential service interruptions.

Another key area where BT is utilizing Cloudera is to power its IoT journey with initiatives such as fleet vehicle analytics and telematics as a service. BT continues to innovate and unveil new and compelling use cases including cybersecurity and IoT analytics and is now positioned to take on new projects more quickly and at a lower cost.

"One of the competitive edge features that we can offer is the ability to instrument those vehicles and collect data from them. Where we want to get to is to be able to predict faults, so we can identify a vehicle failing early."

**–Phillip Radley
Chief Data Architect, BT**

Case Study: Telefónica

Global telecommunications company **Telefónica** has developed a corporate standard around data with Cloudera adoption across all lines of business. Cloudera helped Telefónica by providing a scalable, next-generation platform for data and analytics along with architecture advisory services. With more than **100 applications and use cases** running on the platform, the company can analyze mobility patterns to enhance the customer experience, develop targeted advertising and churn reduction, optimize the network, and analyze voice-to-text care logs to evaluate customer satisfaction.

For example, Telefónica Spain is using the Cloudera platform to capture, store, and analyze customer interaction and experience data. The company used this data to deliver customized TV content, accelerate complaint resolution, and optimize store orders, shipments, and stock.

Real-time customer insights and the delivery of customized experiences for TV viewers helped Telefónica Spain increase customer usage by more than 20%, create a **double-digit increase** in customer satisfaction, and a similar reduction in churn.

A deeper understanding of customers has also helped the organization deliver more relevant offers for improved up-sell efforts. Additionally, real-time insights into store inventory and sales have helped the company increase store sales by **17%**, while reducing in-store stock of mobile devices by **39%**.

Telefónica

"We can now offer customers exactly what they want; not what marketing may think interests them, but what really interests them."

–Carlos Morrás
Manager of Innovation, Big Data and Processes, Telefónica Spain

An Enterprise Data Cloud for Telcos

Given the complexity and variety of customer, network, device, and IoT data, CSPs are reinventing their data management and analytics strategy—transitioning to a multi-function and open platform that is optimized for the massive scale and complexity of the data that the industry demands.
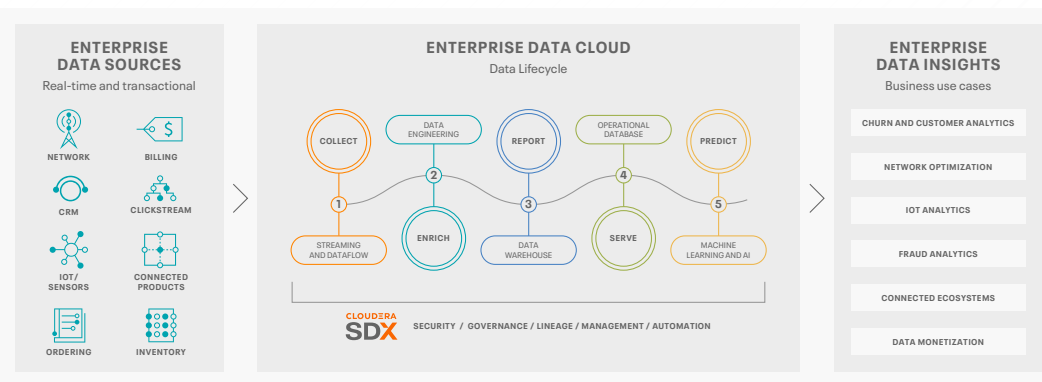
CSPs want the ability to ingest, process, store, analyze, model diverse types of data (structured, unstructured, or semi-structured data), regardless of where it lands — at the edge, on premise, in their data center, or in any public, private, or hybrid cloud.

They need to ingest and process data from multiple sources, combining and correlating network, customer, and device data with activity logs, location, billing and rating data, OSS and inventory data, CRM data, external data, and much more. They also need an integrated suite of proven and open data management tools and analytics engines, in order to drive insights and analytics from all of this data — with the robust security, governance, data protection, and management capabilities that organizations require.

80% of the global top 100 communication service providers run on Cloudera.

Telcos today need an end-to-end data management and analytics platform that can collect, process, manage, and analyze data to drive insights and enable machine learning to implement some of the most compelling use cases.

An **Enterprise Data Cloud** empowers CSPs to get clear and actionable insights from complex data anywhere, from the edge to AI. It provides the flexibility to run modern analytic workloads anywhere, regardless of where the data resides. It offers the ability to move those workloads to different cloud environments— public or private—to avoid lock-in. And it has the agility, elasticity, and ease of use of public clouds and a common security and governance framework to enable data privacy and regulatory compliance by design.

With the ability to analyze data at rest, data in motion, and streaming data, CSPs can use machine learning, advanced analytics, and AI technologies to identify patterns, detect anomalies, and predict potential outcomes for their business.

End-to-End Data Flow for Telcos with the Cloudera Data Platform

Today, leading Telcos worldwide are adopting an enterprise data cloud strategy powered by **Cloudera Data Platform** to manage the end-to-end data lifecycle from ingesting data from multiple sources, to storing, processing, analyzing, serving, and driving actionable insights and use cases.

With Cloudera, CSPs can ingest data from a variety of sources including both streaming and enterprise data sources, enrich and process it across a hybrid infrastructure, and run analytics or apply machine learning algorithms to all data, all while maintaining strict enterprise data security, governance, and control across all environments.

Please find below an overview of the end-to-end data lifecycle from a Telco standpoint.
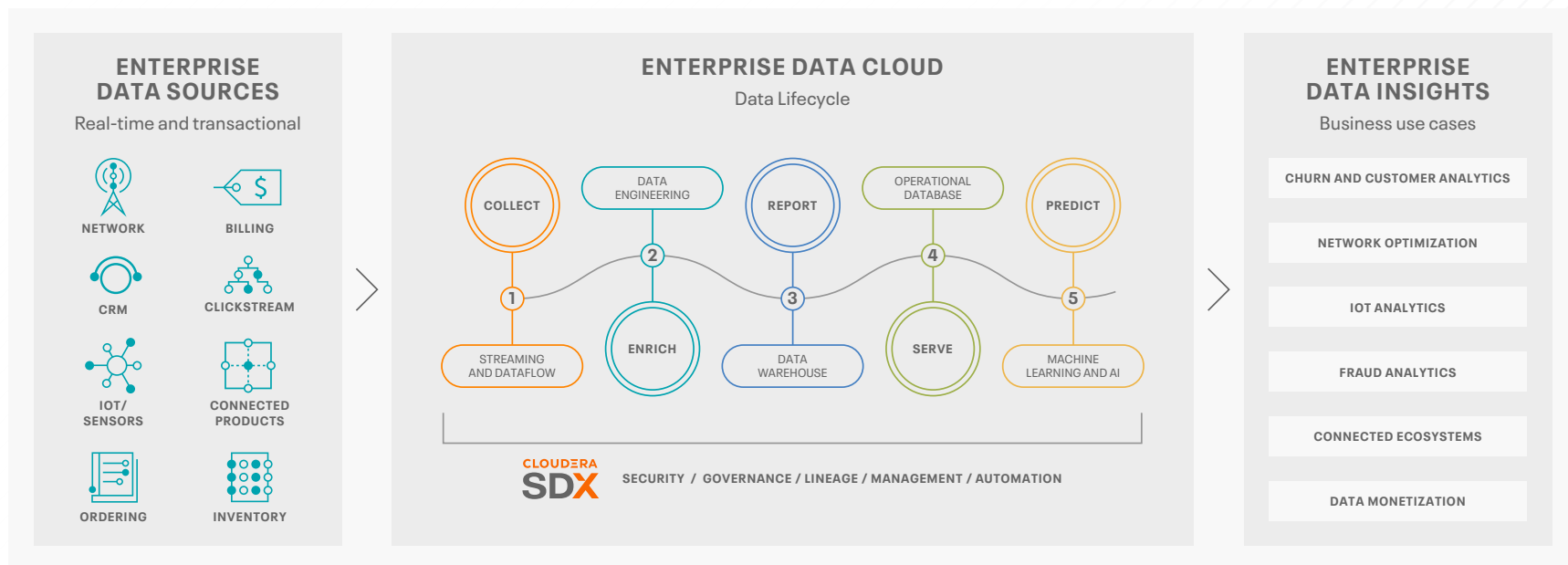
1. Collect

With Cloudera, Communication Service Providers can easily ingest data from multiple sources, including both traditional as well as new and streaming data sources such as IoT and connected devices. Any type of data can be ingested and loaded into Cloudera without altering its format or fidelity, while preserving data integrity and enabling security and governance.

Cloudera DataFlow provides a scalable, real-time streaming analytics engine that ingests, curates, and analyzes data for key insights and immediate actionable intelligence. It can ingest and process real-time data from streaming data sources (such as clickstreams, log streams, social feeds, IoT sensors, smart devices etc.) and also from traditional enterprise data sources such as databases, data warehouses, CRM, billing, rating, network, inventory and other BSS and OSS systems. It addresses the key challenges enterprises face with data-in-motion including:

- Ingesting and enriching real-time data streaming at high volume and high scale
- Driving stream processing and predictive analytics on high-speed data-in-motion
- Tracking data provenance and lineage of streaming data
- Managing and monitoring edge applications and streaming sources

Here is a **primer on Cloudera DataFlow** and key capabilities.

2. Enrich

Preparing data for analysis and insights is the foundation of any data-driven exercise and **Cloudera Data Engineering** helps enrich, transform, and cleanse a wide variety of data and makes it easier than ever to create and execute end-to-end data pipelines.

You can enrich the data, build and manage end-to-end data pipelines, and make it available via Cloudera's Shared Data Experience (SDX) for machine learning or operational and analytic use cases. For operations, this means delivering real-time business information blended with additional data sets that lend context for decision makers. The underlying platform also provides the ability to execute a wide range of data processing workloads in an extremely high-performance manner including batch and real-time stream processing using Apache Spark and Spark Streaming, supported by storage options like Apache HBase, Apache Kudu and cloud object storage.

Learn more about **Critical Success Factors for an Enterprise Data Strategy**.

3. Report

Cloudera offers the flexibility to run multiple analytical options to drive insights, intelligence, and action from all data. Depending on the business needs, organizations can analyze data in a variety of ways including -- interactive SQL, text search, integration with leading BI and visualization tools, or perform advanced analytics and machine learning.

Traditional data warehouses are inadequate to meet the increased scale, economics, and analytics demands that today's Telcos are experiencing. Cloudera Data Warehouse is an auto-scaling, highly concurrent and cost effective analytics service that ingests high scale data anywhere, from structured, unstructured and edge sources. It supports hybrid and multi-cloud infrastructure models by seamlessly moving workloads between on-premises and any cloud for reports, dashboards, ad-hoc and advanced analytics, including AI, with consistent security and governance. **Cloudera Data Warehouse** offers zero query wait times, reduced IT costs and agile delivery.

To learn more, check out our on-demand webinar on **Fundamentals of a Modern Data Warehouse.**

4. Serve

The **Cloudera Operational Database** serves traditional structured data alongside new unstructured data within a unified end-to-end open-source platform. Cloudera Operational DB enables stream processing and real-time analytics on continuously changing data, ensuring the latest data and analysis can be injected into decision making. Users can serve real-time data at scale, with high concurrency and low latency. They can serve up data science at scale in order to easily build, score, and deploy machine learning models into production.

To learn more, please read our whitepaper on **Building Mission-Critical Applications with Cloudera Operational Database.**

5. Predict

CSPs can close the loop on the Data Lifecycle by using **Cloudera Machine Learning** to make predictions that in turn drive key business outcomes. Cloudera Machine Learning can help CSPs accelerate enterprise data science from research to production at scale with self-service, collaborative workflows for building and operationalizing machine learning models and interactive, visual applications. Rapidly onboard new data science teams without interrupting business workloads, giving data science teams on-demand access to governed business data, open tools and autoscaling computing resources for end-to-end ML without waiting. Using Python, R, and Scala directly in the web browser, Cloudera Machine Learning delivers a powerful self-service experience for data science teams to develop and prototype new machine learning capabilities and easily deploy them to production.

Learn more about How to Operationalize Enterprise Machine Learning.

Data Security & Compliance:

All of this needs to be underpinned by best-in-class enterprise grade data security, governance and compliance capabilities. **Cloudera SDX** provides this enterprise wide data security and governance fabric that binds the data lifecycle. SDX enables data and metadata security and governance policies to be set once and automatically enforced across the data lifecycle in hybrid, private or multi-cloud environments, delivering safe and compliant data access across the organization.

To learn more, read this 451 Research report on **Cloudera SDX.**

Drive Insights and Business Outcomes

Thus Cloudera helps deliver insights and business outcomes by enabling the end-to-end lifecycle from data ingest to insight, thereby powering a wide variety of use cases. Organizations can deploy some of the data-driven use cases directly using the platform or run your in-house or best-of-breed applications on top of Cloudera by utilizing all of the data in the platform to enable compelling analytics and use cases that your business demands.

To learn more watch our on-demand webinar on **Data-Driven Transformation for Telcos - Key Use Cases & Examples.**

The Cloudera Data Platform

Cloudera Data Platform (CDP) is the industry's first enterprise data cloud, offering a full range of analytic capabilities from the Edge to AI. CDP delivers powerful self-service analytics across hybrid and multi-cloud environments, along with sophisticated and granular security and governance policies that IT and data leaders demand. And it's built 100% on open source.

Cloudera SDX provides enterprise-grade security and governance on all data including metadata, with dedicated, integrated interfaces to manage it. Data security, governance, and control policies can be set once and consistently enforced everywhere, reducing operational costs and business risks while also enabling complete infrastructure choice and flexibility.

CDP also includes a unified control plane to manage infrastructure, data, and analytic workloads across hybrid and multi-cloud environments. The platform can also connect and power all your in-house or best-of-breed applications to enable some of the most compelling use cases.

Cloudera Data Platform makes it easy to say yes to any analytic workload from the Edge to AI all with enterprise-grade security and governance. Yes to the analytics your people want to use. Yes to operating on any cloud your business requires. Yes to the future with a cloud-native platform that flexes to meet your needs today and tomorrow. Say yes to CDP, and say goodbye to shadow IT. CDP is not like anything you've seen before—It is the industry's first enterprise data cloud.

Any Cloud

EDGE 2AI

Multi-Function

CLOUDERA SDX

Secure & Governed

Open

Get an exclusive look at the new <u>Cloudera Data Platform</u> and learn more about how Cloudera is transforming the <u>telecommunications industry</u>.

About Cloudera

At Cloudera, we believe that data can make what is impossible today, possible tomorrow. We empower people to transform complex data into clear and actionable insights. Cloudera delivers an enterprise data cloud for any data, anywhere, from the Edge to AI. Powered by the relentless innovation of the open source community, Cloudera advances digital transformation for the world's largest enterprises. Learn more at **Cloudera.com**.