NVIDIA PRIMER

ARTIFICIAL INTELLIGENCE AND DEEP LEARNING IN TELCO

WHAT ARE THE TRENDS DRIVING CHANGE IN TELCO TODAY?

The promise of content available on any screen has become a reality. This is enabled by advances in network technology and speeds, new content providers, and the continued explosion of mobile devices, paired with the proliferation of the Internet of Things (IOT). Nothing illustrates the scope of this like the fact that there are now almost as many cell-phone subscriptions as there are people on earth.

Core connectivity drives most carriers' revenues; providing data and voice services to meet demand in a way that is high quality, reliable, and affordable remains a central focus. The industry constantly worries about two things: ways to rationalize networks and how to offer improved and expanded services.

Consumers still have an appetite for more connection — from the smart home (think: lighting, security, and entertainment) and connected cars, all the way to the smart city (think: access to city services, parking, lighting, and video security). In this, carriers want to be more than just the pipe; they want to capitalize on all forms of data and content, whether that's streaming video over cellular, TV and high-speed internet at home for entertainment and gaming, or access to the infrastructure of an entire city. Or, in the words of one data scientist leading the machine learning team at a major company: "We can't just be the pipe, we need to develop compelling services to push to our customers."

Given that their customer relationships now go way beyond mobile voice and data, carriers are focused on the battle to constantly upsell their cellular customers to the "triple play" for voice, high-speed data, and TV. We see this every day with TV commercials promoting TV, voice, and internet at home next to better cellular network coverage and lower bills. They are also getting involved with all kinds of private businesses and public utilities that can offer potential new services. Their overarching goal is to provide a highly personalized customer experience with maximum "stickiness," high customer retention, and low churn (loss to competitors).

On the business side, carriers are searching for high-value differentiating services like content delivery or VPN networks. Traditional companies are very aware they're competing with competitors such as Google or Amazon and are looking to build an infrastructure that is agile enough to bring up new services in minutes or hours, versus weeks or months.

TELEVISION

PHONE

TV

VOICE

HIGH-SPEED INTERNET

WHAT ARE THE IMPLICATIONS?

Because consumer data usage has been increasing dramatically, the investment in customer service, 5G cellular networks, IoT, autonomous vehicles, smart cities, and international expansion now runs into billions of dollars.

Carriers recognize that they should be able to leverage these investments to provide next-generation services but are struggling to identify how.

Operations is one area that is always ripe for improvement. Many still rely heavily on manual processes, but we are at a tipping point of a digital transformation with the greatest potential in customer care, sales, and billing. Carriers are also moving away from proprietary, hardware-based network equipment to server and network virtualization functions, and open software-based technologies. This allows them to manage their networks more efficiently and effectively via automation while being more responsive to consumer demands.

WE ARE AT A TIPPING POINT OF A DIGITAL TRANSFORMATION WITH THE GREATEST POTENTIAL IN CUSTOMER CARE, SALES, AND BILLING.
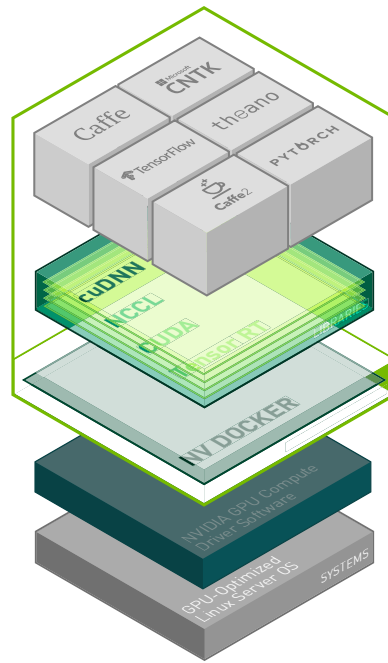
In large Telcos, it's generally the data analytics, innovation, and research groups that work on proof of concept for new artificial intelligence (AI) and deep learning (DL) services. These projects are being triggered by specific applications that need to be accelerated, or by using a particular research framework in deep learning. Technology and IT personnel are then generally pulled in to validate the solution.
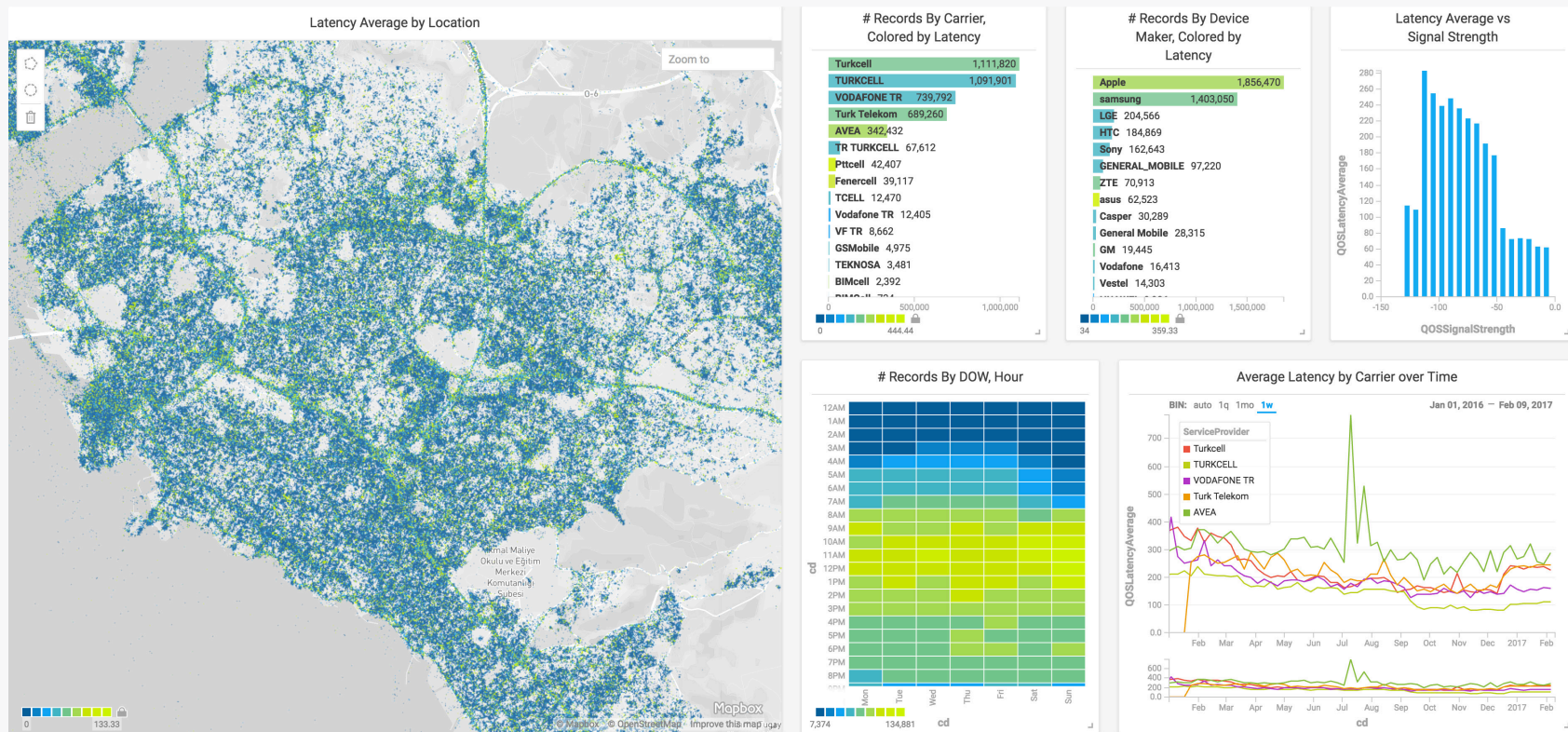
HOW ARE ANALYTICS STRATEGIES IN TELCOS BEING ACCELERATED BY GPU COMPUTING?

Telcos already have tons of CPUs and servers in data centers. Much of their interest in GPU computing is initially driven by learning what can provide acceleration for applications and seeing existing use cases. GPUs are already heavily impacting billing, customer support, subscription management, and over-the-air software updates with real projects going on in all major carriers.

Take, for example, customer service and billing. Think about what often happens when you call your provider and ask them a question about your account. Do you often hear: "Gosh, the computer is slow. I'm waiting on that information?" This is often because the query simply takes so long. GPUs are making an impact where analytics and customer service need to be accelerated. In some cases, GPUs are making the speeds of queries a hundred times faster.

EVERY TELCO HAS MILLIONS OF PHONES WITH THOUSANDS OF SOFTWARE VERSIONS TO TRACK AND UPDATE.

Latency Average by Location

Records By Carrier, Colored by Latency

Turkcell	1,111,820
TURKCELL	1,091,901
VODAFONE TR	739,792
Turk Telekom	689,260
AVEA	342,432
TR TURKCELL	67,612
Pttcell	42,407
Fenercell	39,117
TCELL	12,470
Vodafone TR	12,405
VF TR	8,662
GSMobile	4,975
TEKNOSA	3,481
BIMcell	2,392

0 — 444.44

Records By Device Maker, Colored by Latency

Apple	1,856,470
samsung	1,403,050
LGE	204,566
HTC	184,869
Sony	162,643
GENERAL_MOBILE	97,220
ZTE	70,913
asus	62,523
Casper	30,289
General Mobile	28,315
GM	19,445
Vodafone	16,413
Vestel	14,303

34 — 359.33

Latency Average vs Signal Strength

Records By DOW, Hour

7,374 — 134,881

Average Latency by Carrier over Time

BIN: auto 1q 1mo 1w   Jan 01, 2016 — Feb 09, 2017

ServiceProvider
- Turkcell
- TURKCELL
- VODAFONE TR
- Turk Telekom
- AVEA

Because of over-the-air (OTA) updates, every Telco has millions of phones with thousands of software versions to track. Traditionally it takes them a long time to analyze OTA updates and to track their installed base in general. With GPU technologies they're now able to accelerate those queries dramatically. One real use example today is a major carrier who uses data from 85 million Subscriber Identity Modules (SIM) in phones to track location and software versions to update necessary security patches. Before MapD, Verizon Wireless ran their OTA campaign queries using an Oracle database. Query response times with one competitor could run anywhere from an hour to two hours, depending on the nature of the query. Certain 90-day trend queries would run even longer.

The company recently began to use MapD for analysis of this dataset. As opposed to the Oracle database's hour plus response times, MapD consistently delivers results in less than a second. Along with lightning fast SQL queries, Verizon's analysts are using MapD's Immerse visualization interface to animate and visualize the data. This allows them to spot trends and anomalies instantly, solving issues that were costing $10M per year in configuration and sizing costs.

WHAT IS THE OPPORTUNITY FOR ARTIFICIAL INTELLIGENCE AND DEEP LEARNING?

Network management and expert systems are one of the first applications in Telco for artificial intelligence and machine learning. AI has become a wide application in improving the efficiency of the infrastructure, and some of the world's first practical expert systems based on AI were employed to improve operations and maintenance of Telco networks and services.

Software-defined networks lend themselves to automation, with millions of users, thousands of elements, and a huge variety of technical and business parameters. With IOT, the size of these networks will only grow exponentially in scale and complexity. With this growth, there is a corresponding opportunity for the application of AI. In the future, the industry will look at building self-optimizing networks based on current live or modeled network conditions.

In order to personalize the experience for both customers and advertisers, Telcos use GPUs for deep learning in use cases like image detection, natural language processing, and video analytics.

For example, Telcos can set up an alert that tells the consumer when their favorite team is going to be on TV or on a mobile app. Then set up an alert, say, that can tell the consumer when their favorite team is going to be on the TV, or on a mobile app. It can also be used to track which brands are being engaged and which aren't; who changed the channel at the five-minute mark and why? This type of data can be sold back to advertisers. Was it a particular ad that caused thousands of people to change the channel? Was there something that happened like gore or bad language? What channel or page did they go to next? If carriers can prove to an advertiser when and where the end user clicked through to, that's vital selling information.

MOVIE

TV REMOTE

THEATER

PEOPLE
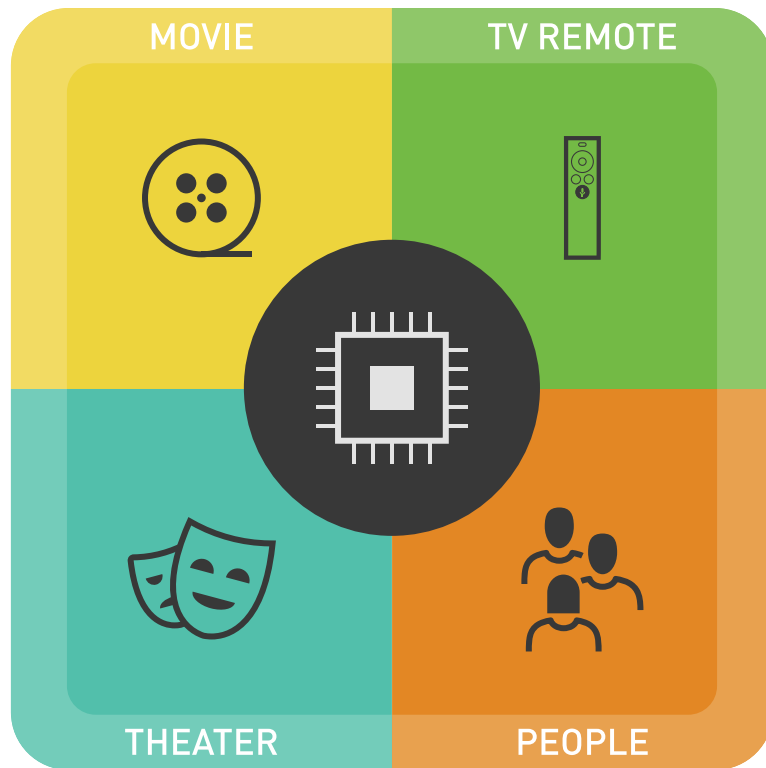
In 2017 over 300 million smartphones will have embedded deep learning.

GPUs are also involved in natural language processing as consumers interact with devices like the TV remote control to find a movie, a particular actor, actress, or genre. In 2017 over 300 million smartphones—a fifth of units sold—will have embedded deep learning, allowing smartphones to perform highly sophisticated functions like indoor navigation, augmented and virtual reality, speech recognition, and enhancements to digital assistants like Siri, Cortana, Google Home, and Alexa. **LEARN MORE**

Another area that may benefit from deep learning is biometric and facial recognition. In 2017 the active base of smartphones equipped with biometric readers will top 1 billion. There are numerous potential use cases for this technology in retail, financial institutions, government, and even schools.

Autonomous vehicles have quickly emerged as a viable consumer product, making it important for carriers to find industry. This is key since connectivity will be central to the many activities and services surrounding this emerging sector.

FACT: THE ACTIVE BASE OF SMARTPHONES EQUIPPED WITH BIOMETRIC READERS WILL TOP 1 BILLION IN 2017.

LEARN MORE

WHAT ARE THE TOP CURRENT USE CASES AND STARTUPS?

graphistry

Graphistry is a software partner that can do a better visualization representation of data. Graphistry is being used from a security standpoint to provide heat maps of lines and towers that might be overloaded.


kinetica

Kinetica is being used for data management queries in Telco. Kinetica's distributed, in-memory database simultaneously ingests, explores, and visualizes streaming data for real-time actionable intelligence.
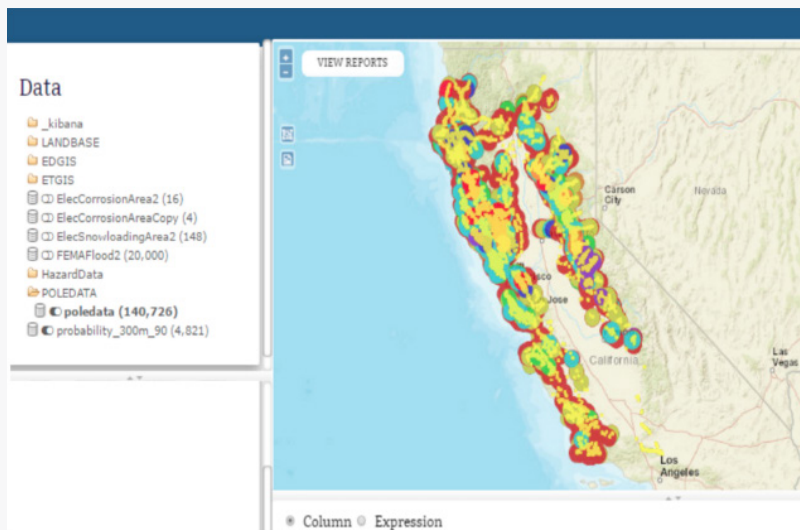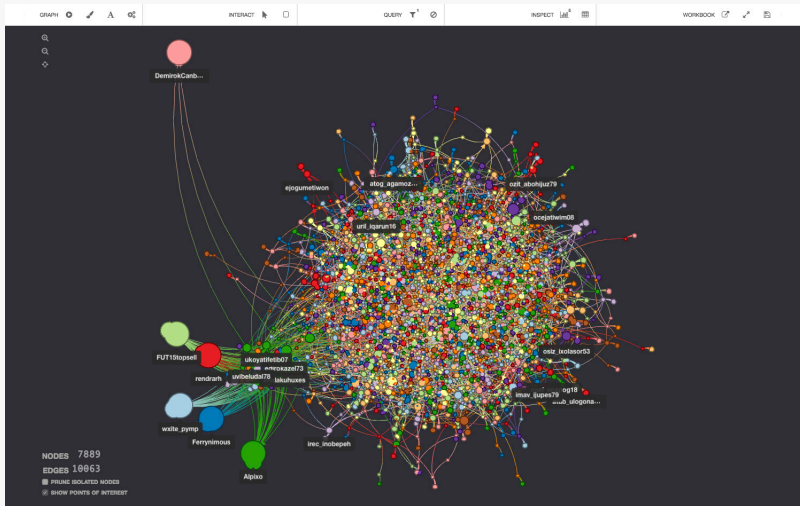
MAPD

MapD provides a next generation database and visual analytics layer that harnesses the power of GPUs to explore multi-billion row datasets in milliseconds. In Telco they are being used to correlate call records with server performance data to spot problems in real-time, plus build ad targeting profiles. And in ad tech — for assessing inventory availability by matching millions of audience members against active ad units.

SQREAM
TECHNOLOGIES
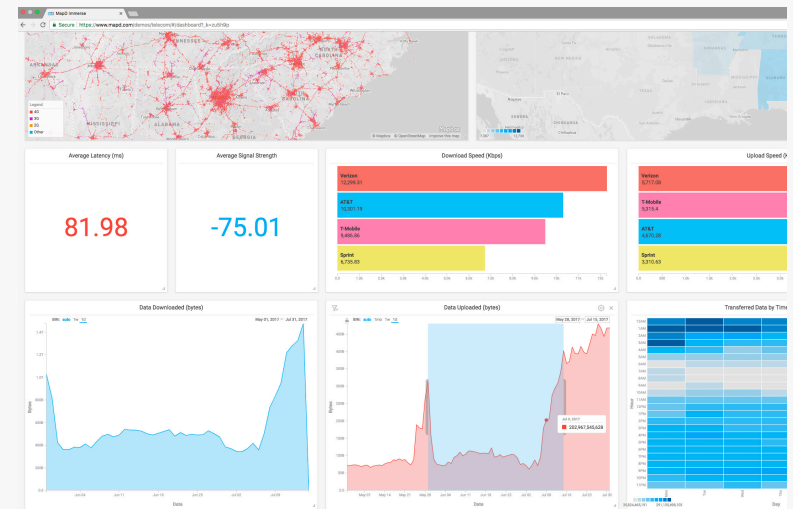
SQream DB is a GPU database solution for big data. SQream DB can be used as an analytical database or as an accelerator to an existing data warehouse. In telecoms, SQream DB is used to correlate between CDRs and geolocation data, for network behavior analysis, network performance monitoring, and identifying complex customer trends and mobility.
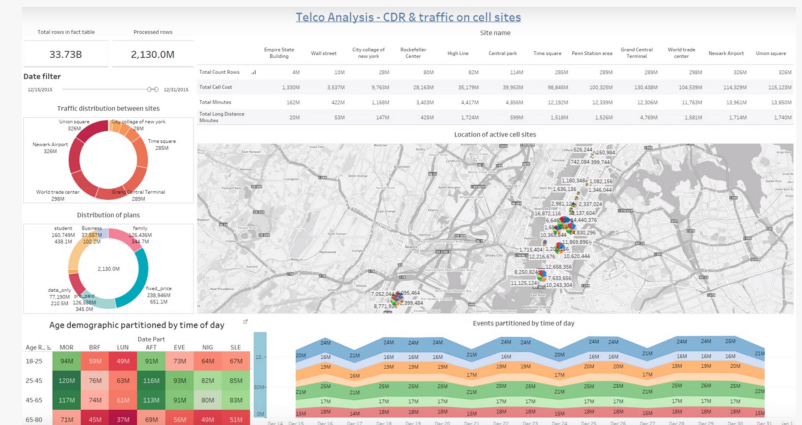
WHAT CUSTOMERS/ COMPANIES ARE DOING INTERESTING THINGS?

Comcast has talked publicly about its natural language processing as the technology behind the X1 voice remote deploying AI solution to millions of customers.

Verizon has applied MapD to the challenge of polling all the smartphones in its network to assess a variety of metrics. This query would take hours to run and hours to evaluate, and as such, the company only did it periodically. Verizon Ventures has Invested in MapD.

KEY NEED-TO-KNOW STATS. WHAT OUTSIDE RESEARCH OR DATA CAN WE REFERENCE TO BACK THIS UP?

DELOITTE: GLOBAL MOBILE CONSUMER SURVEY (GMCS):

> US consumers are looking at their devices more than 9 billion times a day in the aggregate–up 13 percent from last year.

> Smartphone sales are still strong, with penetration up 10 percent year over year, and the highest growth percentages are coming in the 45-54 and 55+ age demographics–groups that have previously lagged younger consumers.

> While they are still relatively niche products, wearables like smartwatches and fitness bands have seen tremendous percentage growth. Smartwatch penetration doubled from 2014 to 2015 and tripled in 2016; smartwatches have now penetrated roughly 12 percent of the mobile consumer market in the US.

LEARN MORE

deeplearning.com

NVIDIA.