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ANALYZING IOT DEVICE PERFORMANCE

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A small number of poorly configured connected devices can cause a signaling storm, degrading an IoT network's performance and, in the worst case, resulting in a network blackout. Telenor Connexion has combined real-time traffic monitoring with data analytics for IoT devices and networks to reduce the risk of signaling congestion and improve operational performance

Source: Telenor Connexion

Across the globe, a multitude of different IoT devices are being deployed and connected by mobile networks. Signaling storms triggered by aggressive connected devices negatively affect IoT network congestion and performance. To avoid this, control plane data from devices, as well as the networks they connect to, needs to be monitored, analyzed and managed in real-time. Improving reliability is also a pre-requisite to enable collection, processing and analytics of user plane data generated by connected devices.

Advanced Real-time troubleshooting Tool Set (ARTS)

ARTS is a cloud-based network connectivity analytics tool designed specifically for connected IoT devices. It can be accessed via a web interface by an enterprise customer support or operations team, providing real-time insights into the performance of IoT devices and networks based on big data analytics techniques and domain-centric data models. It also offers predictive analysis, identifying potential problems, based on patterns of network behavior to allow for faster and more efficient decision making.

As few as 500 aggressive devices can create a network signaling storm, which can cause congestion

This article was made in cooperation with Telenor Connexion.

With more than 15 years of experience in machine-type communications, the company has been a pioneer in the IoT space. Telenor Connexion is wholly owned by the Telenor Group, one of the world's major mobile operators.

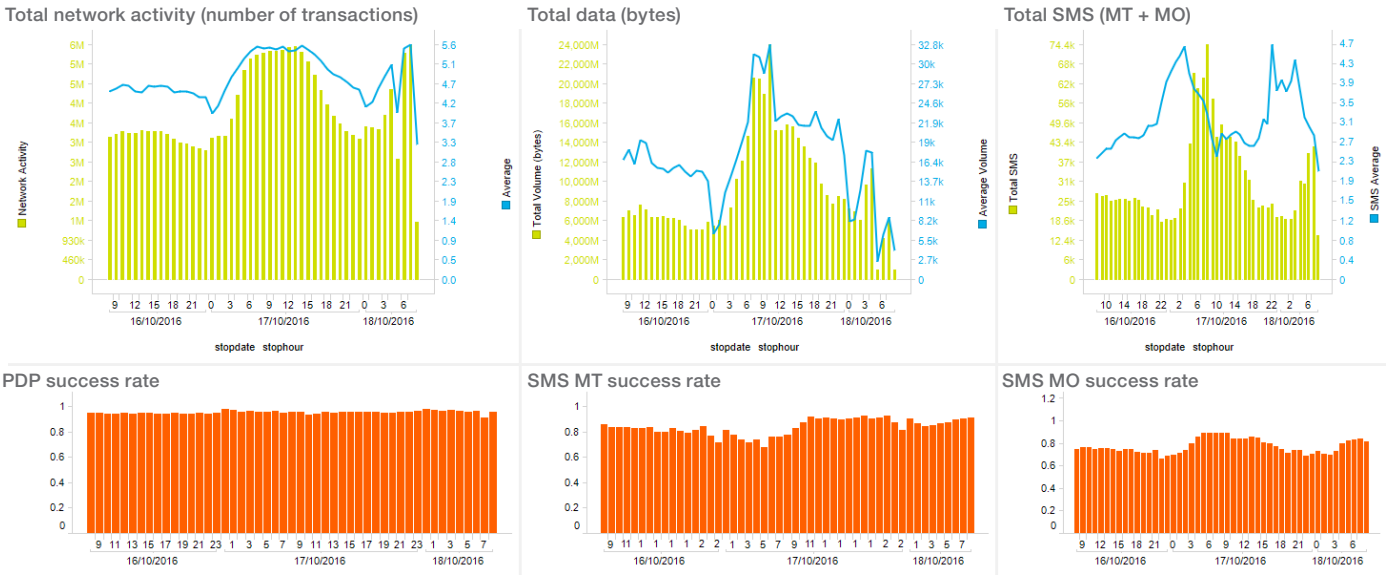
A small number of devices can create significant network problems

The Telenor Connexion-managed base of connected devices (SIM based) has increased at a compound annual growth rate (CAGR) of more than 50 percent over the last 7 years. Presently, the total installed base is around 6 million connected devices, with the majority of traffic transmitted over GPRS and SMS.

In 2014, Telenor Connexion experienced occasions of network degradation caused by a limited number of connected devices. This prompted the company to investigate how their customers' devices were behaving in the mobile networks. It was found that as few as 500 aggressive devices can create a network signaling storm, which can cause congestion. In fact, some customer devices generated more than 100 network events per hour – 5 times the acceptable limit of around 20 network events per hour. Such aggressive signaling behavior can quickly develop into a situation where one congested network starts affecting other networks.

To address this issue, IoT operators need to work closely with roaming operators to shut down or redirect control plane messages for all IoT roaming devices. This impacts all IoT customers, as the whole roaming network range is blocked. Once a network is fully congested, it can take up to two hours to completely re-route roaming IoT devices, and then another two hours for network operations to normalize. For roaming operators, this can negatively affect consumer traffic and customer experience, resulting in negative brand impact.

A selection of monitored IoT traffic activity and network KPIs in a customer IoT network (October 16-18, 2016)



Source: Telenor Connexion (October 2016)

Using big data analytics to avoid network congestion

By collecting and analyzing every network event that an IoT device generates, it is possible to identify aggressive device behavior. Taking the appropriate action to avoid signaling storms then ensures network performance meets service level agreements.

One example of aggressive behavior is when a device attempts to attach to a network and doesn't succeed, and then immediately tries again a number of times in rapid succession. This generates a stream of signaling data that, collectively with similar devices also generating more signaling than usual, overloads the signaling network. Identifying this behavior, and then re-configuring the devices to double the time between each successive attempt to attach to the network, gives network operators time to recognize the situation and address the root cause, thus avoiding network congestion.

Additionally, traffic from connected devices can be migrated into different networks in order to avoid overloading a specific network. For example, some customers have devices in multiple networks in multiple countries; in these circumstances, the SIM in the connected devices can be configured to attach to a specific network in a country based on network performance analysis.

Monitoring IoT network KPIs

The figure shows a selection of network KPIs for the period October 16-18, 2016: the green histograms represent traffic activity, and the red histograms identify corresponding success rate KPIs for SMS and PDP (i.e. the ability of the IoT devices to establish a dedicated data bearer). The histogram on the top left demonstrates that, in this specific customer case, average network activity exhibited a range of three to six network transactions per hour per IoT device (base to peak). In the middle graph, the blue line indicates that the average data volume per IoT device had peak values slightly over 30 KB per hour, with a total of 24 GB per hour of data consumed by all IoT devices between 9 a.m. and 12 noon on October 17. During that same time period, SMS activity was averaging around 3 SMS per hour per IoT device, with total SMS traffic around 50,000 SMS per hour.

As such, the histograms provide an overview of IoT network activity and success rates, making it easy to spot any deviating changes over the 48-hour time span displayed.

Predictive analysis by applying big data analytics

An automatic reporting system monitors the traffic from all customers and generates a bandwidth forecast for the coming six months up to one year. The dimensioning forecast for both signaling traffic in the control plane and payload traffic in the user plane becomes increasingly accurate based on these reports, ensuring that customers avoid network congestion problems.

Applying data analytics to control plane data in networks of connected devices can bring a number of benefits to network operators and enterprises. The threat from IoT devices spamming networks with signaling traffic has been reduced, as a result of insights into which parts of the networks need to be improved. Based on those insights, fair network use policies that detail acceptable device signaling behavior can be implemented. During the past 2 years, the number of potentially aggressive customer devices in IoT networks managed by Telenor Connexion has reduced from 38 percent to 16 percent.[1] This is thanks to a combined knowledge of how the IoT devices perform in the network and implementation of connection efficiency guidelines. In addition, through predictive analytics capabilities, a very high degree of accuracy in bandwidth dimensioning forecast is achieved for both control plane and user plane traffic, enabling improved resource planning.

[1] The remaining 16 percent are distributed over several networks and not posing an immediate threat

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