

# USING ANALYTICS TO OPTIMIZE THE CUSTOMER EXPERIENCE IN THE CONNECTED HOME

STRATEGIC WHITE PAPER

Being able to manage the connected home environment is quickly becoming a major differentiator as cable MSOs increasingly look to elevate the customer experience. With the number of connected devices and services—from smartphones and tablets, to video and security—growing so fast, and with networking technologies become more diverse, managing the connected home has become a complex task. This paper shows how and why operators can use analytics to provide enhanced capabilities in knowledge gathering, data collection and measurement to better manage the connected home. Special attention is given to the Customer Experience Maturity Curve, and to how operators must focus on analytics, particularly as these pertain to home devices and home networks, online video, Internet security, as well as customer care. Reaching the curve's optimization stage is proposed as a key objective for cable MSOs.

A Technical Paper prepared for the Society of Cable Telecommunications Engineers



# TABLE OF CONTENTS

Overview / 1

Introduction / 2

    The connected home environment / 2

    Optimizing the customer experience / 3

Home device and home network analytics / 6

    Predictive analytics / 8

Online video analytics / 9

Internet security analytics / 11

    Leveraging Internet security analytics in customer care / 12

Customer care analytics for continuous improvement / 13

Conclusion / 15

Acronyms and abbreviations / 16

# OVERVIEW

Managing the connected home environment, and indeed optimizing the customer experience in the connected home, can be a critical differentiator for cable MSOs today. But the increasing diversity of home devices and network technologies adds layers of complexity to managing the customer experience.

Residential gateways (RGWs), Smart TVs, smartphones and tablets are just a few of the devices in today's connected home, which are generating enormous amounts of usage and performance data. In addition, services such as Wi-Fi, streaming video, and Internet security are being delivered to a variety of different devices and users in the home. Again, this is generating a lot of information—information that operators can collect, store, analyze, and manage, in order to optimize the customer experience in the connected home.

The key data and analytics that can be used by operators for managing the connected home are related to 1) home device connectivity, usage, and performance, 2) online video quality of experience (QoE) assessment, 3) Internet security and malware protection, and 4) measurement, optimization, and continuous improvement of an operator's customer care processes.

**Home device and home network analytics** allows operators to collect device and home network data, and use the resulting intelligence to proactively discover, diagnose, and resolve issues.

**Online video analytics** combines data from video player plug-ins, CDNs and QoE agents to measure subscriber QoE, and assess viewing trends, content usage, and CDN performance.

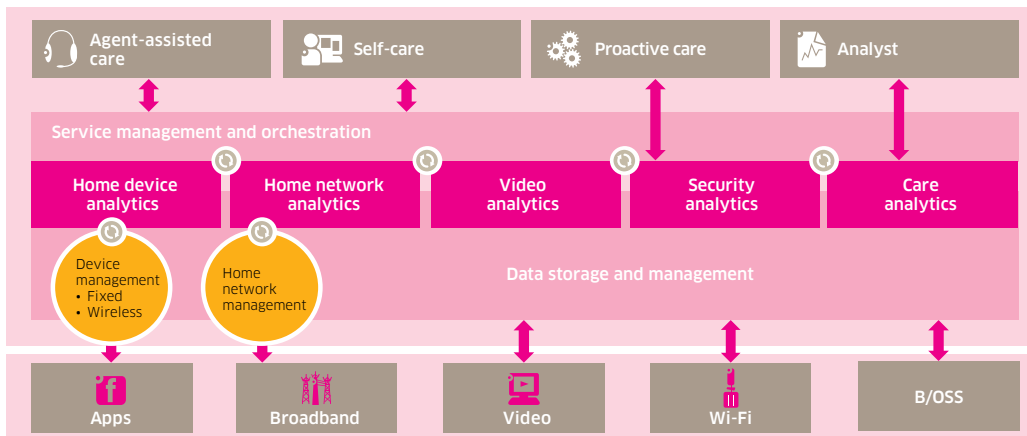
**Security analytics** helps to establish and maintain a safe home network environment by providing network-based analysis of Internet traffic for malware and protecting the network and subscribers.

**Care analytics** leverages the wealth of intelligence embedded within customer care sessions and their associated workflow steps to create more efficient customer care processes.

Through the use of analytics, operators can:

- Quickly identify anomalies, implement improvement programs, and understand customer behavior.
- Create and maintain a culture of customer experience (CX) excellence that is aligned with CX business goals and metrics around Net Promoter Score (NPS), customer satisfaction, churn reduction, brand loyalty, and subscriber ARPU.
- Manage the subscriber experience proactively and predictively.
- Continuously improve customer care processes and technologies.

Figure 1. Customer experience (CX) analytics



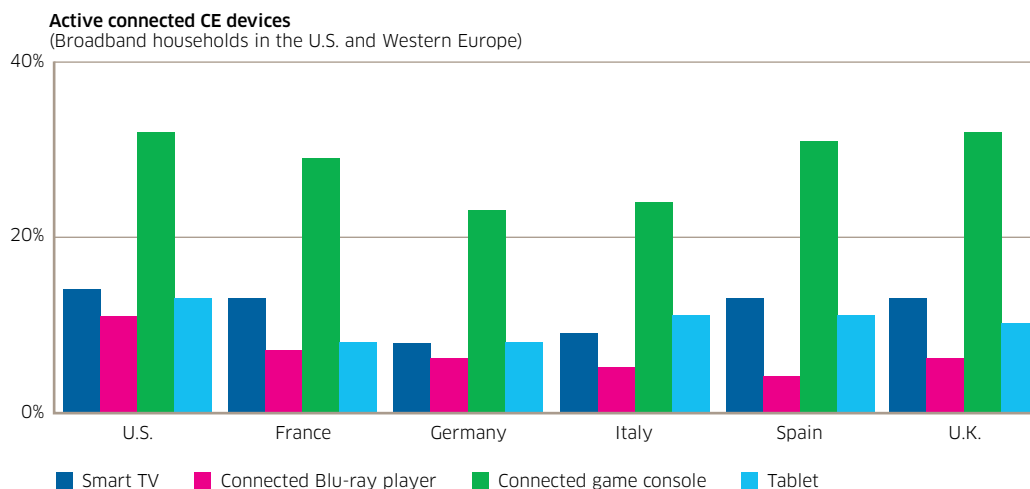
## INTRODUCTION

### The connected home environment

The increasing diversity of home devices and network technologies has added layers of complexity to the connected home environment. Residential gateways (RGWs), Smart TVs, smartphones and tablets are just a few of the devices in today’s connected home. In addition, services such as Wi-Fi, streaming video, and Internet security are being delivered to a variety of different devices and users in the home. The connected home, as well as the behavior of subscribers, is dramatically evolving—such that:<sup>1</sup>

- On a typical Saturday night in the United States, 40% of broadband traffic comes from streaming video.
- For 12- to 34-year-olds, television viewing most likely occurs on laptop, tablet or smartphone.
- 87% of connected device sales by 2017 will be tablets and smartphones.

Figure 2. Connected CE devices in broadband households



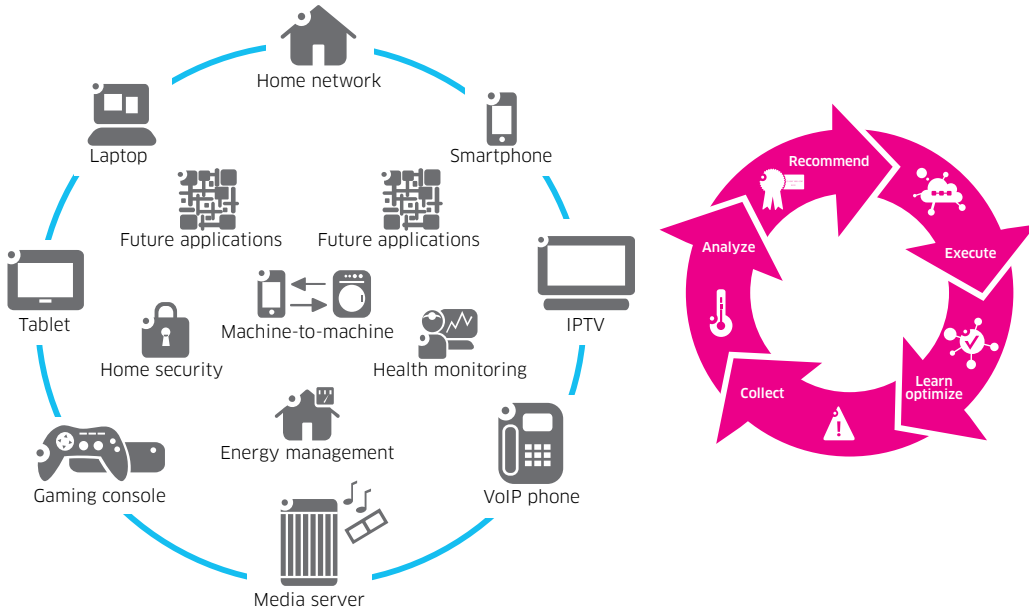
In addition, operators are deploying sophisticated home gateways, and these gateways can deliver IP-based, whole-home services as well as advanced Wi-Fi capabilities, including the ability to be used by service providers as “Community Wi-Fi” hotspots.

<sup>1</sup> Parks Associates, *Online Video and internet TV Services: Global Outlook*, 2012

Smartphones and tablets that are connected to mobile networks are also connecting to Wi-Fi in the home, presenting configuration and support challenges for operators. Online, streaming video—delivered to a variety of devices in the home—requires operators to have greater insight into video quality of experience. New home services are being offered by operators, such as home security, home health monitoring, and energy management. This is driving proactive and self-healing capabilities for providing service assurance for critical home-connected applications.

Operators can look to analytics to address this complex environment, and provide enhanced capabilities in knowledge gathering, data collection, and measurement.

**Figure 3. CX analytics and the evolution of the home network**

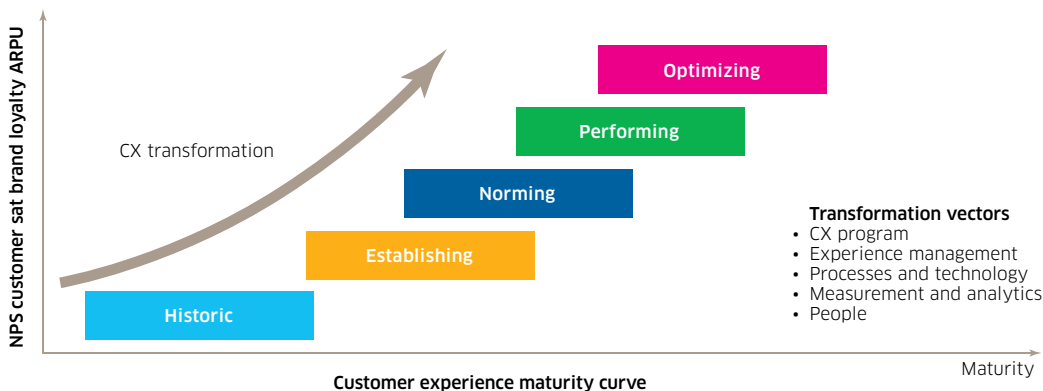


## Optimizing the customer experience

### Customer Experience (CX) Maturity Model

The need for operators to use analytics to optimize the customer experience can be understood even more clearly by looking at the CX Maturity Curve. This maps an operator’s customer experience transformation through five phases, against several transformation vectors, leading to optimizing.

**Figure 4. Customer Experience (CX) Maturity Curve**



The stages of the Maturity Curve can be characterized as:

**Historic:**

- Ad hoc processes
- Siloed and inconsistent customer experience
- Limited KPI measures
- High support costs
- People: Lack of skills, training, and assessment

**Establishing:**

- Processes documented but not well followed
- Limited subscriber context shared across touch points
- KPIs driven mainly as reactive—near real-time
- CX strategy established, but difficult to measure
- People: Evidence of skills/job framework

**Norming:**

- Processes well documented, tracked, and mostly followed
- Purpose-built care based on CX imperatives with limited success
- Basic KPI measures in place, and tracked to meet CX imperatives
- Limited proactive capabilities
- People: Tiering of agents/skills; incentive programs in place

**Performing:**

- Common processes established and shared across touch points
- CX continuous improvement cycle deployed
- CX measures cascade from KBO à KQI à KPIs
- End-to-end service view of the subscriber modeled to provide context for processes
- People: Incentive programs for NPS/CLV

**Optimizing:**

- Processes: End-to-end basis, with tracking and continuous improvements
- Well-maintained CX strategy with incentives across the business (NPS/CSAT)
- Customer channel known, and measured through analytics
- Proactive care: Retention-oriented triggers; loyalty
- People: Reward and incentive programs; gamification

As operators move up this curve, they move from:

- Processes that are ad-hoc, and not well documented or followed to ones that are defined on an end-to-end basis with tracking and continuous improvement
- A customer experience strategy that is siloed across services and inconsistent across customer care touch points to a well-maintained strategy, with incentives across the business related to, for example, customer satisfaction (CSAT) and net promoter score (NPS)
- Limited KPI measures and lack of stakeholder visibility (e.g. network operations, call center, product management, IT) to proactive capabilities and a clear assessment of processes measured through analytics

Many operators are in the norming and performing stages.

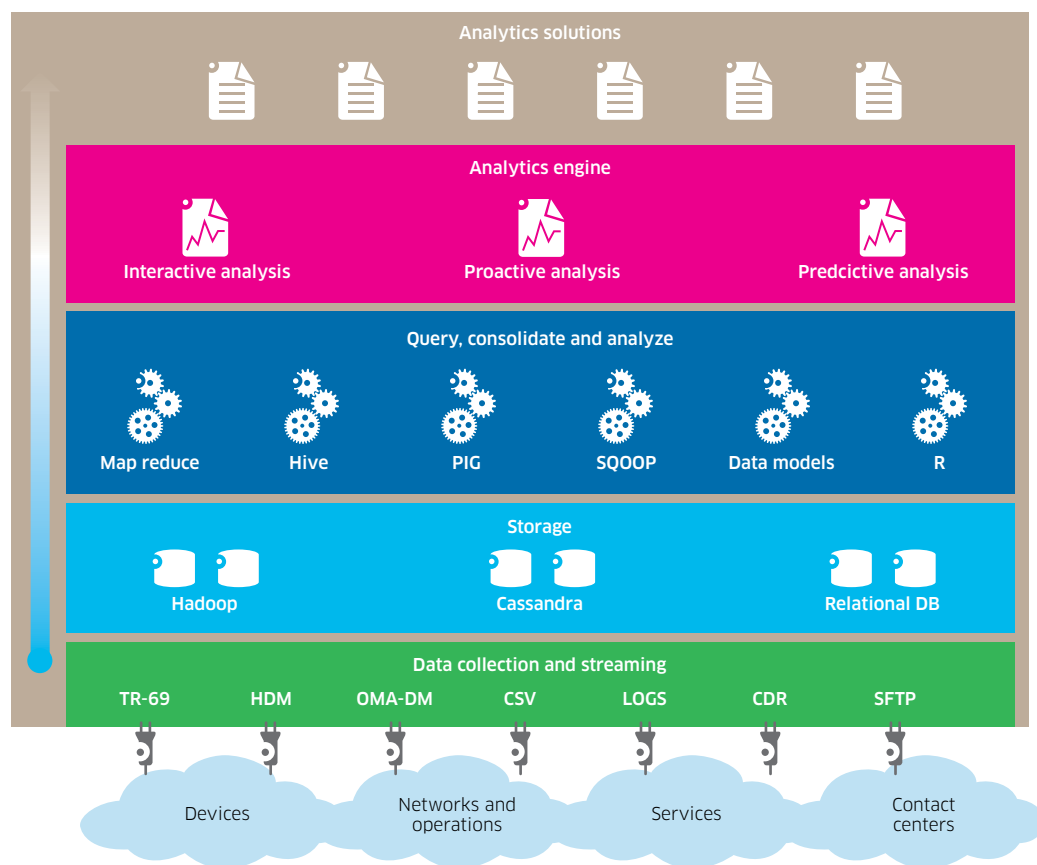
As operators begin to apply analytics to the transformation vectors, and move closer to the optimizing stage, they are able to:

- Quickly identify anomalies, implement improvement programs, and understand customer behavior
- Create and maintain a culture of customer experience (CX) excellence that is aligned with CX business goals and metrics around Net Promoter Score (NPS), customer satisfaction, churn reduction, brand loyalty, and subscriber ARPU
- Manage the subscriber experience proactively and predictively
- Continuously improve customer care processes and technologies

### Using analytics to reach the optimizing stage

Figure 5 represents an analytics framework that can help bring operators to the optimizing stage of the CX Maturity Curve.

Figure 5. Analytics framework



Scalable data collection and real-time streaming analytics allows operators to collect and store any data, as often as they need. TR-069 and streaming video QoE clients can be used to collect data from devices, and data is collected about network operations, services, and call centers interactions using, for example, CSV files, logs, CDRs, and SFTP.

Massive parallel processing and storage uses HADOOP for big data storage and batch processing, CASSANDRA for real-time data analytics (for example, for real-time customer support), and relational database for data storage for reports and dashboard tools.

Data retrieval and processing that is built on top of HADOOP, and is used for data querying and analysis—using data processing frameworks and tools, such as HIVE, MapReduce, and SGOOP.

Analytics engine and business intelligence consolidates, correlates, and analyzes data for automated actions or human interpretation. This includes filtering and normalization of raw data, and mapping of the data to particular KPIs and use case templates.

Domain-specific analytics solutions allow operators to organize the resulting analytics events and alerts into particular business needs, such as home device analytics, online video analytics, or security analytics.

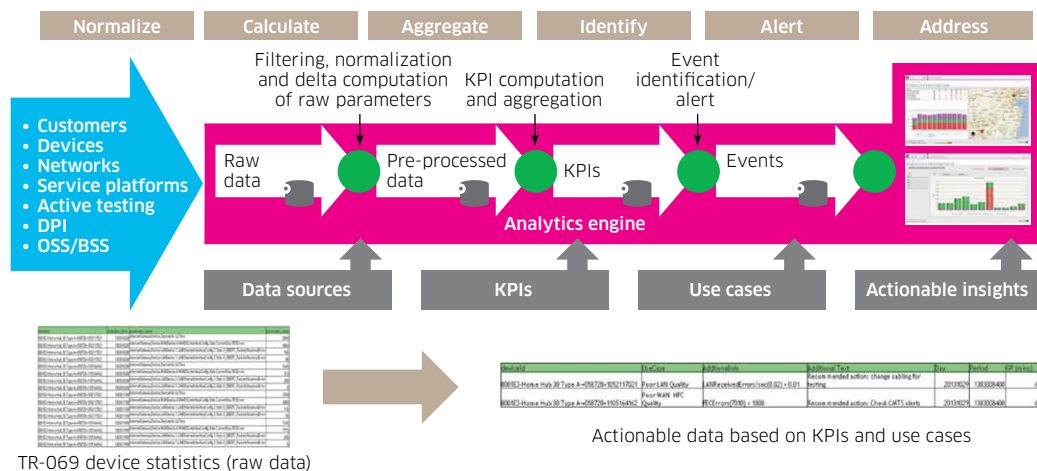
## HOME DEVICE AND HOME NETWORK ANALYTICS

Home device and home network analytics leverage TR-069, and associated device and data models (such as TR-181), to help operators deliver actionable insights using key performance indicators (KPIs) and use cases for devices, the home network, services, and broadband access. The key use case categories that operators typically want to address are:

- Activation and provisioning: Is the service ready for use? Are there any critical deployment issues?
- Availability: Can I use the service when I want to?
- Stability: Does the service stay up?
- Service quality: How good is the service when I use it?

As depicted in Figure 6, raw data is collected, and then filtered and normalized against device templates, which define the data to be analyzed and how to preprocess it. The data is then mapped against KPIs and use case templates, generating events which can be visualized in business intelligence tools, or can generate alerts to trigger the actions of other systems.

Figure 6. Home device analytics: From raw data to actionable insights





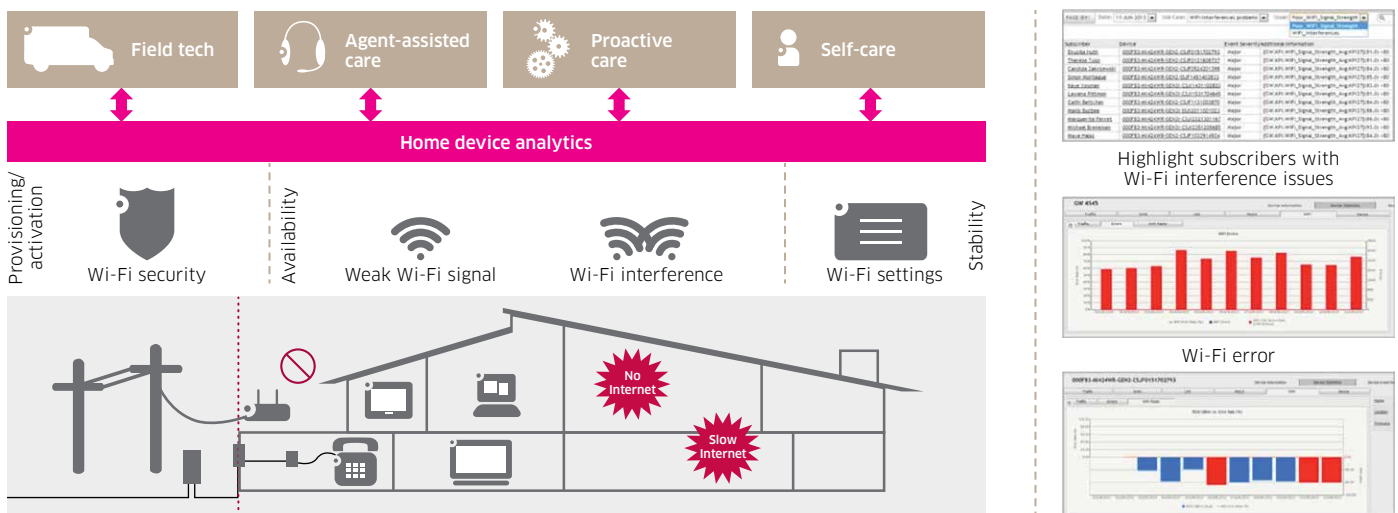
KPIs for home devices, services, and the home network can include things, such as:

- **Home gateway:** uptime, reboots, firmware updates, CPU/memory, configuration, port mappings
- **Video service:** via TR-13 > minutes of use, traffic, packet loss, video quality
- **Wi-Fi:** via TR-18 > uptime, traffic, connected devices, signal strength, retransmissions

Wi-Fi use cases are of particular interest to operators today. Security, signal quality, interference issues, and wireless settings and configuration are some of the most common use cases. Using the TR-181 device data model, Wi-Fi gateway statistics can be collected and analyzed—and events and alerts can be sent to a CSR dashboard, a self-care application, a field-tech application, and other management systems and business intelligence tools.

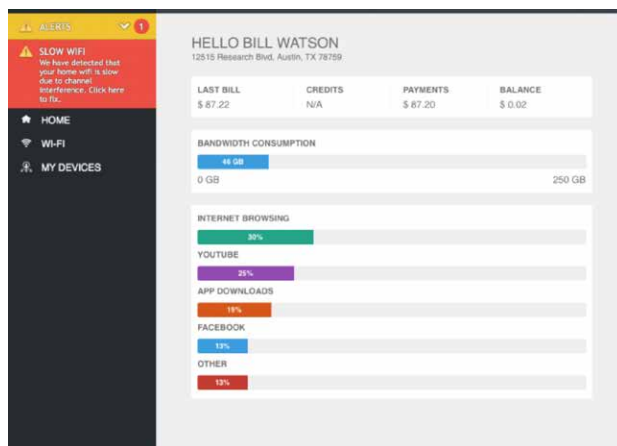
Figure 7 depicts Wi-Fi troubleshooting use cases using home device analytics.

**Figure 7. Home Wi-Fi use cases for home device analytics**



In the case of a self-care application, after home device analytics has detected a performance issue, subscribers can be alerted to the problem (shown in Figure 8), and then guided through the remote reconfiguration of the Wi-Fi gateway, with TR-069 driving the management actions behind the self-care app.

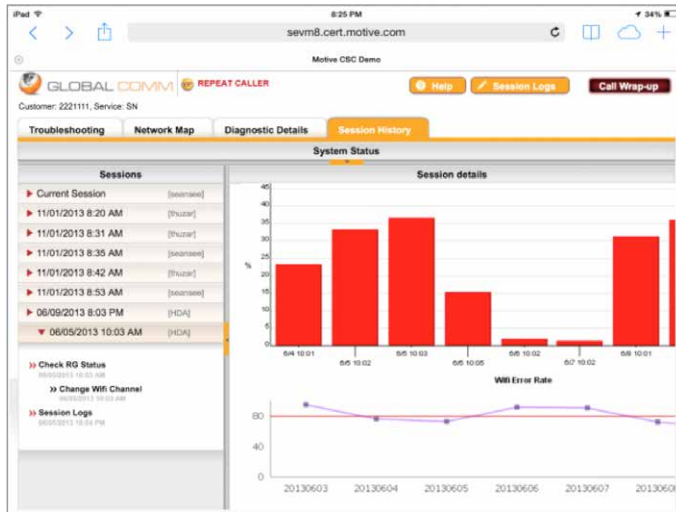
**Figure 8. Wi-Fi analytics triggering alerts in a self-care application**



Similarly, Wi-Fi performance data can be provided to help desk CSRs in order to better understand what is going on in the home network. Figure 9 shows how Wi-Fi analytics can provide historical data in a CSR dashboard.

In addition, Wi-Fi analytics can be used in troubleshooting a “community” Wi-Fi service where the gateway in the home supports two SSIDs, one of which is used by the operator to offer Wi-Fi service to other subscribers when they’re away from home. In this case, Wi-Fi performance and usage data is collected, and correlated to what is happening on both the public and private SSIDs.

Figure 9. Wi-Fi analytics providing historical performance data in a CSR dashboard

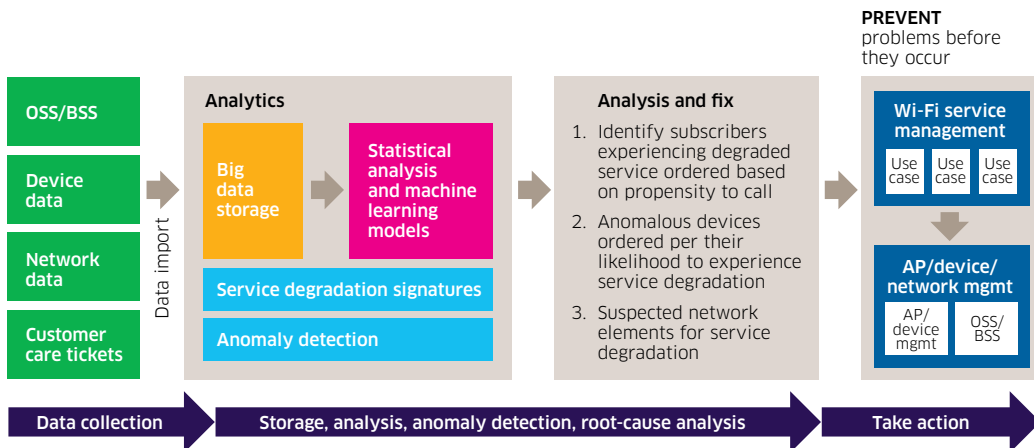


### Predictive analytics

Ultimately, operators can extend the use of home device and home network analytics (and indeed other analytics) to a predictive mode, where issues are detected, analyzed, and fixed before they ever result in a subscriber-affecting issue.

In this case, device data and trouble ticket data is collected and analyzed, correlations between trouble tickets and device performance metrics are uncovered, and models and classifiers can be built to predict customer trouble tickets using TR-069 data.

Figure 10. Predictive home device and home network analytics



# ONLINE VIDEO ANALYTICS

As mentioned previously, online video streaming is becoming an increasingly popular service in the home, delivered to a variety of different devices. As a result, it is important for operators to use online video analytics to measure subscriber video QoE and provide effective support for streaming video services.

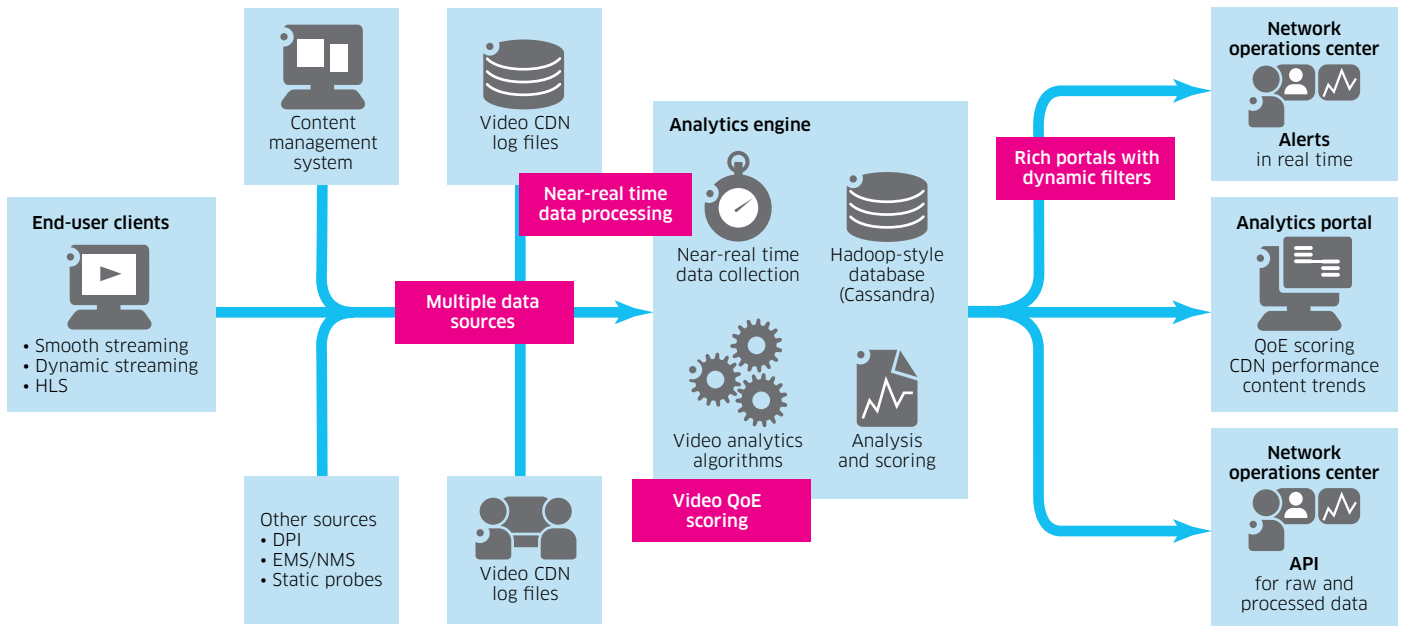
Online video analytics acquires data from a variety of different data sources, including streaming video player plug-ins, network QoE agents, and video CDN data.

A **video player plug-in** is software that is added to the subscriber’s video player(s), and continuously and passively measures the subscriber viewing experience, reporting events that are used for QoE scoring and dashboard creation. The software can be added to the video player(s) in PCs, smartphones, tablets, and other Internet-connected devices

**Network QoE agents** are software clients that are installed on standard hardware, and deployed in the operator’s network. These QoE agents behave like virtual end-users, and they actively measure content availability and quality.

**Video CDN log files** provide data about CDN performance, content usage, and trends that can be cross-correlated with other QoE data.

Figure 11. Online video analytics framework



As shown in Figure 11, the video QoE data can be collected and processed in real-time for alerts, and in near real-time for analytics. Scoring of the data allows operators to answer questions, such as:

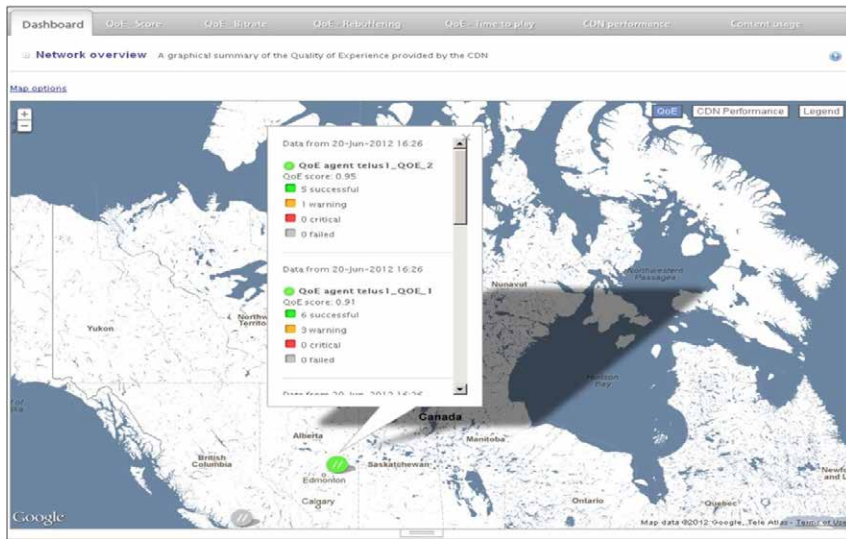
- How is my video CDN performing?
- What is the time between the click and the flick?
- How often are videos interrupted?
- What is the impact of adaptive streaming?
- Is the delivered video encoding rate sufficient?

The QoE scoring considers key variables that provide operators with insight into the major causes of poor end-user QoE, such as:

- Time to play
- Bit rate
- Bit rate variation
- Level changes
- Rebuffering rate and rebuffering ratio
- Content delivery nodes data.

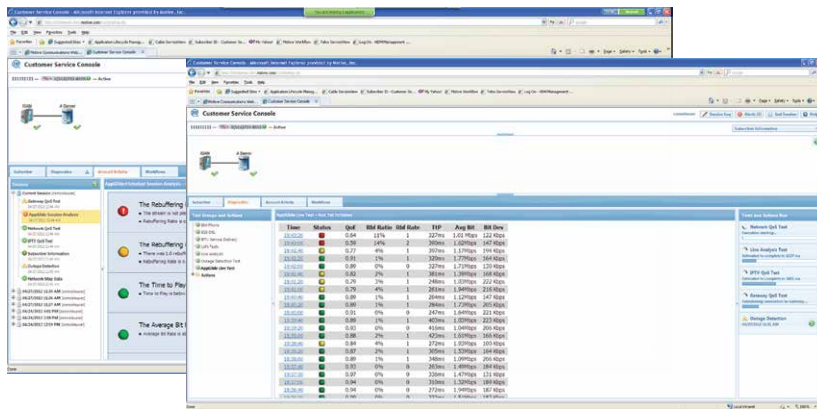
The aggregated QoE score may be used to send alerts, or can be presented in a portal dashboard for Network Operations (see Figure 12), or sent to other B/OSS systems.

**Figure 12. QoE score dashboard on the video CDN**



Critically important is the case where the subscriber-specific video QoE data can be provided to a customer care agent as part of the support session. The care agent can be provided with near real-time QoE data, as well as historic QoE scores and diagnostics.

**Figure 13. Video QoE data provided in CSR dashboard**



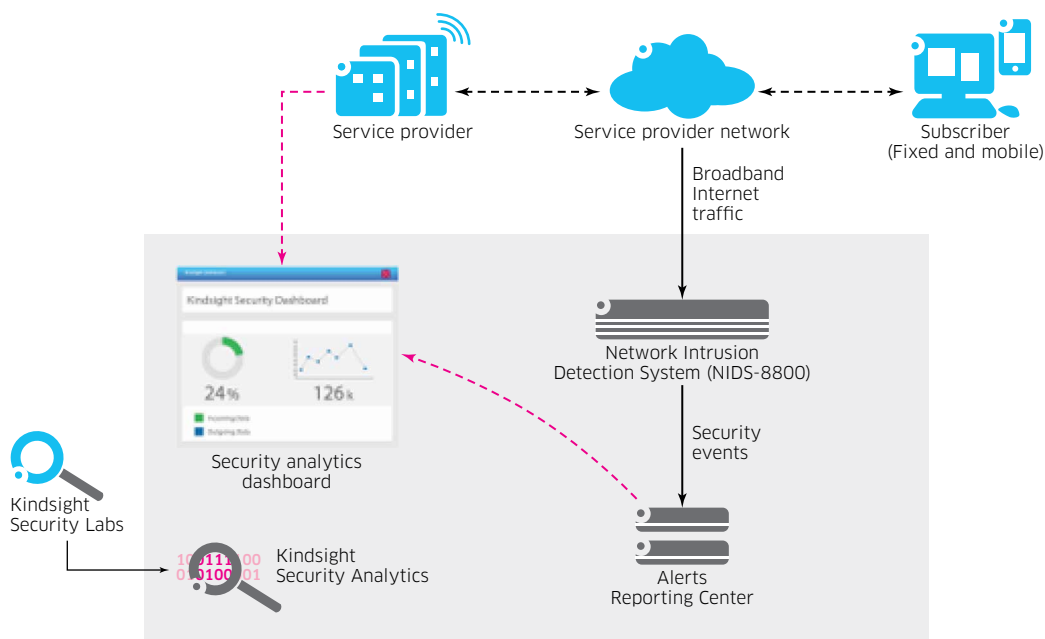
With this information, customer care agents can much more quickly resolve issues and with fewer escalations.

# INTERNET SECURITY ANALYTICS

Because of the variety of different devices that are being connected in the home, and the fact that many of these devices are wireless devices (often with different OSs) that connect to multiple Wi-Fi networks as well as mobile networks, Internet security analytics is becoming an important part of managing the connected home customer experience.

Operators can deploy Internet security analytics as a network-based service that is a supplement to client-based, anti-virus software. This service is built upon a Network-based Intrusion Detection System (NIDS) that is deployed in the operator network. It analyzes the Internet traffic from subscribers' home networks for the presence of malware, communicates events to an alerts reporting cluster (ARC), which provides data aggregation, storage, and analysis, and reports to a security analytics dashboard (see Figure 14).

Figure 14. Internet security analytics



Security statistics can be aggregated and operators can use the analytics dashboard to drill down to specific subscribers, pinpoint infections and discover why a particular subscriber's device is behaving abnormally.

The dashboard provides easy access to a broad range of security statistics and analysis, including:

- Number of infected devices
- Malware types observed
- Historical trends, frequency and recentness of specific malware
- Malware behavior summaries
- Periodic infection reports and outbreak incident bulletins
- Network impact analysis

Figure 15. Security analytics dashboard



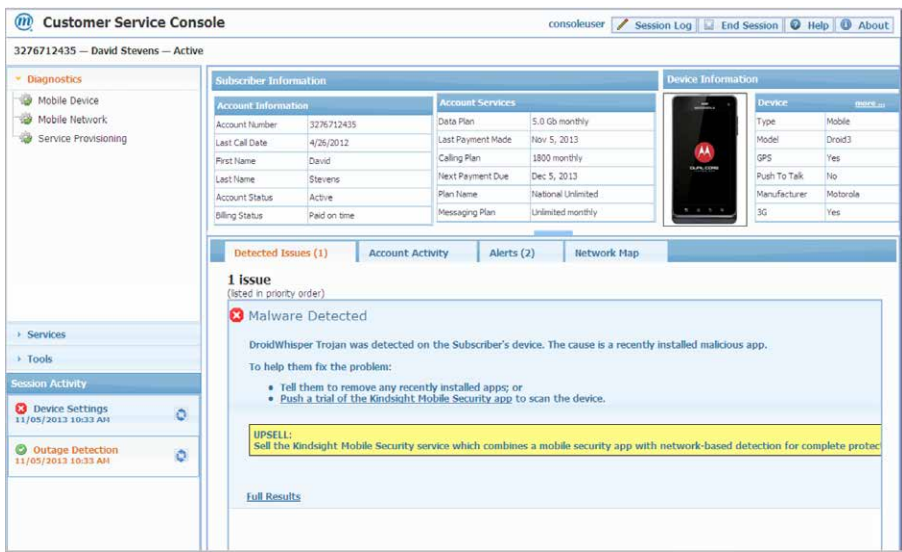
### Leveraging Internet security analytics in customer care

When the operator call center can take advantage of security analytics, it allows CSRs to take some of the burden off network operations, and participate in the first troubleshooting steps, and it results in less trouble tickets due to sub-par device performance due to infections.

Internet security analytics can be used by customer service agents when the call center needs to rapidly triage, diagnose and resolve security threat issues. A CSR may not recognize a subscriber’s issue as a botnet infection. But security analytics from the network-based malware detection sensors provide real time accurate information on the presence of malware on the subscriber’s home network and make the data available to CSRs via their call center console interface.

The CSR can then guide the subscriber through remediation actions, including providing the subscriber with remediation app to remove the infection.

Figure 16. Security analytics provided in help desk console



# CUSTOMER CARE ANALYTICS FOR CONTINUOUS IMPROVEMENT

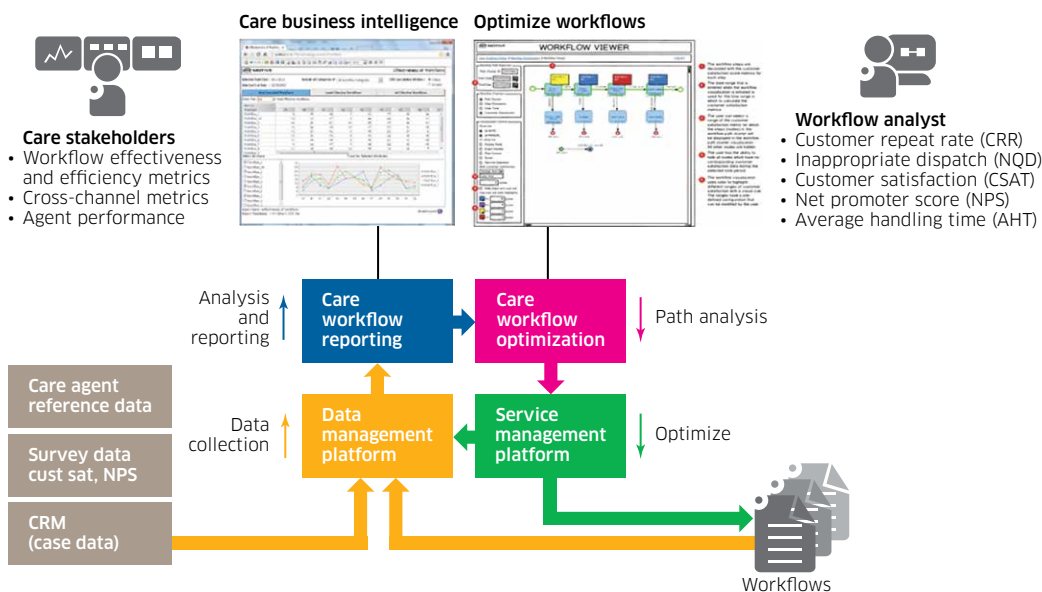
Care Analytics enables operators to continuously improve and optimize their customer care and business processes. Care Analytics allows operators to leverage the wealth of intelligence embedded within customer care sessions and their associated workflow steps to improve the customer experience in the connected home.

Using Care Analytics, operators are able to:

- Identify newly emerging customer issues that drive up call volume
- Identify workflows that have the most/least value to the business
- Visualize workflow statistics to quickly identify optimization opportunities
- Generate meaningful and timely reports to understand the most effective paths in workflows

In Care Analytics, the data that is collected is related to the performance and execution of customer care sessions: workflow definition and execution data, CRM and case data, customer satisfaction data and net promoter scores (NPS), and call center agent data. This data is stored in the Hadoop Distributed File System (HDFS) and various workflow and path analysis KPIs are calculated and stored in a Relational Database Management System (RDBMS), and the data is presented in visualization tools, including optimization and reporting dashboards.

Figure 17. Care analytics overview



One example of Care Analytics is in workflow reporting, where an operator is able to understand how well customer care processes are performing for their business.

Figure 18. Assessing the effectiveness of workflows

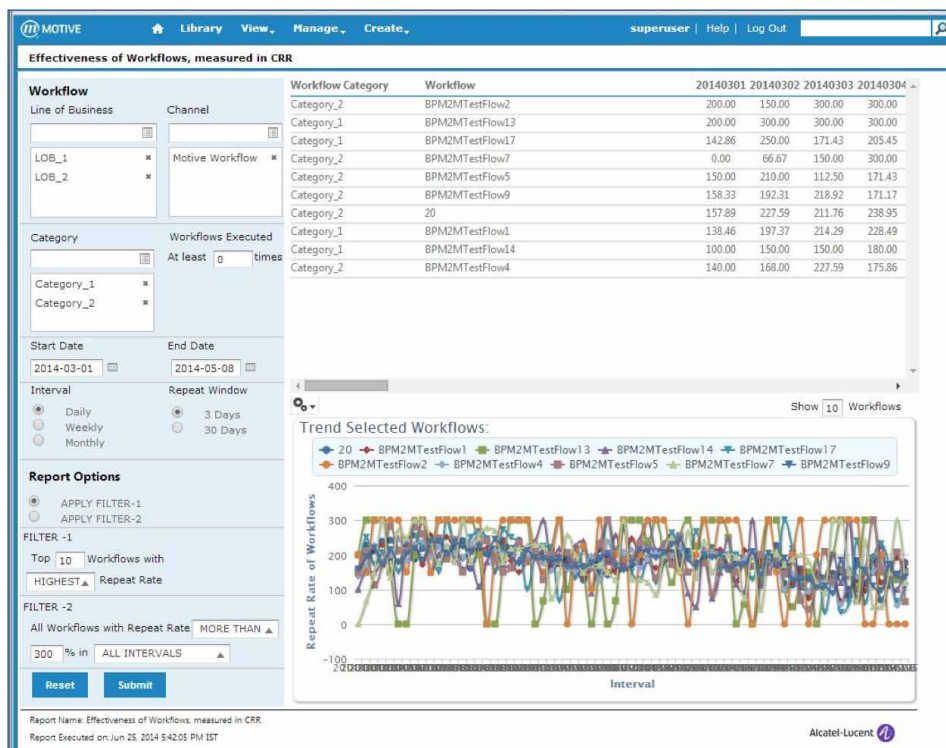


Figure 18 shows a report on workflow effectiveness—how each workflow executed in a care session can be correlated with a business metric, for example whether or not the session resulted in a repeat call to the help desk. Business analysts are able to interactively filter the data that is reported in order to understand workflow effectiveness for this business metric.

Other standard reports can measure agent performance, call abandonment, workflow and service operation timing, and correlation between customer care channels (e.g., subscriber self-care and agent-assisted care).

Another example of Care Analytics is in workflow visualization, where an operator wants to optimize workflow performance by determining where to make workflow or process changes that will have the biggest impact on the customer care experience.



Figure 19. Workflow visualization

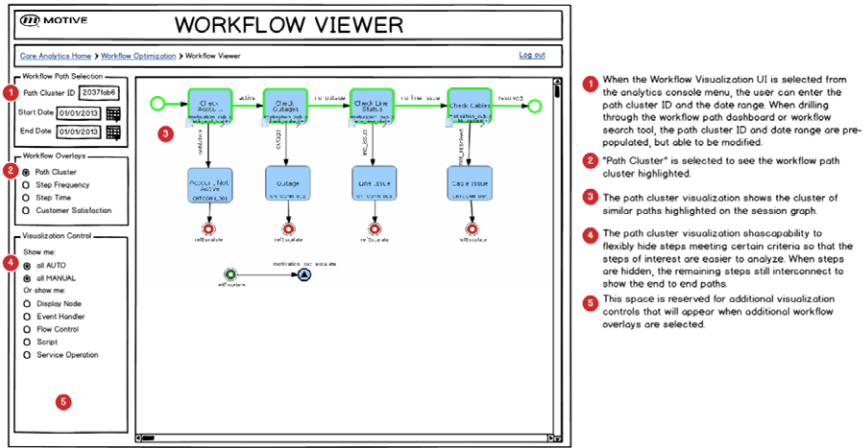


Figure 19 shows how a workflow analyst can find workflow paths that are the most impactful to a given business metric—for example, the customer repeat rate (CRR), inappropriate dispatch, customer satisfaction/net promoter score (NPS), and average handle time (AHT).

Workflow visualization can help analysts troubleshoot workflows to determine what is causing issues, such as a poorly designed service operation, logic step, or business process, and the visualization insights can be overlaid directly on the schematic diagram of the workflow.

## CONCLUSION

Clearly, it’s a challenge for operators to provide a differentiated customer experience and world-class service assurance and customer care in today’s connected home environment.

The connected home is becoming a very complex environment, requiring enhanced focus on knowledge gathering, data collection, and measurement in order to ensure customer satisfaction, competitive differentiation, brand loyalty, end-to-end support infrastructure efficiency, and continued subscriber ARPU growth.

Optimizing the customer experience in the connected home requires operators to embrace the use of analytics in order to:

- Quickly identify anomalies, implement improvement programs, and understand customer behavior
- Create and maintain a culture of customer experience (CX) excellence that is aligned with CX business goals and metrics around Net Promoter Score (NPS), customer satisfaction, churn reduction, brand loyalty, and subscriber ARPU
- Manage the subscriber experience proactively and predictively, and
- Continuously improve customer care processes and technologies

Areas in which analytics can be used by operators for managing the connected home will continue to evolve, but we have seen operators have a significant impact on improving the customer experience today by taking advantage of home device and home network analytics, online video analytics, Internet security analytics, and customer care analytics.

# ACRONYMS AND ABBREVIATIONS

AHT	Average Handle Time
ARC	Alerts Reporting Cluster
ARPU	Average Revenue Per User
B/OSS	Business and Operations Support Systems
CDN	Content Delivery Network
CDR	Call Detail Record
CLV	Customer Lifetime Value
CRR	Customer Repeat Rate
CSAT	Customer Satisfaction
CSR	Customer Service Representative
CX	Customer Experience
HDFS	HADOOP Distributed File System
KBO	Key Business Objective
KPI	Key Performance Indicator
KQI	Key Quality Indicator
NIDS	Network Intrusion Detection System
NPS	Net Promoter Score
QoE	Quality of Experience
RDBMS	Relational Database Management System
RGW	Residential Gateway
SFTP	Secure/SSH File Transfer Protocol
TR-069	Broadband Forum protocol for remote management of end-user devices
TR-135	Data model for a TR-069-enabled set-top box
TR-181	Device data model for TR-069