JOLATA

Making the network for you

WHITE PAPER

A Billion Metrics at a Time

Providing Precise Visibility in the Age of SDN and NFV

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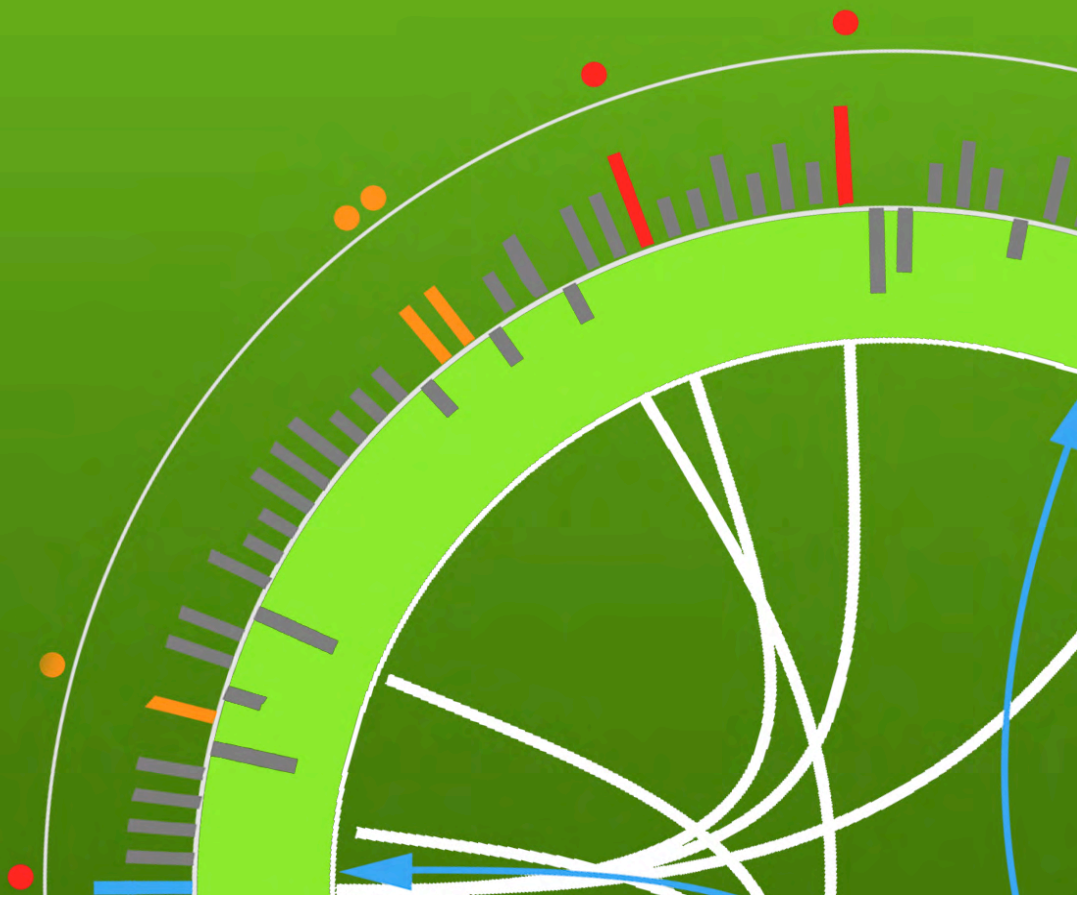


A Billion Metrics at a Time:
Providing precise Visibility in the Age of SDN and NFV

Introduction

There are three driving forces in the market today creating a perfect opportunity for innovation and disruption. These driving forces are 1) the changing application landscape forces Communication Service Providers (CSPs) to re-optimize their networks, 2) the near-saturation of the mobile market driving CSPs to focus on customer experience management, and 3) the advent of machine-to-machine communication that pushes CSPs to deploy new revenue-generating capabilities at the edge, rather than the core.

Software-Defined-Networking (SDN) and Network Function Virtualization (NFV) are two major innovations that are disrupting the market. SDN and NFV are two major architectural shifts in the communication service provider (CSP) world that promise to increase utilization of existing investments, improve service quality for existing services, and provide additional agility in offering new services.

In the brave new world of SDN and NFV, the centralized controller acts as the "brain" that controls all aspects of the network, and the distributed data forwarding planes act as the "hands and feet" that shuffle packets through as fast as they can. However, the network is still missing the "eyes and ears" to help it understand precisely, and ideally in real-time, what's happening, and to enable the controller to make intelligent routing and topology decisions. Heretofore, the lack of network performance observability has hindered the ability of service providers and enterprises to enable new services and centralize their networking policies, and thus they continue to suffer heavy operations overhead.

The *Jolata Precision Platform* is a big data analytics platform for precise and real-time network performance monitoring. It is an independent solution, hence agnostic to the brand of network equipment it is monitoring. By aggregating, analyzing and visualizing millisecond-precision network performance statistics for any flow, on any node and anywhere on the network, operators can:

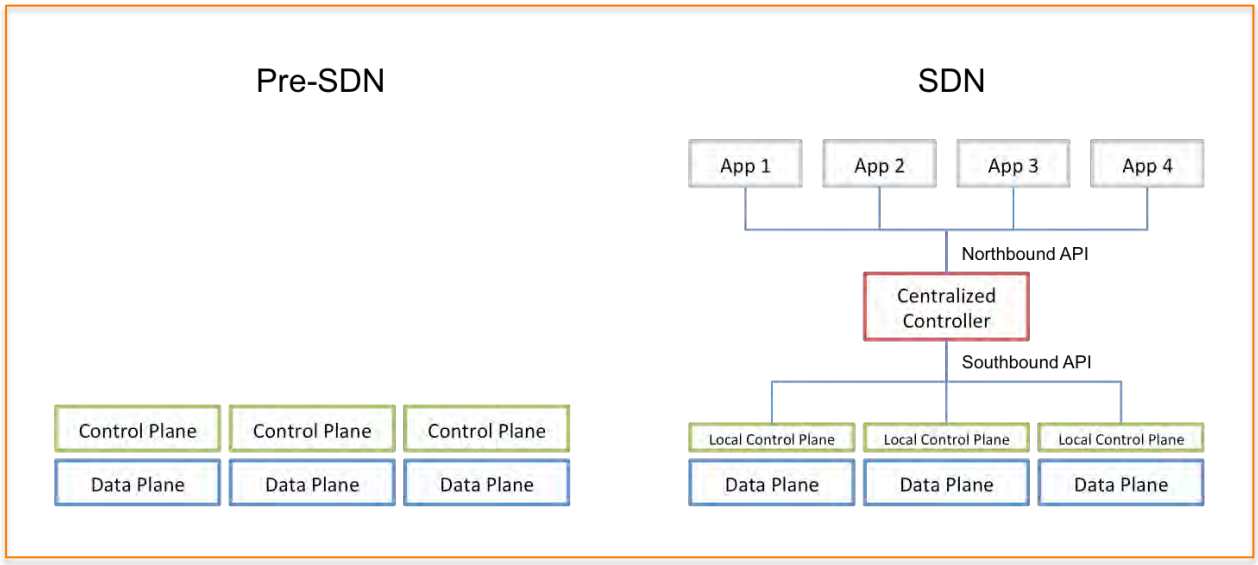
1. Create new mobile edge services that enable machine-to-machine communications
2. Manage and control network investment/TCO for both existing and new capacity
3. Optimize network testing infrastructure and future-proof network quality and customer experience (e.g., response time) through better network planning and provisioning at lower testing costs

To provide such unprecedented visibility, the Jolata solution can ingest every packet from thousands of locations on the network, digest billions of packets per second to determine findings, and finally

suggest actions within seconds. The Jolata solution is ten times more precise, scalable and complete compared to other existing solutions, due to its groundbreaking architecture.

Software-Defined-Networking (SDN)

SDN is an architectural approach that separates the control plane from the data (or forwarding) plane on the network equipment. In the SDN approach, the data plane continues to be decentralized and is part of the network equipment. However, certain key aspects of the control plane will form a centralized controller that has global view of the network, and can enable external applications to interact with and program the network.



By centralizing certain key aspects such as routing configuration, path calculation, inventory tracking and network statistics, the centralized controller can become much more intelligent, and can optimize network traffic in a way that was not possible before.

The benefits of SDN for service providers include heightened utilization of networking, lower CAPEX/OPEX, and simplified network deployment and operations.

Network Function Virtualization (NFV)

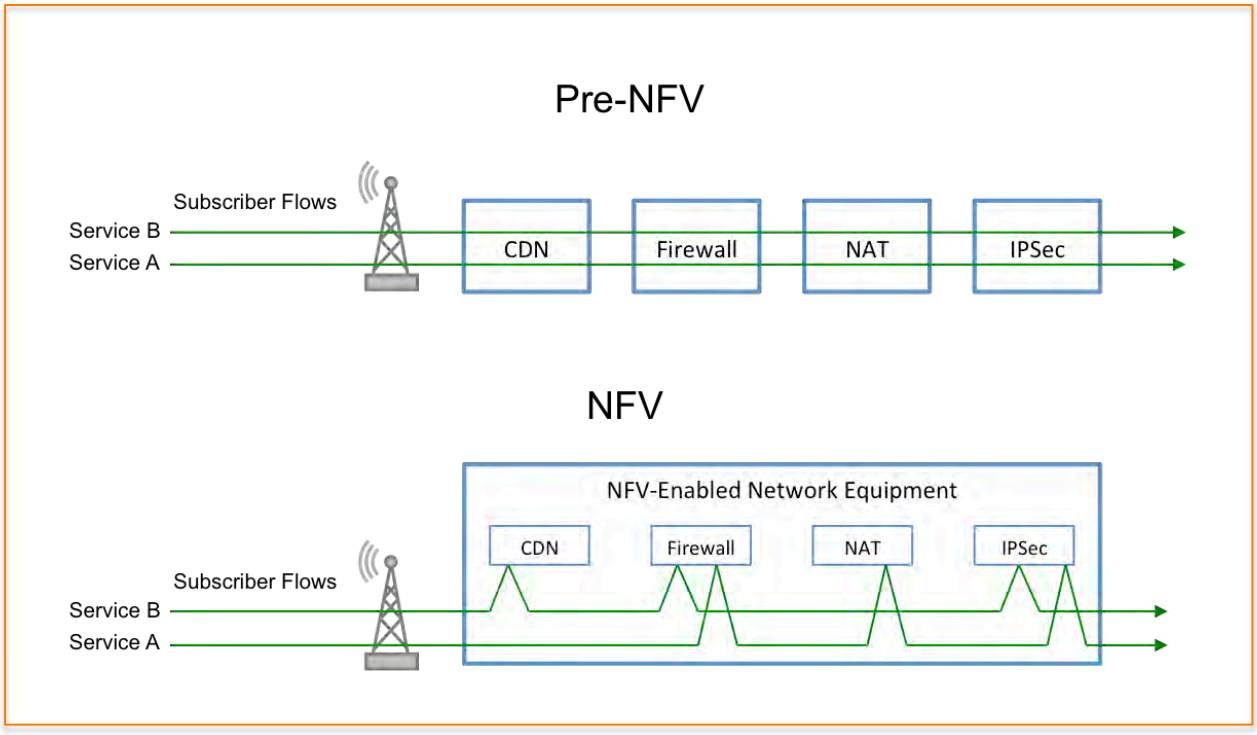
NFV transform the way service providers are architecting networks by leveraging standard IT virtualization technologies to consolidate many network functions onto standard hardware. NFV solves three major problems for service providers:

- Invasive and costly physical appliance installations at every site that require each of the network functions

- Rigid and inflexible network configurations that cannot respond dynamically to network changes
- Performance penalty introduced for all traffic flows regardless whether the flows require certain network function or not

A typical carrier network has many network functions that perform very specific tasks. These network functions include firewall, IDS/IPS, CDN, DPI (deep packet inspection), NAT, SGSN/GGSN, and many others. Traditionally, many of these network functions are run on proprietary hardware from different vendors, and they require a dedicated physical appliance installed per site. This invasive approach constrains innovation and competition, and increases burden on support and maintenance. Also, to add a network function to an existing network, downtime must be scheduled, which then increases operational complexity and decreases subscriber satisfaction.

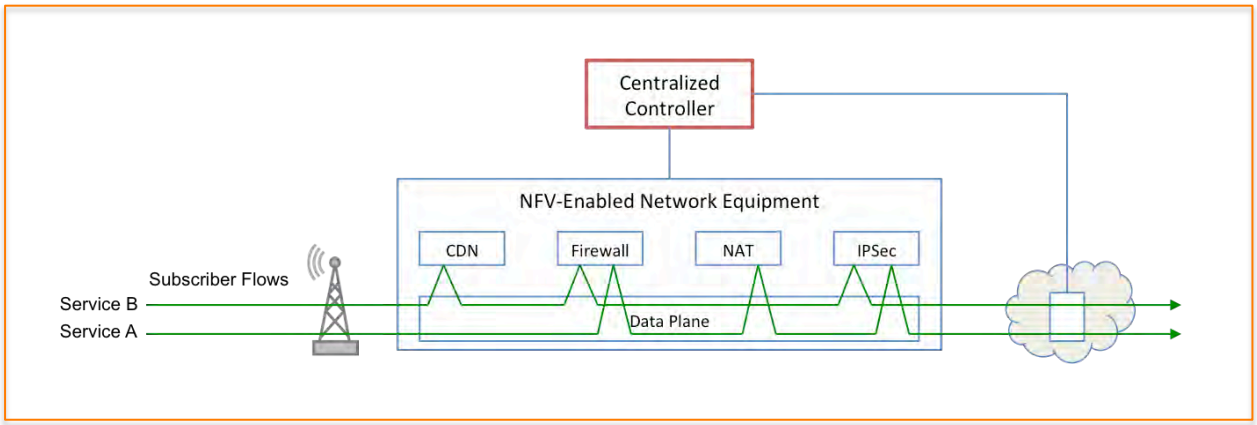
In addition to operational overhead introduced by having many physical devices, this approach also introduces a heavy performance penalty for service chaining. Service chaining is where multiple network functions, such as firewall and IPSec, are connected together in order to support a certain application. For example, if a service provider wants to offer a CDN function to some of their customers, the service chain for CDN traffic would ideally be a firewall service, a CDN function and possibly an IPSec service.



In today's networks, because many of these functions are standalone physical devices, the physical network connections are configured in

such a way that ALL traffic must go through ALL of the network functions (see the Pre-NFV diagram below.) There's no easy way for a service provider to configure the network in such a way that only subscriber flows that require CDN function will go through the CDN appliance.

Due to these limitations, all traffic flows are slowed down because all traffic must go through all network services, and service providers must provision more capacity for these network service to handle all of the traffic, instead of just the traffic that require the service.



The combination of SDN and NFV (see diagram above) enables service providers to virtualize network functions and dynamically optimize the traffic flow based on the specific network functions required, as well as the subscribers that initiated those flows. As shown in the NFV diagram above, service providers, leveraging SDN and NFV capabilities, can configure different traffic flows to go through different network functions, thus offering different class of services and capabilities depending on a variety of factors.

Jolata Precision Platform

The *Jolata Precision Platform* is built based on two fundamental concepts: accurate timing and complete data. First, accurate and precise network timing is the foundation to understanding and optimizing network performance. If you can't see the network with precise accuracy, then you can't measure it. If you can't measure it, then you can't diagnose it, optimize it, or manage it. For example, most traditional network monitoring tools provide measurements at every one to five minutes. However, at such low time resolution, a whole class of network problems, such as network congestion due to traffic microbursts, will be missed.

This is especially important in an SDN and NFV environment, where the decision making process is centralized in the SDN controller. In order for the SDN controller to accurately and intelligently make

routing and policy decisions, such as routing traffic around a highly-utilized network red zone, or to increase capacity of network function by adding additional VMs, the SDN controller must have accurate, precise and real-time information.

Second, complete network information enables accurate assessment of network qualities and quick determination of root causes when problems arise. The Jolata solution captures and tracks every single packet as it traverses the network, and constructs *Multi-Point Flows* in real-time with precise measurements of throughput, loss, latency, jitter and other metrics. Traditional network monitoring tools are incapable of providing such a complete set of information for the network operators.

For example, traditional network monitoring tools usually give operators a single number that represents round-trip network latency. However, this is insufficient because this single number cannot tell the operator where the slowness happens if the network is having problems, nor can this single latency number convey to the network operator how slow the network is at the trouble spots.

Jolata's solution provides a complete set of metrics at different segments of the network, enabling them to hone into the trouble spots on the network thereby rapidly accelerating root cause analysis and helping resolve issues in far less time and with fewer resources.

For an SDN and NFV-enabled network, Jolata provides unprecedented visibility into the most detailed level of a network's information flow.

- To provide complete visibility, the Jolata solution analyzes every packet on the network and calculates metrics for millions of flows
- To provide precise visibility of the location and time of network events, the Jolata solution statistically analyzes network traffic at multiple points of the network, and provides accurate location with microsecond accuracy per millisecond time window
- To provide real-time visibility, the Jolata solution presents the calculated metrics in seconds to the Jolata dashboard

Platform Overview

The *Jolata Precision Platform* consists of three tiers:

- The *Dashboard Application* is responsible for presenting and visualizing the results of the analysis within seconds
- The *Analytics Platform* is responsible for aggregating the data sent by the Jolata meters and analyzing billions of metrics per minute
- The *Data Plane* consists of Jolata Meters is responsible for capturing, time stamping, and fingerprinting hundreds of gigabits of data per second on the network

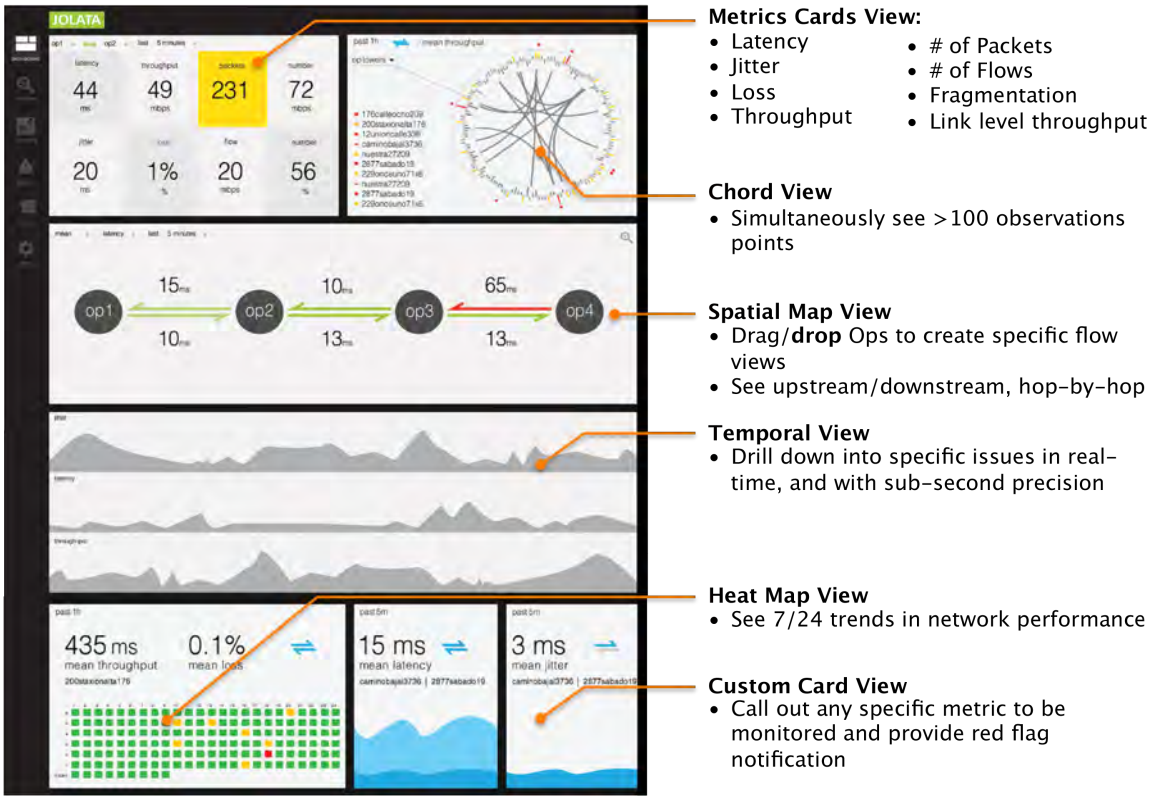
Jolata meters are deployed at different network locations, or observation points (OPs), including the edge (e.g., cell site routers or servers), aggregation points (e.g., access network or metro area network or Top Of Rack switches (TORs)) and core network locations (e.g., mobile switch center, data center or exchange). The Jolata meters are responsible for capturing, timestamping, fingerprinting, and correlating packets across multiple observation points. In general, the more locations that are monitored, the more accurate and complete the information will be to the end user. These meters can be external devices (Linux-Intel servers) that process the packets, or better still, embedded agents running in the network elements themselves (e.g., in the eNodeB, cell site router, TOR, or in smart SFPs – small form factor pluggable transceivers).

The Jolata analytics platform can be deployed regionally or globally running on standard Linux servers. The analytics platform is responsible for aggregating and analyzing all the information generated by the Jolata meters. The Jolata analytics platform contains two components. The first is a stream-processing engine that automatically analyzes data as they come in to compute KPI's, and in real-time generate alerts and visualizations to inform users of the current network status.

The second component is a batch-processing engine that performs machine-learning algorithms on large set of data in order to build accurate models of the network. The database behind the analytics platform is a scalable, distributed, in-memory columnar data store that is built to ingest billions of metrics per minute with a query latency of less than half a second. The disk store provides an 8:1 compression ratio that enables customer to store vast amounts of data for historical purposes.

The Jolata web services layer exposes a REST API that can be consumed by any external process. The response is a well-defined JSON representation that can be easily consumed by any client. The web services layer is scalable and distributed across multiple servers for high availability.

Lastly, Jolata's unique, patent-pending dashboard UI enables customers to focus on the most critical key performance indicators (KPIs), including network latency and jitter, throughput at IP and link levels, loss, fragmentation, packet count and flow count. These appear as "Metric Cards" in the upper left hand corner of the dashboard (see diagram next page). Each metric is updated in real-time to ensure network status information is always current.



The Chord diagram (top right) provides a holistic view of up to 150 individual network locations or observation points, each OP represented by a "compass point" on the circumference of the chord. The Chord diagram shows qualitatively which parts of the network are over- or under-utilized.

If higher resolution information about a specific network segment is required, it is possible to simply drag-and-drop the nodes or chords of interest into the Spatial Map (below the Chord diagram) to build a linear, end-to-end view representation of the relevant network path. This Spatial Map visualizes the network, segment-by-segment, giving additional detail of how the network is behaving.

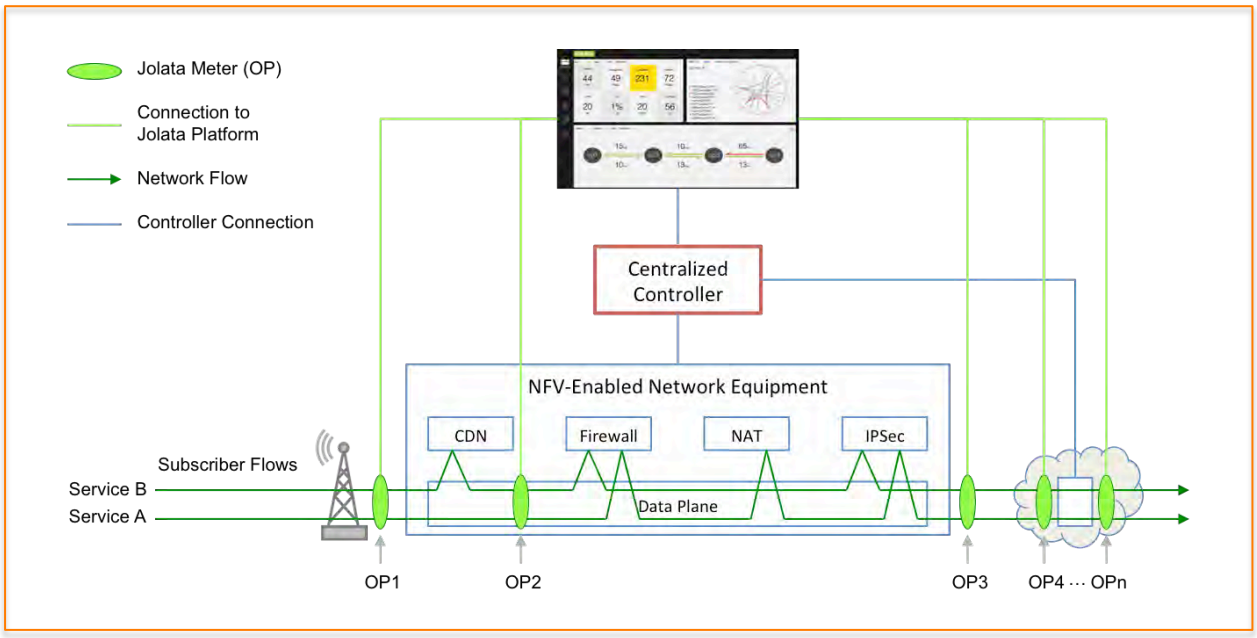
It is also possible to drag-and-drop individual nodes or segments from the Chord diagram or Spatial Map into the Temporal view. The Temporal View is updated with the most precise data within seconds of its occurrence, delivering sub-second details of the most critical metrics.

Critical trends are easily viewed using the red/yellow/green coded 7x24 Heat Map in the bottom left corner which shows data for the last 7 days, 24 hours per day, on an hourly basis.

From anywhere on the intuitive dashboard, it is possible to filter, highlight, drilldown, and analyze any part of the network end-to-end, quickly and precisely.

SDN/NFV Integration

Within SDN and NFV-enabled networks, the centralized controller acts as the "brain" that controls all aspects of the network, the data forwarding planes act as the "hands and feet" that shuffle packets through as fast as they can, and the *Jolata Precision Platform* act as the "eyes and ears" that provide precise visibility and real-time feedback to the SDN controllers.



In this deployment example,

- Jolata can deploy its unique metering technology to observe traffic at different locations, or Observation Points (OPs)
- Through these meters, Jolata's platform aggregates precise and real-time statistics on all of the network flows, including routes taken, latencies, jitter, loss and other metrics
- By collecting these statistics, the Jolata platform then creates an accurate and real-time map of the network that knows precisely the best path for packets to travel (imagine Waze-like capability for network topologies)
- Leveraging this real-time network map, The SDN controller can intelligently make decisions on the routing policies, as well as optimized service chains

The first Jolata meter (OP1) can be deployed between the eNodeB and the cell site router, observing traffic coming off of the air

interface. This is the first location where all packets coming off of the air interface can be observed.

A second Jolata meter (OP2) can be deployed as software running inside an SDN/NFV-enabled eNodeB. The deployment of this meter can be anywhere in the service chains. The goal of this meter is to measure the flow latencies for traffic that goes through different service chains.

A third Jolata meter (OP3) can be deployed after the traffic exits the eNodeB, thus providing precise network metrics for all the network flows that passes through the eNodeB as well as the different service chains.

In addition, other Jolata meters (OP4 to OPn) can be deployed at various network locations to accurately and precisely measure network flows and performance.

By deploying multiple Jolata Meters inside an SDN/NFV-enabled network, network operators can gain the following advantages:

- Precise network metrics on latency, jitter, loss, throughput, raw throughput, fragmentation, packet count and flow count
- Active, up-to-the-second, network topology based on actual network flows
- Real-time feedback to the SDN controller as performance of the network changes

Summary

Both the network architecture and the application landscape for communication service providers (CSP) and enterprise network operators are changing rapidly.

Traditionally, the large majority of traffic on most operator networks is video streams, which account for 50% of the overall traffic. While this still holds true from a bandwidth usage perspective, mobile applications such as chat or game applications are increasingly taking over the networks from a packet count perspective. Far more, but far smaller packet sizes will dominate networks moving forward. This requires a completely different set of optimization techniques by the CSPs, and therefore a different level of intelligence about precisely how your network is operating.

In addition, as companies start implementing their SDN and NFV strategies, complete and precise real-time network visibility becomes essential to the success of these efforts. Traditional solutions that exist in the market today cannot scale as the networks grow in size,

become more distributed and virtualized, and are increasingly sensitive to latency problems.

Finally, CSPs are continuing to push new capabilities to the edge of mobile network in order to create new revenue streams, and enable new applications and services. Examples of these new revenue-generating services include providing services to enable local loop machine-to-machine communication, edge caching and optimization of web content and applications, and service-aware scheduling of applications. These new capabilities at the edge allow CSPs to control capacity investment, maximize revenue for existing assets and create new revenue from hosting premium content and applications.

According to Analysys Mason, network quality of service (QoS) is responsible for 40% of all churn. Therefore, forward-thinking CSPs and enterprise network operators who are investing heavily in SDN and NFV technologies to increase their network's agility, are also focusing on customer experience as a core differentiator to win and keep customers.

The *Jolata Precision Platform* allows network operators to see and measure every packet and flow on the network in real-time. By leveraging patent-pending technologies to fingerprint, correlate, analyze and visualize the complete network in real-time, the Jolata solution enables network operators to meet or exceed the SLAs they have with existing customers and services, and develop new services over their SDN and NFV-enabled networks.

Fundamentally, if you can't accurately measure your network, you can't see the problem, and If you can't see a problem, it's almost impossible to fix it. Jolata is working today with large-scale network operators to:

- More rapidly determine root cause and diagnose issues related to latency, throughput, loss and jitter than any of their existing solutions,
- Precisely monitor, analyze and visualize every flow on financial exchange's backhaul, with up to one millisecond accuracy
- Help one of the world's top wireless operators to verify system performance of both individual components as well their network architecture – by evaluating using their actual network traffic
- Help them leverage their existing infrastructure to create new, higher margin premium services

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