

Mobile carriers are facing a deluge of traffic in their pipes from an increasingly mobile workforce and the proliferation of smart devices and applications. From home, work, and all points between, mobile subscribers are leading “always connected” digital lifestyles. Once satisfied with voice calls and SMS, today’s subscribers obsessively update friends and family through social media, watch streaming video highlights of last night’s championship game, share photos, play head-to-head video games, and tune in to streaming music. Video is becoming increasingly pervasive and taking up orders of magnitude of bandwidth than that of legacy voice traffic.

Enabled by the freedom of the Internet, customer behavior is transcending a network controlled by the MSP (i.e. Managed Network) to the ‘unmanaged’ Internet (also known as over the top). Over-the-top (OTT) communications service Skype for instance is estimated to be costing the telecoms industry \$100m per day, or \$36.5bn per year, not only due to the amount of data traffic it generates but also for the competing services that it offers.<sup>1</sup> Big Data is no a longer a problem unique to enterprise data centers. The variety, velocity of growth, and volume of data sources within a telecom environment—network devices including smartphones, and tablets—is daunting and what we are witnessing today is only the tip of the iceberg.

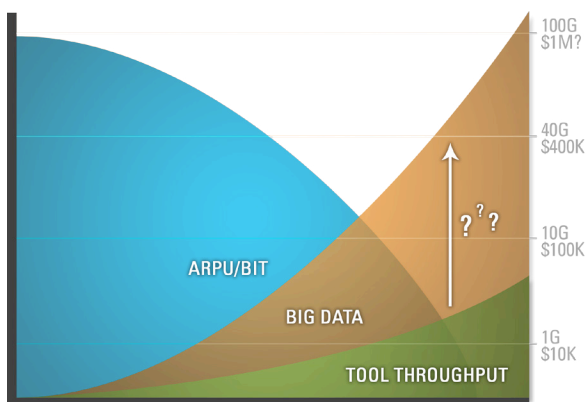


Figure 1: Big Data challenge

<sup>1</sup> Sahota, Dawinderpal. (September 27, 2013) “Skype costing mobile operators \$100m per day,” September 27, 2013. Retrieved from Telecoms.com at <http://www.telecoms.com/183462/skype-costing-mobile-operators-100m-per-day/>

Unfortunately this massive demand for data does not always correlate to the revenue it generates (see Figure 1). Carriers today must assume the cost of transporting the data and maintaining the networks that carry it. Continued network investments for transporting this data and monitoring the network keeps CAPEX requirements high while lacking the corresponding incremental increase to average revenue per user (ARPU). Network analytic tools do not get cheaper as network speeds increase. To ensure accurate data processing and analysis, analytics tools must have visibility into the high speed data transport pipes at the network core and concentration points. However, connecting individual tools across the network is expensive and further chips into ARPU.

Mobile service providers operate in an extremely dynamic and competitive environment of technological advances and elastic consumer demand. Mobile data traffic congestion and an inability to proactively invest in timely network optimization can lead to customer churn and missed marketing and revenue opportunities. Service providers must consistently deliver high-quality, high-speed data to retain subscribers and maintain/increase customer sentiment.

In order to make this happen, service providers must have visibility into all the segments of their network. The data itself should be correlated to the subscribers and their applications. However the sheer scale of this data—in terms of volume (size), velocity (rate at which this data is generated) and variety (the multiple silos that it resides in)—makes it difficult to manage, leading to “blind spots” regarding the relationship between traffic, network load, and subscriber experience. Big data represents challenges for any service provider, but it also represents great opportunity.

Big data is the means by which a service provider can get closer to its subscribers and their experiences on the network by turning the flood of data into an advantage and truly understanding one’s network and one’s customers. With these insights, service providers can find ways to increase ARPU and new services while reducing customer churn. It is the individual, transactional-level visibility that provides the ultimate view into customer experience and behavior. The harnessing of big data enabled by end-to-end subscriber level visibility combined with the application of Big Math represents a significant competitive advantage.

The era of Big Data is upon us. The stakes are high and the challenges are complex. Big Data can help drive service provider goals:

- Optimizing ARPU by Enhancing Operational Efficiency
  - Maintaining business continuity
  - Ensuring technology interoperability
  - Effective capacity & performance management
- Reducing Customer churn:
  - Maximizing subscriber quality of experience (QoE)
  - Evaluating and refining new service offerings

Let's look into each of these in greater detail:

### ***Optimizing ARPU by Enhancing Operational Efficiency*** **Maintaining Business Continuity**

The rapidly growing rate of data volumes, driven by the explosion of smartphones and tablets, coupled with the availability of thousands of new applications, is creating a new and challenging environment for the mobile service provider. Even as increased service use pushes networks to the limit, subscribers continue to demand high-quality, high-speed data 24X7, 365 days a year. As Big Data continues to increase, there is little carriers can do to slow down the deluge of information traversing the networks. This is creating a problem for carriers in that incoming revenue (ARPU/Bit) is decreasing as providers are forced to offer larger pipes, without passing on the cost to customers. This, combined with the rising cost of tools to analyze the vast amounts of data, causes the carriers' existing business model to break down. Carriers are therefore looking for ways to realistically keep their business costs in line and more importantly retain existing expense structure while providing the subscribers with the quality, uptime, and reliability they expect.

### **Ensuring Technology Interoperability**

As LTE continues to roll-out across the globe, these all-IP based mobile networks will initially exist as hot spots during the early deployment phases. This means there will likely be frequent inter-technology handovers between 3G and LTE. An operator's ability to detect, isolate, and resolve interoperability issues goes hand-in-hand with visibility. Getting the data right is key, but getting ALL of the relevant data is what is required. It is the individual, subscriber-level visibility and details that provide the ultimate view into service and network issues correlated to specific subset of affected customers. Real-time analytics enhanced by subscriber-level visibility into Big Data traffic, enables MSP's to respond to network issues based on SLA's, i.e. focus on pieces of the network infrastructure that are delivering the highest value to the service provider's premium customers.

Optimized troubleshooting workflows and proactive monitoring enabled by end-to-end visibility are therefore fundamental to quickly identifying service-impacting issues before they affect customers, and preventing reoccurrences.

### **Effective Capacity Management**

Service providers are not only looking at effective capacity management for today, but are also looking for a solution which to build readiness for tomorrow's needs. Intense competitive challenges, technology changes, and service convergence have resulted in network growth. Building out excess capacity when it is not needed and the inability to forecast can put immense pressure on the operator's CAPEX budget. In order to remain competitive in today's complex and hypercompetitive communications environment, operators need to have the ability to plan, predict, and optimize their investment in network rollout and identify potential stress points. Operators cannot optimize the design and management of their networks until they fully understand the drivers of traffic. To be successful, engineering and planning teams therefore require pervasive end-to-end subscriber-level visibility to characterize and correlate customer, application, and operational data.

### ***Reducing Customer Churn*** **Maximizing Quality of Experience**

Service providers must consistently deliver high-quality, high-speed data to retain subscribers and maintain/increase customer sentiment. Though initial battles may be won based on an operator's ability to support the latest "must-have" devices, customer retention and loyalty have to be earned over time. Pervasive visibility into the subscriber-level application/network availability and performance are key metrics for gauging end-user quality of experience (QoE).

As connections grow from 1Gb to 10Gb, 40Gb and 100Gb, the Big Data velocity and volume challenge is further intensified and mobile carriers are looking to efficiently, effectively, and economically monitor this traffic for quality of service. As the proliferation of smart devices and HD-enabled tablets continues to drive the volume, velocity, and variety of data traffic, the distribution of network load among users, however has not been proportionate. Every network has a set of heavy users who are consuming a greater amount of network resources and thereby compromising the overall QoE of others. Unfortunately a lack of a representative view of the overall traffic distribution has led to the enforcement of usage policies in a one-size-fits-all fashion which often has little effect on congestion and in fact has a negative impact on the experience of other subscribers. Tackling the mobile carriers' Big Data challenges requires intelligently breaking down the problem into smaller, more manageable chunks, while maintaining carrier control over QoE.

### Evaluate and Refine New Service Offerings

To differentiate themselves and protect the customer experience, operators are moving away from flat-rate pricing plans and “best effort” performance models. By fine-tuning their portfolios and tailoring pricing strategies based on usage patterns and premium level content, operators can better serve their clients and hold price points based on the quality of experience provided. Essentially, operators can reposition their businesses to become more services-centric than network-centric, to profit from the increasing demand for content and applications. For operators striving for providing a holistic customer experience it is absolutely essential to correlate network traffic to specific subscribers that generate this traffic in order to fully understand what is happening in the complex intersection of network and business data across voice, data, and content in order to provide differentiated services to customers. Gaining subscriber-level intelligence, understanding usage, performance, and consumption trends will allow carriers to make better-informed decisions that maximize profits, improve service quality, and reduce customer churn.

### *Big Data Visibility into Mobile Data Services to Increase ARPU and Reduce Customer Churn*

In the hyper-competitive environment, service providers are looking to differentiate themselves by:

- Driving down costs
- Generating new revenue streams
- Retaining/attracting customers

As users continue to demand ever-higher throughput, lower latency, and higher capacity, the growing volume, velocity, and variety of mobile traffic presents both enormous technical challenges and significant revenue opportunities. If the visibility layer can access and effectively serve this Big Data up to the monitoring tools, meaningful and actionable analytics can be derived.

### **So how much of this traffic can truly be monitored end-to-end? What can service providers do to leverage the power of Big Data?**

Effective monitoring of Big Data calls for intelligently reducing the amount of traffic to make it more suitable to connect to existing tool sets. Carriers require a solution that:

1. Combines volume, port density, and scale to connect the right analytical tools to the appropriate large or bonded pipes
2. Enables the tools to see a view of the relevant traffic in a session aware and stateful manner

3. Conditions data through advanced filtering and packet manipulation to reduce the amount arriving at each tool, while ensuring that the data is formatted precisely for the tool's consumption

This way, each tool is able to process more data without needing to parse the incoming stream or waste precious processor cycles from the more important task of data analysis. Carriers can thus select to see as little or as much as they determine appropriate.

Big Data analytics powered by Big Data visibility represents a potential gold mine of opportunity for those looking to gain better insight into customer relationships, optimize infrastructure investments, evaluate new service offerings in an increasingly competitive industry.

### *Gaining Subscriber-Level Visibility*

#### **GTP Correlation**

GPRS Tunneling Protocol (GTP) is commonly used to carry mobile data across the networks and includes the control plane (GTP-c) and a user-data plane (GTP-u) traffic. Therefore, visibility into a subscriber's activity requires the ability to understand the stateful nature of GTP (v1 and/or v2) and to correlate subscriber-specific sessions to gain an accurate view of the subscriber's activities.

Gigamon's GTP correlation application helps carriers gain access to the subscriber's data in these GTP tunnels by reliably correlating and passing all of the identified subscriber's control and data sessions to the analytics/monitoring probes and billing subsystem to ensure an accurate view of the session.

Further, given the rate of increase in the volume of information traversing through the mobile service provider networks, the tools infrastructure has been unable to scale accordingly and proliferating tools across the network to monitor millions of subscribers can be very expensive and cost prohibitive.

With Gigamon's GTP correlation application, carriers can intelligently filter, replicate, and forward specific subscriber sessions to the specific tools by correlating the subscriber ID, also known as the international mobile subscriber identity (IMSI), that are exchanged as part of the control sessions to the corresponding tunnel ID or tunnel endpoint ID (TEID) that are part of the user-data plane traffic. This can optimize current tool infrastructure investments by providing only relevant data to the tool while increasing visibility into subscriber traffic that can help improve QoE and performance.

When combined with GigaSMART® packet modification operations like slicing, monitoring tools can perform more efficiently by eliminating unwanted packet content. Gigamon's GTP correlation application also has the ability to ensure that all IP fragments within the subscriber session are sent to the same tool.

By gaining a complete activity view of high-value subscribers, carriers can look to optimize ARPU by improving operational efficiency, ensure business continuity and QoE, and identify and monetize new offerings. When used with FlowVUE™, Gigamon's intelligent sampling of active subscribers, carriers can have a representative view of a subscriber's usage patterns. Armed with these subscriber level insights, Gigamon can help operators to identify roaming subscribers across peered networks through IMSI filtering.

### GTP Correlation Features

- Stateful Filtering Based on Subscriber ID's (IMSI)
  - Stateful correlation of GTP-c with GTP-u messages
  - Correlate subscriber ID with corresponding tunnel ID
  - Forward subscriber-specific control and user plane sessions to a tool or a group of tools

- Traffic Filtering, Replication, and Distribution Based on:
  - GTP TEID and inner-packet parameters including: Src/Dst IPv4/v6 Addresses, Protocol, Src/Dst Port, IP Version, TOS, TTL, DSCP, Fragmentation Flags, TCP Flags
- Support LTE and 3G Networks Including GTPv1 and GTPv2

### GTP Correlation Key Benefits

- Optimize the Tools Infrastructure
  - Optimize tools processing by accurate filtering, replication, and forwarding of monitored subscriber sessions
  - Reliably correlate subscriber sessions (control and data) to increase analytics accuracy
- Pervasive Visibility into Subscriber Traffic
  - Extended visibility is critical for proactive identification of service-impacting issues and offending subscribers
  - Facilitate drilldowns into roaming users across peer networks
- Maximize Quality of Experience and Monetizing Services
  - Pervasive subscriber-level visibility to facilitate monitoring tools to gauge end-user QoE
  - Real-time stateful visibility enables reliable accounting, billing, and subscription management

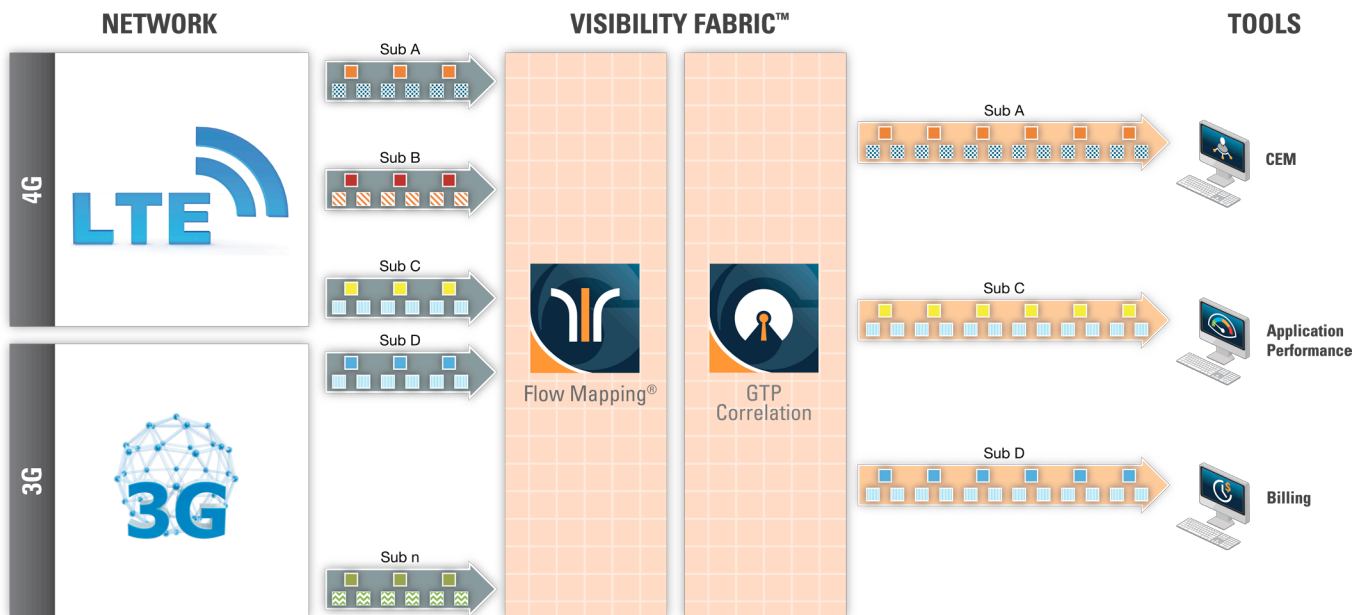


Figure 2: GTP correlation

**Active Subscriber-Aware Sampling  
FlowVUE Application**

Gigamon’s FlowVUE application offers a new subscriber-based IP sampling paradigm which helps carriers turn Big Data into manageable data. The application enables existing tools to connect to the latest high speed pipes by providing a representative view of traffic for diagnostic coverage. GPRS Tunneling Protocol (GTP) is commonly used to carry mobile data across service provider networks and includes the control plane (GTP-c) and a user-data plane (GTP-u) traffic. FlowVUE allows for active sampling of a subscriber’s device (known as a user endpoint IP or UE IP) across GTP-u tunnels. The integrity of the subscriber flows is preserved by forwarding all the flows associated with the sampled UE IP to the probes and analysis tools.

In contrast, traditional methods randomly sample packets without any correlation to the flows which provides limited visibility into subscriber behavior and experience. FlowVUE intelligently reduces the amount of traffic, while keeping the integrity of the data flows intact, but at a lower speed feed within a smaller pipe.

Leveraging FlowVUE, providers can enhance QoE monitoring by forwarding all of the control plane traffic to the tools infrastructure and only perform intelligent user-plane sampling (a configurable percentage of UE IPs) to get a representative view of application

usage. Not all traffic is created equal. Certain traffic types have a higher incident rate of error or need greater monitoring. Other traffic types rarely need monitoring. When combined with the advanced filtering capabilities of GigaSMART adaptive packet filtering, operators can further filter, replicate, and forward specific traffic flows of interest based on application ports and packet content-based payloads for all or a subset of the sampled subscribers (see Figure 3). This further reduces the volume of traffic to the tool infrastructure. The ability to sample a subset of subscriber devices and transmit all the associated sessions of interest to the monitoring tools, intelligently reduces the amount of data while enabling Big Data throughput processing, with existing cost structures.

**FlowVUE Features**

- Flow-aware Sampling of Subscriber Devices
  - Intelligently filter and forward all flows “sourced” from a sampled set of subscriber device IP’s
- Flexible Sampling Engine
  - Subscriber IP/IP Ranges
  - Sampling Rates
- Intelligent Tracking of Active Subscribers
  - User-configurable timeouts to detect and replace inactive devices
- Sampling Supported for IP-based Flows and IP-based Flows Encapsulated in GTP-u Tunnels

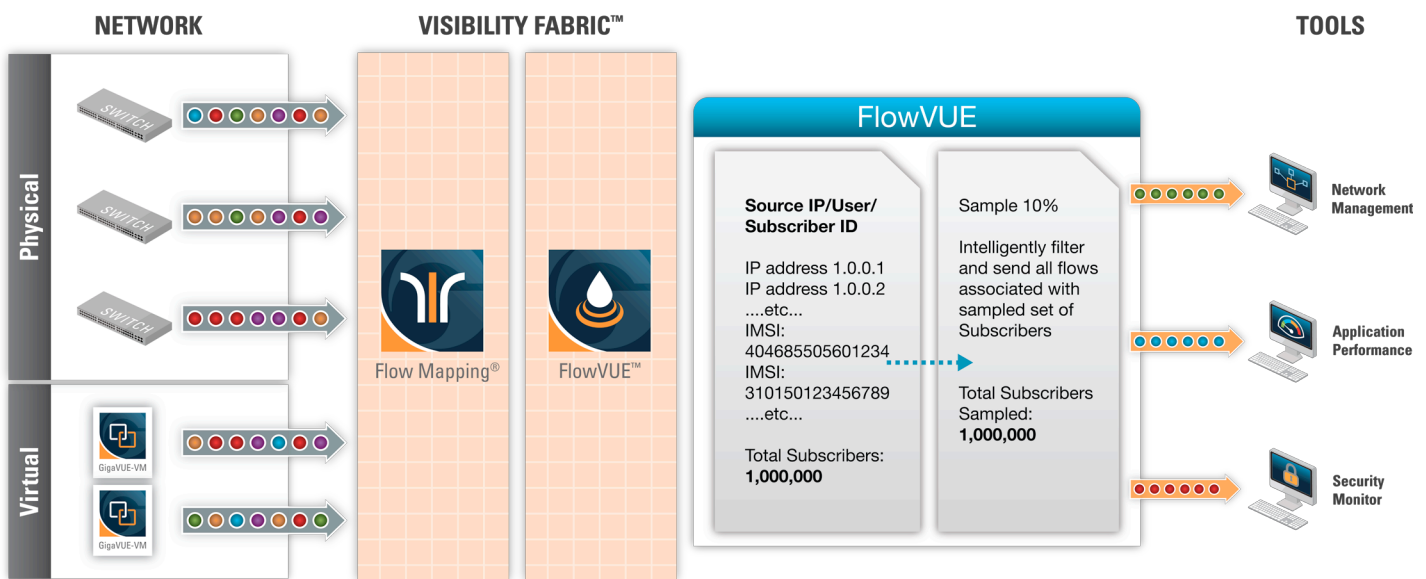


Figure 3: FlowVUE application



**FlowVUE Key Benefits**

- Turning Big Data into Manageable Data
  - Enable carrier to selectively reduce traffic bound to monitoring and analytic tools
  - Deterministic results at a fraction of the data rate
- Maintain ROI
  - Mitigate rising tool costs by preserving or increasing tool utility based on real-time reduced data volume
- Harness Big Data as a Competitive Asset Versus an Overwhelming Burden
  - Tailoring pricing strategies based on usage patterns

**Achieving Pervasive Visibility**

**Gigamon Visibility Fabric™ Architecture**

In this era of Big Data, mobile carriers have searched for a way to efficiently and effectively monitor performance and QoE for their subscribers, as well as identify and monetize new offerings. Converging on a single platform that not only simplifies and automates network traffic visibility, but also provides built-in intelligence to address Big Data will shape how mobile carriers choose to monitor and manage their network to provide better, faster connections and new services.

Legacy approaches to monitoring have offered limited traffic visibility with limited filtering capabilities; are difficult and costly to scale and manage; and often require change orders or network downtime in order to adapt to the evolving network.

Gigamon provides the architecture and intelligence for mobile operators to create a monitoring infrastructure that is designed for the new era of Big Data providing pervasive visibility, awareness, and control from the converged edge to the cloud. Sitting between the IT infrastructure and the tools that need the access to data, the Visibility Fabric provides a holistic approach to traffic visibility that includes:

**Architecture Advantages:** The GigaVUE<sup>®</sup> family of fabric nodes offers the volume, port-density, and scale needed to connect the right analytical tools to the appropriate large or bonded pipes. Tool trials are streamlined, new tools can easily be added or removed, and uptime is protected while downtime is prevented with a solution that is outside the production network providing pervasive visibility.

**Feature Advantages:** Advanced filtering and packet manipulation reduce the amount of data arriving at each tool while ensuring that the data is formatted precisely for the tool’s consumption. Each tool is optimized by not needing to parse the incoming stream or waste processor cycles on non-relevant data so it can focus on the more important task of data analysis.

**GigaSMART Apps:** Traffic intelligence and management provides effective monitoring of Big Data through the logical reduction of traffic so that it is more suitable to connect to an existing speed tool at 1Gb or 10Gb. Gigamon’s GTP correlation enables visibility at the subscriber/session level in order to maximize QoE and monetize services. The FlowVUE application intelligently manages Big Data traffic through active subscriber-aware flow sampling while keeping the integrity of the data flows intact.

**Conclusion**

With the Visibility Fabric in place, the monitoring and security tools that had limited visibility into the volume of traffic can now deliver their full value, provide end-to-end, edge-to-core visibility, and detailed analysis of performance impacting events. Service providers can proactively maintain a subscriber’s QoE while securing the integrity of the network. Through features including Flow Mapping<sup>®</sup>, GTP correlation, FlowVUE, and de-duplication, the Big Data curve can be tamed and tool throughput can be optimized (see Figure 4).

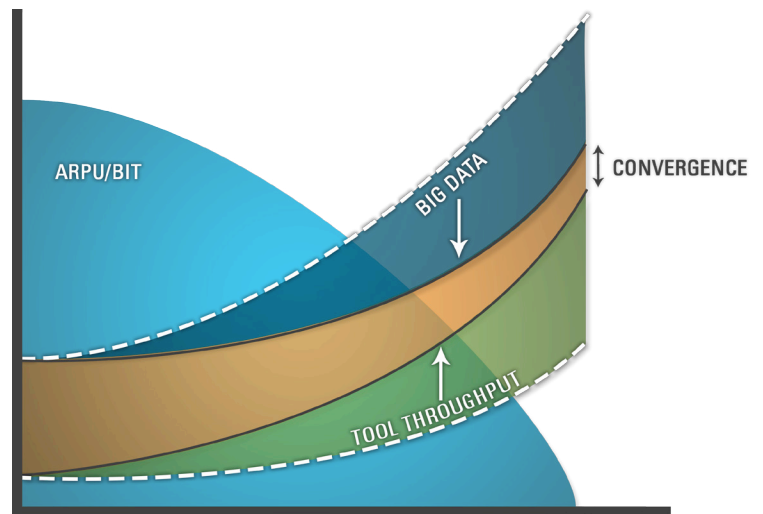


Figure 4: The Gigamon solution turns Big Data into manageable data by converging the gap between the rising traffic tide and what tools can process today.



As much of the data is pre-processed, Gigamon effectively increases the throughput of tools, through features such as header stripping or slicing, as well ensuring the tools only see the data they need to see. Gigamon's advanced features will assist the carrier with finding new ways to generate income. Gigamon allows carriers to break out of the confinements of traditional business models and reinvest CAPEX in new ways, as well as increase their competitive edge through subscriber cost reduction offers, or extra benefits.

### **About Gigamon**

Gigamon provides an intelligent Visibility Fabric™ architecture to enable the management of increasingly complex networks. Gigamon technology empowers infrastructure architects, managers and operators with pervasive visibility and control of traffic across both physical and virtual environments without affecting the performance or stability of the production network. Through patented technologies, centralized management and a portfolio of high availability and high density fabric nodes, network traffic is intelligently delivered to management, monitoring and security systems. Gigamon solutions have been deployed globally across enterprise, data centers and service providers, including over half of the Fortune 100 and many government and federal agencies.

For more information about the Gigamon Visibility Fabric architecture visit: [www.gigamon.com](http://www.gigamon.com)