Depend on the Five9 Cloud

Moving on premises solutions to the cloud is compelling for a number of reasons but there are still some areas of potential risk around picking the right vendor. This white paper is designed to help you assess and evaluate the Five9 cloud solutions as viable replacements for on premises contact center infrastructure. It was written to provide an understanding of how Five9 software development and company processes meet the reliability, scalability, security, and quality requirements of your contact center.

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Reliability, Availability and Uptime

In October of 2015 Five9 launched the Five9 trust site which publishes the last 12 months of reliability for the Five9 service. This transparency of availability is a proof point for customers and prospects that the availability of our service is a top priority for Five9.

The Five9 Trust Site provides customers and prospective customers with the ability to see our average monthly system availability. Also available within the trust site are sections that cover Five9 security & privacy information as well as voice and data network details.

Additionally, customers who have Five9 login credentials can access the System Status page, which shows any active incidents currently affecting the platform. Five9 also provides self service capabilities, including the ability for customers to submit a trouble ticket online and receive updates electronically.

Architecture

Network Redundancy

The Five9 IP Network Infrastructure is built to support the most stringent requirements in terms of robustness and security. Many of our customers must comply with data protection laws, regulations, and industry standards in various jurisdictions throughout the world. As such, the Five9 platform offers world-class security features and resiliency.

The Five9 IP topology consists of redundant Layer 3 switches, routers, and firewalls, as well as intrusion detection and protection systems used by many of the top security experts worldwide. All hardware is redundant with load sharing front-end and back-end switches, routers, and firewalls.
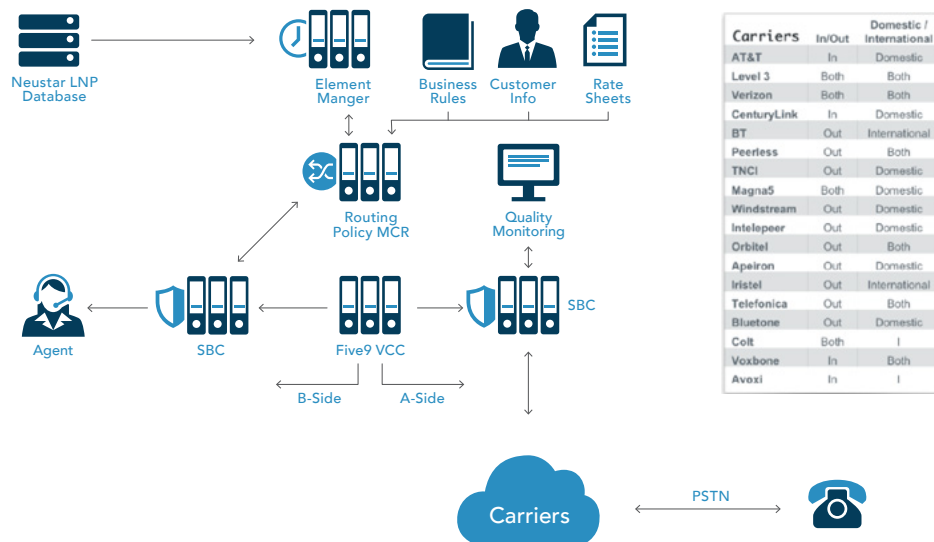
Carrier Redundancy

Five9 offers a robust voice services offering that includes redundancy with 3 carriers for 1-800 service, 4 for DID, 18 carriers for domestic long distance, and 10 carriers for international, including inbound and outbound. Five9 is a Toll Free RespOrg and offers 1-8XX, international Toll Free and Domestic and International DID services.

Long distance partners include AT&T, Verizon, Level 3, BT, Telefonica, Windstream, Peerless, Intelepeer, Novatel, Iristel, Voxbone, Colt, XO, Orbitel, Apeiron, and Impact Telecom. Five9 uses primarily VoIP using SIP protocol but also offers TDM to meet certain requirements as needed.

Most customers choose to have Five9 handle all telecom services, domestically and internationally, but we accommodate requests from customers to utilize their own telephony services. This is done via SIP trunks either to the customer PBX or to the customer's chosen telecom carrier.

This environment of carriers allows for distribution of calls to carriers such that if one or many carriers are having network impairments, calls are routed to other, non-impacted providers offering the best quality calling platform in the industry.

Carriers	In/Out	Domestic / International
AT&T	In	Domestic
Level 3	Both	Both
Verizon	Both	Both
CenturyLink	In	Domestic
BT	Out	International
Peerless	Out	Both
TNCI	Out	Domestic
Magna5	Both	Domestic
Windstream	Out	Domestic
Intelepeer	Out	Domestic
Orbitel	Out	Both
Apeiron	Out	Domestic
Iristel	Out	International
Telefonica	Out	Both
Bluetone	Out	Domestic
Colt	Both	I
Voxbone	In	Both
Avoxi	In	I

Voice Redundancy and Quality Control

The Five9 telephony layer utilizes a best-of-breed telephony switching, routing, and security platform known as a Session Border Controller (SBC) for voice over IP calling traffic, as well as a multiple interexchange carrier routing protocol that utilizes over a dozen Tier 1 domestic and global telephony providers to route telephone calls to destinations all over the world.

Five9 deploys Sonus SBCs with a global routing database in all US locations and European data centers. SBCs are capable of handling all SIP and RTP sessions and perform not only a security purpose but also transcoding and other media handling functions.

The feature set provides a high level of fault tolerance for outbound and inbound call traffic, allowing Five9 customers a dynamic layer of protection from any single carrier failure. Five9 utilizes performance metrics like Post Dial Delay, Answer Seizure Ratio, Jitter, Packet Loss, Latency Mean Opinion Score and R-Factor to rank the quality of each carrier.

All media is anchored in the Five9 platform where audio can be mixed and calls enhanced.

## Fault-tolerant Hardware Architecture

The Five9 architecture is designed with fault tolerant principles in the early stages of the Five9 development life cycle, through deployment, and into maintenance phases. Five9 deploys and operates technology in paired datacenters without reliance on any one location. The network and telecommunications capabilities are consistent across locations with the ability to move traffic between the paired sites seamlessly. Five9 implements fault tolerant telecom edge with many carriers for route redundancy, as well as multiple network providers with diverse paths in each location.

The switching and routing platform is a high-availability topology which has full redundancy capabilities within the same geographic location, as well as automatic failover to devices in other Five9 data centers in other geographic locations, making the platform highly available and geographically diverse.

Geographic Redundancy

The Five9 US datacenters are located within the CoreSite facility in Santa Clara, California, within the QTS facility in Atlanta, Georgia and in Terremark / NAP of the Americas in Miami, Florida (voice POP only, serving LATAM). The European datacenters are located within Equinix facilities in Slough, United Kingdom, and Amsterdam, Netherlands. In addition to being fault tolerant within each datacenter, datacenters are designed to be able to pick up the traffic of their pair in the event of a massive outage. Customers can run primary in either of the paired datacenters and utilize the other paired site as a failover location. The same infrastructure exists in each of the paired sites with two way replication for seamless failover capability.

Five9 provides capabilities that help our customers ensure continuity during natural disasters or other unforeseen events that can potentially disrupt operations of an entire region. Customers can opt for Geographic Redundancy, ensuring that their operations transition between our geographically-distributed data center within minutes after a catastrophic event. Five9 also backs up customer data to another facility to ensure against data loss in the event of a natural disaster at a primary data center.
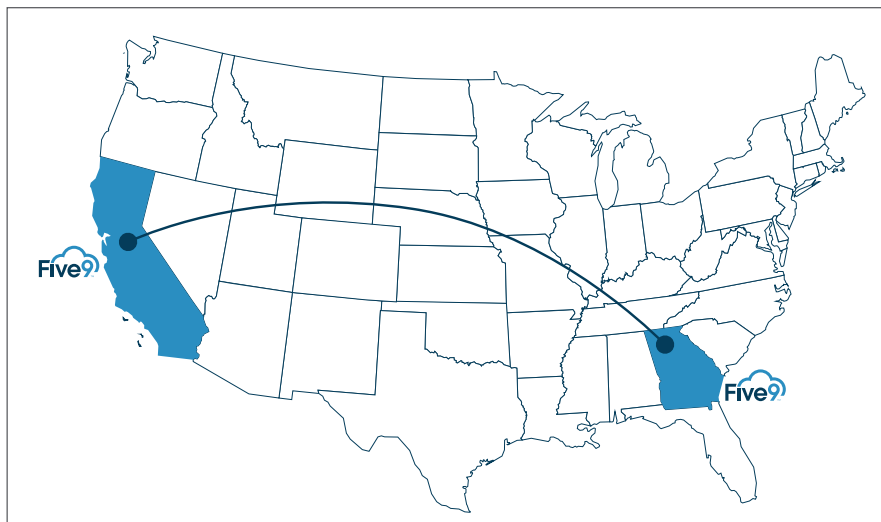
North American and European geography redundancy.

Network Operations – Dedicated to Uptime

The telephony platform is monitored at all times by the always-on Five9 Network Operations Center (NOC), which has locations in the US and Eurasia and is staffed by dedicated, Five9 employees.

Scalability and Service Availability

Five9 sizes all aspects of its infrastructure to including hardware and bandwidth to allow a 20% increase in traffic. As that 20% buffer is used, we add capacity which means we are always adding capacity to the system. At no point do we allow the capacity to get over 50% of either the primary or secondary data center in either the North American theater or in EMEA. These two buffers in addition to ensuring fail over readiness in the event of a disaster means that we have available capacity for our customer base should some or many companies need to add agent capacity quickly.

Modern Infrastructure

Microservices Approach

The use of microservices doesn't automatically make for better software. Aside from the business capabilities of the application, it's possible to use a microservice based architecture and still have an unstable architecture that isn't resilient, doesn't scale and can't easily be updated. Having said that however there are some features of microservices that if taken advantage of, can lead to a solution that is more scalable, resilient, elastic, and more easily maintained.
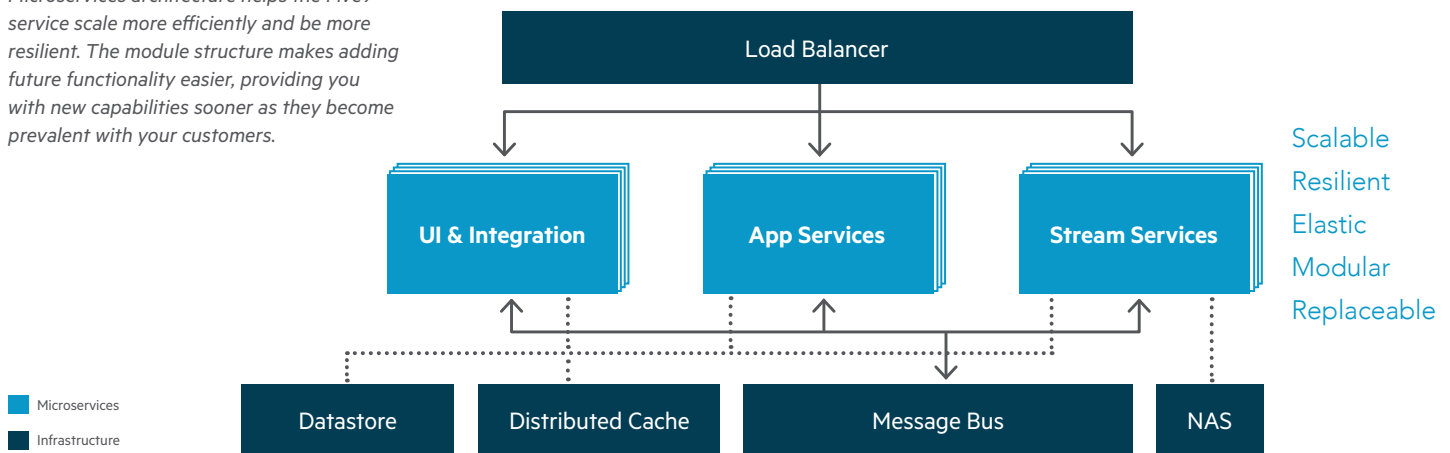
In 2015 with the Five9 Freedom release, Five9 started the migration of its architecture to microservices. At that time we created microservices for the customer service media channels including Chat, Email, Voice and Social. We moved languages and Integration elements into their own microservices in addition to other components. Amongst other benefits this enabled us to launch the updated web based agent desktop.

It also set the ground work for additional microservices work. In the 2017 summer release we created a new set of microservices to enable the Global Voice and Class 5 soft switch of that release. Both the converted code and the net new code take advantage of microservices architecture to enable more scalable, resilient, and elastic service. Voice capabilities for example can scale both vertically and horizontally as needed based on customer use. As use of voice scales for example, new processes can be spun up. If use decreases unused processes are closed. This makes the service more efficient because it doesn't lockup processing or memory if its not needed.

In addition, the benefits above, the modular nature of microservices, and specifically the well-defined REST APIs means that components are now easier to update and add. This is good for Five9 and our customers because it makes us nimbler for technology advancements such as the Internet of Things, Artificial Intelligence, and other as yet unadopted innovations.

Microservices Architecture

Microservices architecture helps the Five9 service scale more efficiently and be more resilient. The module structure makes adding future functionality easier, providing you with new capabilities sooner as they become prevalent with your customers.

Scalable
Resilient
Elastic
Modular
Replaceable

■ Microservices
■ Infrastructure

Load Balancer

UI & Integration   App Services   Stream Services

Datastore   Distributed Cache   Message Bus   NAS

Security

The security and technology risk management experts at Five9 continuously assess the threat levels of the Five9 infrastructure to maximize the level of security integrity offered to our customers, providing them with the level of service they expect and deserve.

Holistic Approach

Five9's holistic approach to security ensures multiple layers of security are present to detect and mitigate real or potential threats throughout the communication system:

- Web application and next-generation firewalls
- Intrusion prevention and detection systems
- Periodic internal and external vulnerability scanning

Routine firmware updates and testing to mitigate vulnerabilities. Updates to underlying software components as needed for identified security risks.

Administrative, Physical, and Technical Safeguards

Five9 has designed and implemented administrative, physical, and technical safeguards in accordance with a number of data protection laws, regulations, and standards including, but not limited to, the Health Insurance Portability and Accountability Act (HIPAA), Payment Card Industry Data Security Standard (PCI DSS), General Data Protection Regulation.

- Our administrative safeguards include an information security management process aligned with ISO 27001/27002; full-time security personnel; and processes for information access management, workforce training and awareness, and ongoing evaluation of the control environment
- Our physical safeguards include facility access controls and workstation/device security measures
- Our technical safeguards include controls for role-based access, audit logs, data integrity, and data transmission security

Defense-in-Depth Approach

This defense-in-depth strategy provides layers of security from the edge of the Five9 network to the core to mitigate the risk of unauthorized access or use of systems that contain confidential customer or corporate data.

Five9 has also implemented "least privilege, minimum-necessary" role-based access controls to restrict access privileges to systems containing confidential customer or corporate data only to those employees whose roles require it.

Five9 Staff

Five9 Information Security is accountable for:

- Monitoring intrusion prevention and detection systems
- Regularly performing information security assessments and vulnerability scans
- Taking appropriate actions to patch system vulnerabilities
- Promptly investigating and reporting security alerts and assessment findings to executive management
- Escalating product enhancements and improvements to engineering based on discovered vulnerabilities

The work that this team performs is essential for continuous improvement of the Five9 environment and ensures Five9 has timely visibility into security and privacy risks, issues, and incidents.

Five9 also provides ongoing information security and privacy training to all workforce members to ensure a common understanding of applicable data protection laws and regulations, as well as how to watch for and report security risks and issues to executive management. This effort is designed to promote a culture of compliance and reinforces the concepts of "Know it. Own it. Control it." with respect to data protection accountability at all levels of the company.

Defense-in-Depth Architecture:

- Palo Alto Networks next-generation and Cisco stateful inspection firewalls and Sonus session border controllers
- Hewlett-Packard intrusion prevention/detection and FireEye advanced threat awareness and protection systems
- Internal and external vulnerability scanning
- Symantec anti-virus/anti-malware
- Gemalto (Safenet) two-factor authentication and virtual private networking
- Customer data is encrypted in transit
- Call recordings can be encrypted at rest using AES 256-bit encryption

Five9 has implemented

- Stateful inspection firewalls,
- De-militarized zones (DMZs),
- Intrusion prevention
- Detection systems (IPS/IDS),
- Vulnerability scanning
- Annual penetration testing
- File integrity monitoring (FIM)
- Anti-virus/anti-malware protection
- Two-factor authentication
- Virtual private networking (VPN) to defend against cyber exposures

Continuous Improvement

Five9 annually engages an independent auditor to perform a SOC 2 Type 2 attestation covering the Trust Services Security, Availability and Confidentiality Principles.

Compliance

- Customer Proprietary Network Information (CPNI)
- Health Insurance Portability and Accountability Act (HIPAA)
- Gramm-Leach-Bliley Act (GLBA)
- General Data Protection Regulation (GDPR)

PHYSICAL
NETWORK
PREVENT
GUARD
PROTECT
MITIGATE
DATA

This spring and summer of 2017 Five9 released more than 29 enhancements to close down possible security issues identified through its security software, intrusion detection capabilities, third party security authorities and other sources.

What Has Five9 Enhanced in its 2017 Summer Release?

With every release of Five9 software we make improvements to the underlying platform that is used to provide the highly available Five9 solutions. In the 2017 summer release however we had a number of improvements come together to form a substantial set of improvements that will benefit our existing and future customers. These platform enhancements fall into a number of areas.

- Availability and Reliability
- Scalability
- Security
- Openness and integration

Environmental Changes

It may not surprise you to learn that Five9 service relies on other technology to function. From operating systems to java environments, we use technology as foundation to build our service. When choosing technology we are careful to balance new features against security and stability concerns. To that end, within our summer release we again updated a number of aspects of the underlying technology infrastructure to take advantages of bug fixes, security enhancements, and reliability improvements. We make incremental updates all the time with the service so that we can maintain a pliable platform for feature enhancements as new technology breakthroughs change consumer buying and communication habits. Some of the areas we focus on for Security, flexibility for enhancement, and stability include:

- Operating Systems
- Java containers (Centos, JBoss, etc.)
- Browsers
- Java Versions
- Third party infrastructure products
  - Shared Cache
  - Databases
- Best of Breed Five9 contact center service elements
  - Answering Machine Detection
  - Text To Speech and Speech Recognition
  - Speech Recognition
  - Work Force Optimization

For most third-party software elements, we evaluate release changes annually. In some cases based on specific release cycles or identified threats discovered we will update on an ad hoc basis.

Because of the dependence between the Five9 service and browsers we have close relationships with the leading browser providers. We are part of their release cycles, we test the browsers for compatibility during the beta phase, and release any required changes in conjunction with the general availability of those new versions to the market wherever possible.

Five9 is constantly looking at our QA process to maximize the speed of new valuable features to market and ensure high quality releases. Five9 invested substantially in this summer's release setting up new environments, enhancing our customer rollout process, and hardening our beta program so that the software does what is supposed to do and has minimal if any negative impact on your operations.

Enhanced Testing Process TAG (Test Automation Group)

Automated and manual testing is an important part of every Five9 release. As the functionality of our platform has grown the scope and depth of the Five9 testing has grown to keep pace.

As part of the 2017 summer release Five9 has significantly enhanced our testing to ensure a reliable release and pave the road for new features to enhance your customer service operations in the future. Some of highlights of this investment include:

1. Number of concurrent resources being testing has been increased

2. Role based user testing has been greatly expanded

3. Enhanced testing automation to cover the largest users of specific functions within the Five9 Service has been added

4. Environment release coexistence testing has been expanded

5. More use cases of concurrent load testing have been added

6. Additional spike test scenarios have been added

Five9 is using statistical analysis of our customer data usage to help inform the automation of our testing procedures. Because we are a cloud company and know how our customers are using the platform, we can design testing prior the release of a new version of the software that tests against that usage and ensures the smooth migration for our customers.
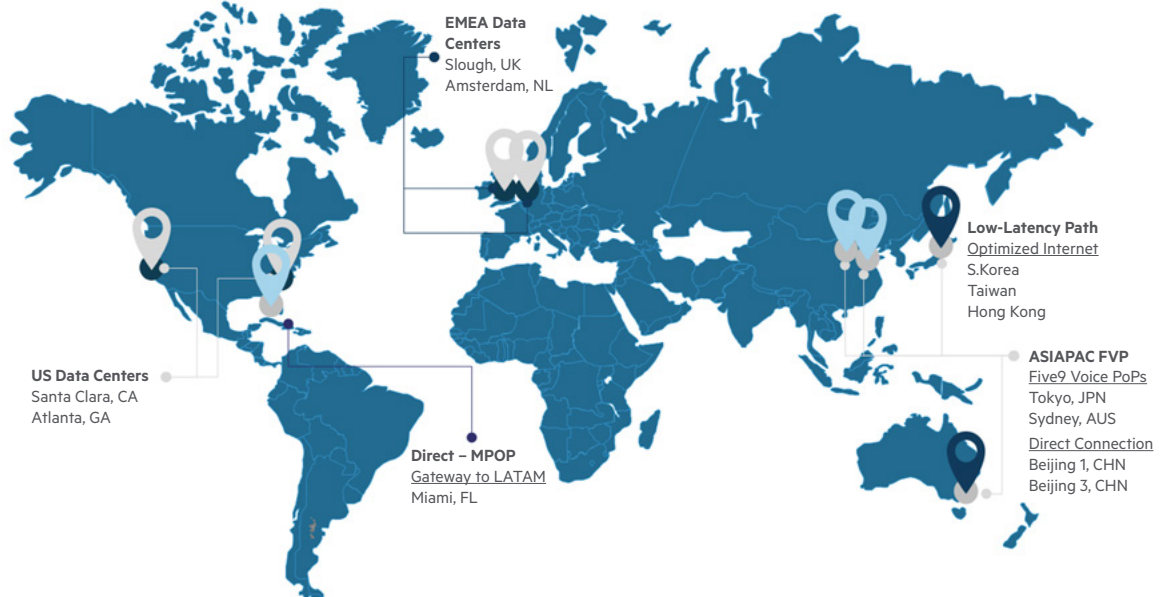
Enhanced and Hardened Soft Switch

As part of our ongoing infrastructure refresh program we will replace a key part of the Five9 service backbone. Specifically we have developed a new hardened carrier grade soft switch for insertion into the Five9 architecture. This Carrier grade switch has been designed to scale to meet the needs of our future customers while driving down the Five9 cost for maintaining that solution, freeing up that money to improve other parts of the Five9 offering.

Global Voice

Great Voice Quality for Great Customer Conversations

Five9 realizes that to have a great conversation you need great voice quality. That's why we enhanced our service to provide the highest quality voice connections that are free from Jitter, voice gaps, delay, or line noise. Your customers will think you are in the next room while in reality you can have agents located anywhere on the globe. Now you can focus on agent training, resource costs, agent location and all the other elements that go into building a great customer service operation that can creates consistently amazing customer experiences.

We leverage Amazon Web Services to build in Region PoPs. Therefore, we are able to take advantage of existing infrastructure to deliver enhanced reliability through use of multiple availability zones/regions when deploying our Global Voice Architecture.

Five9 Data Centers

Five9 Public Cloud Data Center

Five9 Direct Connectivity
China
LATAM

EMEA Data Centers
Slough, UK
Amsterdam, NL

Low-Latency Path
Optimized Internet
S.Korea
Taiwan
Hong Kong

ASIAPAC FVP
Five9 Voice PoPs
Tokyo, JPN
Sydney, AUS
Direct Connection
Beijing 1, CHN
Beijing 3, CHN

US Data Centers
Santa Clara, CA
Atlanta, GA

Direct – MPOP
Gateway to LATAM
Miami, FL

In the 2017 summer release Five9 introduced a new carrier grade soft switch that allows the Five9 service to provide in-region voice along with a global ACD. In-region voice uses strategically placed voice pops to ensure the shortest connection between speakers. This eliminates poor audio connection due to voice gaps, delay, or Jitter. When paired with a global ACD it gives enterprises the ability to create follow the sun routing strategies that look for the best possible agent for that specific customer or prospect interaction.

In addition to the in-region voice capabilities, the soft switch allows enterprises to deploy customer service operations with thousands of agents with a very high level of reliability. If a customer needs to support more agents we can add soft switch instances in a voice cluster. If a customer requires support for rapid calls in short bursts we can scale vertically by increasing processing and memory capacities.

To ensure the highest quality voice, in addition to the Five9 Voice POPs (Point of Presence) we have added to our global architecture, we have also created hop off points in China, South Korea, and other countries in order to better optimize voice paths. We will use these hop off points as part of our Smart Pathing technology ensuring that the connection from your customers to your agents is always the shortest possible path with the lowest jitter, packet loss and delay. The use of private tunnels between your agents and the hop-off points enhances the effects of Smart Pathing and helps with data in motion security of media and signaling.

Five9 Voice PoPs

Five9 has located voice pops strategically around the world to ensure customer and agents are close enough that there is no perceived delay in the voice communication. A voice pop is a way to leverage the increasingly ubiquitous network infrastructure of the world to provide local, latency free, redundant, high quality, HD voice from any location to any location in the world. The speed of light being what it is, voice communication, converted into packets and traveling across fiber can travel approximately half way around the world before a delay is perceived. By setting up Voice Pops in carefully selected locations we can ensure the distance between customer and agent is as short as possible. Time sensitive resources such as announcements, TTS, and voice prompts, voice recording as well as answering machine detection and speech recognition can be located locally.

Meanwhile, control of the routing and customer service channels can be controlled via VCC with a single contact center instance. This enables global routing strategies that take advantage of your global agent network for every customer interaction.