The 2017 Guide to WAN Architecture & Design

Executive Summary

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Introduction

2017 Guide to WAN Architecture and Design (The Guide) was published both in its entirety and in a serial fashion. The three serial publications were:

- Part 1: State of the WAN

  This section focused on providing insight into the current state of the WAN and it contained the results of a survey that was distributed in May of 2016.

- Part 2: WAN Evolution

  This section contained the description of a hypothetical company called NeedsToChange and it also contained how the sponsors of The Guide suggested that NeedsToChange should evolve its WAN.

- Part 3: Planning for a Successful Transition to a New WAN

  This section of The Guide contained a detailed call to action as well as a summary of the key WAN architecture, management and security considerations that were brought out in Part 2.

Below is a summary of The Guide.

State of the WAN

WAN Evolution

The modern WAN got its start in 1969 with the deployment of the ARPANET which was the precursor to today's Internet. In addition to the continued evolution of the Internet, the twenty-year period that began around 1984 saw the deployment of four distinct generations of wired WAN technologies and services. This deployment started with Integrated TDM-based WANs in the early 1990s and ended in the early 2000s with MPLS.

The early to mid-1980s also saw the beginning of the deployment of four generations of cellular services. The next generation of cellular services, denoted 5G, should be in production in the 2018 to 2020 timeframe.

WAN Use Cases

The vast majority of WAN use cases can be put into three broad categories:

- Connecting a distributed set of people and devices to centralized resources;
- Connecting multiple data centers;
- Providing peer-to-peer connectivity.

In many instances the WAN solution that is appropriate for one class of WAN use case is not appropriate for others. For example, a solution that is appropriate to connect multiple data centers is unlikely to be an appropriate solution for connecting mobile users to centralized resources.

Factors Impacting the WAN

The Survey Respondents indicated that the following factors were likely to have the most impact on their WAN over the next twelve months:

- Increase security;
- Reduce cost;
- Support real-time applications such as voice and/or video;
- Provide access to public cloud computing services;
- Prioritize business critical traffic.

Concerns with WAN Services

The following table identifies the concerns, listed in descending order of importance, that network organizations have with their use of MPLS and the Internet.

| Table 1: Concerns with WAN Services	
Concerns with MPLS	**Concerns with the Internet**
Cost	Security
Uptime	Uptime
Latency	Latency
Lead time to implement new circuits	Cost
Security	Packet loss
Lead time to increase capacity on existing circuits	Lead time to increase capacity on existing circuits
Packet loss	Lead time to implement new circuits
Jitter	Jitter

Some of the limitations that are associated with cellular services include variable signal coverage, link setup latency and constantly evolving specifications; i.e., 4G, LTE, XLTE, 5G.

Satisfaction with the Current WAN Architecture

Only a third of organizations are either very satisfied or completely satisfied with their current WAN architecture. This indicates that a large portion of the WAN marketplace would likely be receptive to alternative WAN architectures.

Location of WAN Functionality

In contrast to traditional WAN architectures, in the emerging WAN architectures there are a number of places to host functionality such as orchestration, control and security. **Figure 1** highlights the places where network organizations think such functionality should be located based on a survey question that allowed for multiple answers.

Figure 1: Location of WAN Functionality
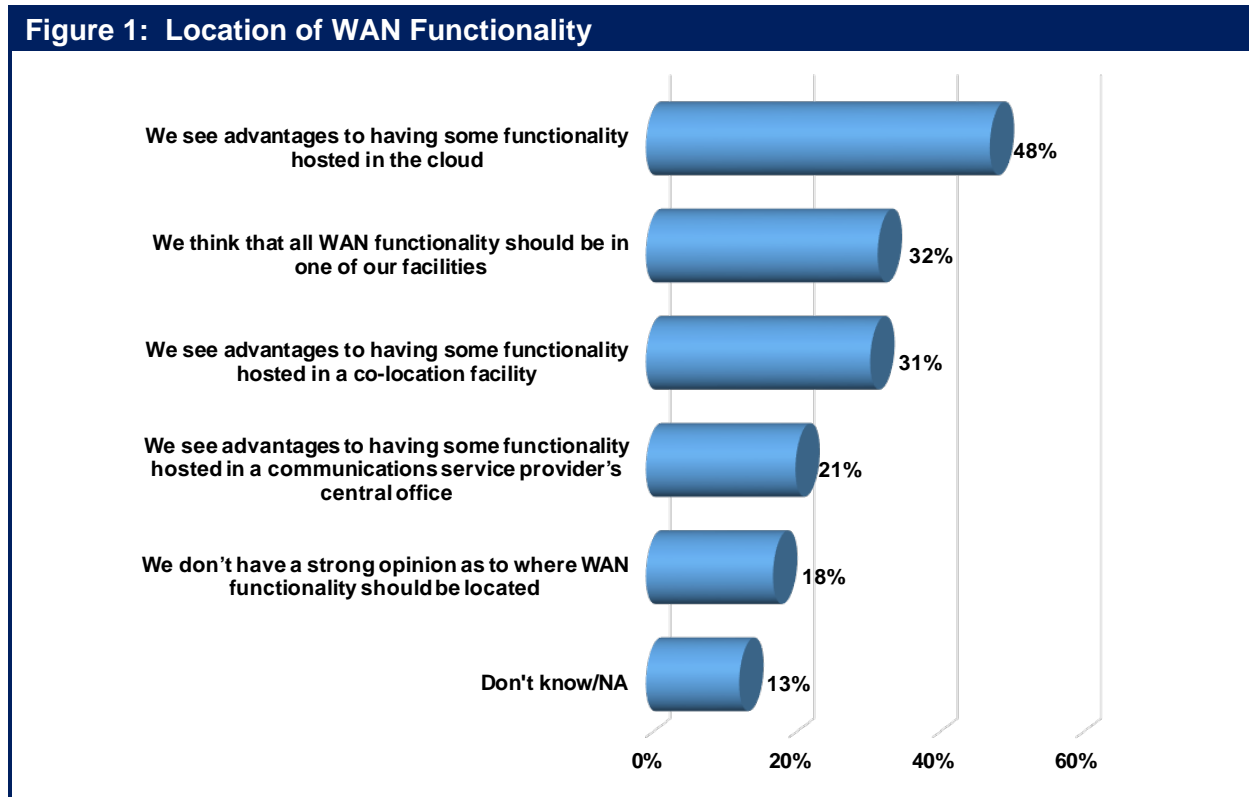
Choice of Implementation Options

When network organizations evaluate new WAN solutions they have a variety of implementation options to consider. The bullet list below indicates the options that network organizations prefer based on a survey question that allowed for multiple answers.

- Do-it-Yourself (DIY): 54%
- Managed Service: 42%
- Network-as-a-Service (NaaS): 27%

Choice of Vendors

Whenever there is a transition point in IT there is the potential that some vendors will gain market share and that some will lose market share. Based on a survey question that allowed for

multiple answers, 27% of the respondents indicated that it was highly likely that their organization would stick with their incumbent vendor for a new WAN solution. 22% said that their organization would actively seek alternative vendors.

WAN Management

The visibility that network organization have into their WAN for troubleshooting problems related to network and/or application performance degradation is shown in **Figure 2.**

Figure 2: WAN Troubleshooting Visibility
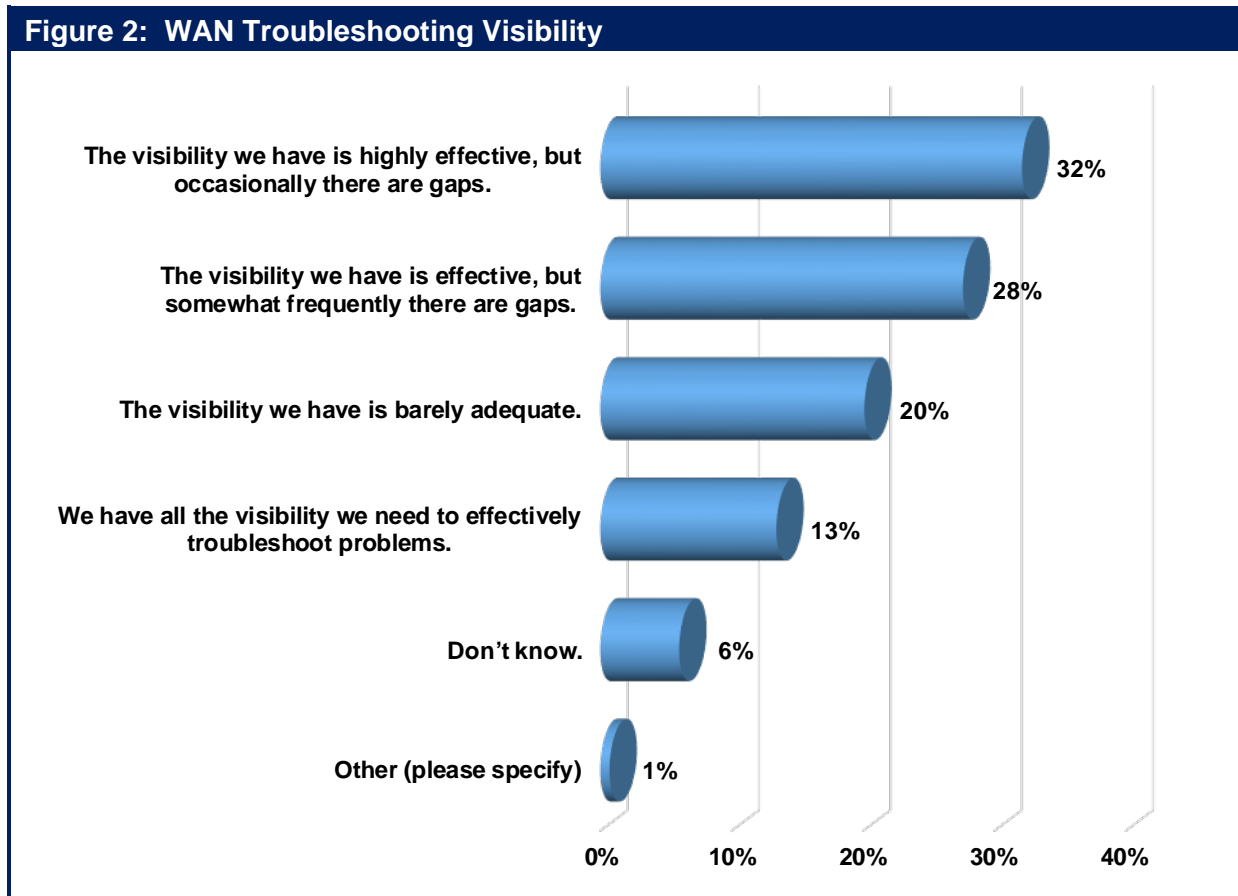
The deployment of new WAN solutions is an opportunity for network organizations to improve on their ability to troubleshoot the WAN and hence improve their ability to support the company's critical business processes.

Planning for a Successful Transition to a New WAN

Call to Action

Below is a brief outline of some of the key components of a project plan for evaluating new WAN solutions.

- **Identify the Focus and Extent of the Project as well as the WAN Challenges**

  As previously discussed, there are varying types of WAN use cases and as part of creating a project plan, the network organization needs to decide on which WAN use cases the project will address.

  In conjunction with the key stakeholders, the project team needs to determine how broad and how deep of an analysis it will do. A broad and deep analysis can yield more insight than would be produced by a more cursory analysis. However, the broader and deeper the analysis the more it costs and the longer it takes.

  The project team should identify the WAN challenges that they are currently facing or expect to face and use these challenges to structure their analysis of alternative WAN solutions. The project team should also assign a weight to each challenge. The challenges and the weights that are assigned to them should be reviewed with the key stakeholders.

- **Create an Effective Project Team and Choose Vendors**

  As part of evaluating alternative WAN designs, there are a number of components of each design that need to be analyzed. One viable option is to create a project team where each team member is a subject matter expert (SME) on one of the components.

  One way to choose vendors is to enter into a high level conversation with what the team determines to be a feasible set of vendors. If the content of those conversations impresses the team, they can do a deeper analysis with a short list of vendors who they believe can best meet their needs.

- **Manage existing contracts**

  One possible decision that a network organization could make after evaluating alternative WAN designs is to decide to significantly reduce their use of MPLS. The implementation of that decision might not be possible in the short term based on the contract that the organization has with their WAN service provider. This isn't necessarily a major problem as few companies would want to do a flash cut of a new WAN architecture. An approach that incorporates the need to minimize the risk of implementing a new WAN architecture, with the need to honor existing contracts, and the typical requirement to work within the current manpower limits of the network organization is to phase in the new WAN architecture over time.

- **Build a business case**

  The easiest and most compelling way to build a business case for a WAN upgrade is to base the business case on hard savings, such as the reduction that results from cancelling an MPLS service and replacing it with a less expensive Internet circuit. Upon completion of a POC, network organizations should be able to accurately calculate these potential savings

  Soft savings, such as improving flexibility, while important, can be both harder to measure and more difficult to use as justification for upgrading the WAN.

Key WAN Architecture and Design Considerations

Below is a description of some of the considerations that network organizations need to include in their evaluation of alternative WAN architectures and designs.

- **The Role of Cellular**

  Cellular services have long been used as a back-up to wireline WAN services. Increasingly cellular services are being used as either the primary WAN link or are used in conjunction with a wireline service in an active-active configuration.

  Some of the other key use cases for cellular services in an enterprise WAN include supporting:

  - Temporary networks;
  - In-vehicle networks;
  - The Internet of Things (IoT).

- **Location of Key WAN Functionality, the Use of Policy and Support for Real-Time Applications**

  In a traditional WAN, functionality such as optimization is typically provided onsite. However, as previously described currently there are a number of other options for where to house key functionality. In many instances network organizations will find that the best solution is for WAN functionality to be located in multiple types of sites.

  Functionality currently exists that enables dynamic load balancing over WAN links to be done based on a combination of policy and the characteristics of the WAN links. Since there are differences in terms of how this functionality is implemented, network organizations need to understand what those differences are and what the impact of those differences is.

  There are a number of ways that a WAN can provide support for real-time applications. One way was already mentioned – the use of a policy engine that can steer certain traffic to the most appropriate WAN link. In some cases, the optimization techniques that are mentioned below can make it easier to support real-time applications.

- **Optimization**

In many instances, optimization functionality can significantly improve application performance. Relevant optimization functionality includes:

- Data Reduction:
  - Data Compression
  - Differencing (a.k.a., de-duplication)
  - Intelligent Caching

- Mitigate packet loss:
  - Congestion Control
  - Forward Error Correction (FEC)
  - Packet Reordering

- **Security**

As they examine new WAN solutions, network organizations need to look at functionality such as firewalls and determine whether that functionality should be in a branch office or in a central site. They also need to evaluate whether or not to implement other security functionality, including:

- Encryption
- Device authentication
- URL filtering
- Network access control

- IDS/IPS
- Micro-segmentation
- Anti-malware

- **Automation**

The use of policy for managing application performance was already discussed. Another use of policy is for device configuration and security policy management. Some WAN solutions make it possible to create device configurations and security policies in a centralized location and push them out to branch offices in a way that requires no manual intervention at the branch offices.

- **Customer Premise Equipment**

The emerging set of WAN solutions offer alternatives for the customer premise equipment (CPE) that is deployed both at the branch office and at the data center. One alternative is whether the network organization wants to continue to use their existing routers or to replace them with a new device, either initially or over time. Another consideration is the ability of the CPE to support the dynamic insertion of multiple L4 – L7 services.

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Jim Metzler has a broad background in the IT industry. This includes being a software engineer, an engineering manager for high-speed data services for a major network service provider, a product manager for network hardware, a network manager at two Fortune 500 companies, and the principal of a consulting organization. In addition, he has created software tools for designing customer networks for a major network service provider and directed and performed market research at a major industry analyst firm. Jim's current interests include cloud networking and application delivery.

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