White Paper

SLA Compliance:
Wireless Fidelity Achieved

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Introduction

Networks are living creatures, ever-growing, ever-changing, and Wi-Fi networks change even more quickly and in more ways than wired networks. New APs are deployed, neighboring networks pop up, clients roam, data rates change, flash crowds converge on one part of the network. Users love the freedom and mobility, but they also are demanding that IT consistently deliver them predictable performance in spite of the dynamic nature of the network. Wi-Fi networks are getting faster and smarter and that helps. But Wi-Fi administrators are still hampered by having minimal visibility into how well they are actually delivering what their users expect. They don't have visibility into the actual performance level being provided to the Wi-Fi clients by the infrastructure and their infrastructure only has limited ability to dynamically adjust to deliver the experience their users are demanding. Today's Wi-Fi administrators can only hope their clients are getting the planned level of performance - and that isn't good enough.

Before Wi-Fi protocol analyzers, administrators and consultants alike were only able to troubleshoot by continually reviewing the network design of and device operation within the network infrastructure. Gathering meaningful performance statistics and performing trouble analysis and repair was difficult, if not impossible. With the introduction of Wi-Fi protocol analyzers, these professionals had the equivalent of RF goggles. They could now see what was happening and could reactively troubleshoot problems. The problem with this approach is a lack of ability to properly diagnose and repair performance problems in near real-time. With this in mind, Aerohive has introduced the next level in network visibility and reactive response. Aerohive's new infrastructure-side performance monitoring and response system, dubbed SLA Compliance, increases the troubleshooting granularity and active response speed far beyond what any IT professional could accomplish manually and paves the way for IT to move towards actual performance guarantees.

Wi-Fi That Works

Some call it Wi-Fi Utility. Others call it network determinism. We call it Wi-Fi that works. The IEEE's plan for the 802.11 standard has always been to implement inter-AP protocols to do the work of client handoffs, spectrum management, and much more. Aerohive aligned its thinking and methodology with that of the IEEE, building its own high-performance Cooperative Control protocols between its HiveAPs. Then the Wi-Fi Alliance began with an advertising slogan of, "The Standard for Wireless Fidelity." Again Aerohive has answered that call, implementing real *Wireless Fidelity*, when defined means: adherence, reliability, integrity, precision, and surety.

We believe that there should be some baseline of performance that you can count on – or even better – guarantee. Every network technology has to start somewhere and then progress forward. First, Ethernet was established in data centers, and then in distribution and access layers. Next a variety of Internet access technologies such as dial-up and ADSL were introduced. Now it's Wi-Fi's turn. We take most of these connectivity technologies for granted, and Wi-Fi should be no different. There are several parameters that factor into utilitarian networking. Let's take a look at some of those factors.

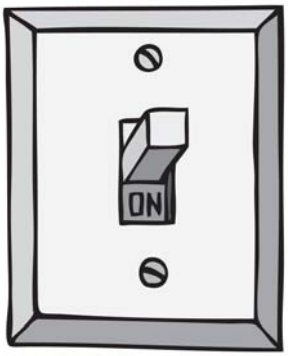
A Simple Machine

Does it work every time you need it? If you haven't tinkered with it in a while, will it still give you unwavering dependability? Unfortunately, the answer is often no. So, the

challenge is to build the equivalent of a networking simple machine. We know that a lever, a pulley, or an inclined plane is going to function every time. It's in their nature. That's what we need here as well, only we're dealing with over 2,600 pages of the IEEE 802.11 standard (with amendments), so that's no simple undertaking. The concepts we're talking about are *reliability*, *availability*, and *predictability*.

The first rule of building a reliable system is to remove all unnecessary parts, and that is where *simple* machines get their names. One relevant example of minimization: replacing a Wi-Fi controller with inter-AP protocols. Protocols are either on or off (refer to Figure 1). They don't experience wear and tear, they don't use any power, they don't require licensing or warranties, and they don't take up space in a landfill when they die. And make no mistake, controllers die.

Figure 1: Utilities Offer Two Options: On / Off



When your network is mission critical, nothing less than *just works* will do. Words like *partially*, *mostly*, and *sort of* just won't cut it.

Industry Response To-Date

Vanilla 802.11 is a distributed free-for-all, devoid of certainty, and where Wi-Fi is used only as a network of convenience, performance is often near the bottom of the priority list. Due to Wi-Fi's transition to mission-critical status in the enterprise, vendors have been incrementally delivering features that offer measures of improved performance. These features generally fall into two categories: *prioritization* and *optimization*. You may have heard of some of them: WMM QoS, Bandwidth Management, and Airtime Fairness. Some of these features are better than others, and all of them are a step in the right direction, but they are simply pieces of a larger puzzle.

Today's leading enterprise-class Wi-Fi solutions attempt to optimize client performance and deliver predictable behavior. However, they are unable to effectively report on whether they were successful in delivering this performance and have no automated response mechanism for when they are unsuccessful. This is where Aerohive has innovated. Aerohive's new *Performance Sentinel* and *Airtime Boost* features provide network administrators with unprecedented levels of Wi-Fi visibility and determinism by monitoring every client's throughput performance against its predefined service level agreement (SLA). Additional airtime is automatically allocated to those clients that are not meeting their SLA so that they can be moved into compliance. These two features are each a *first* in the Wi-Fi industry.

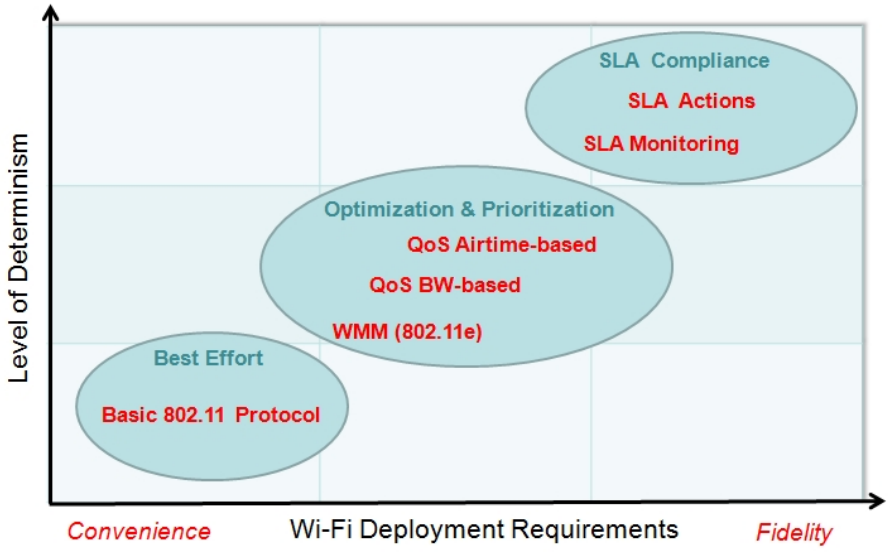
The Big Picture

Real wireless fidelity requires a holistic approach to SLAs. Figure 2 illustrates the industry's step-by-step progression toward SLA monitoring and actions. A holistic approach must include the ability to ensure a throughput requirement is achieved through:

- **SLA definition & monitoring**
  - Enables the administrator to specify a minimum throughput threshold
- **Problem analysis**
  - Isolates problems down to client or AP when there is a violation
- **SLA actions**
  - Dynamic resource allocation to recover from violations

SLA visibility, fault-recovery actions, and in-depth analysis will allow the network administrator to see the big picture while the Wi-Fi platform does all of the work.

Figure 2: The Progression from Convenience to Fidelity



What does Ms. Smith, the payroll clerk, care about WMM traffic prioritization or airtime scheduling? She doesn't. She, like all other Wi-Fi users, wants to know that her network connection will give her what she's supposed to have wherever and whenever she goes. She wants a guarantee. It's just that simple.

Ms. Jones, the network administrator, wants something too, but her perspective is different. Ms. Jones wants Ms. Smith to get the expected network behavior, and if that doesn't happen, she wants to know when, why, what action was taken, and whether or not the action repaired the problem. Before this can happen, SLAs must be defined, monitored, and enforced.

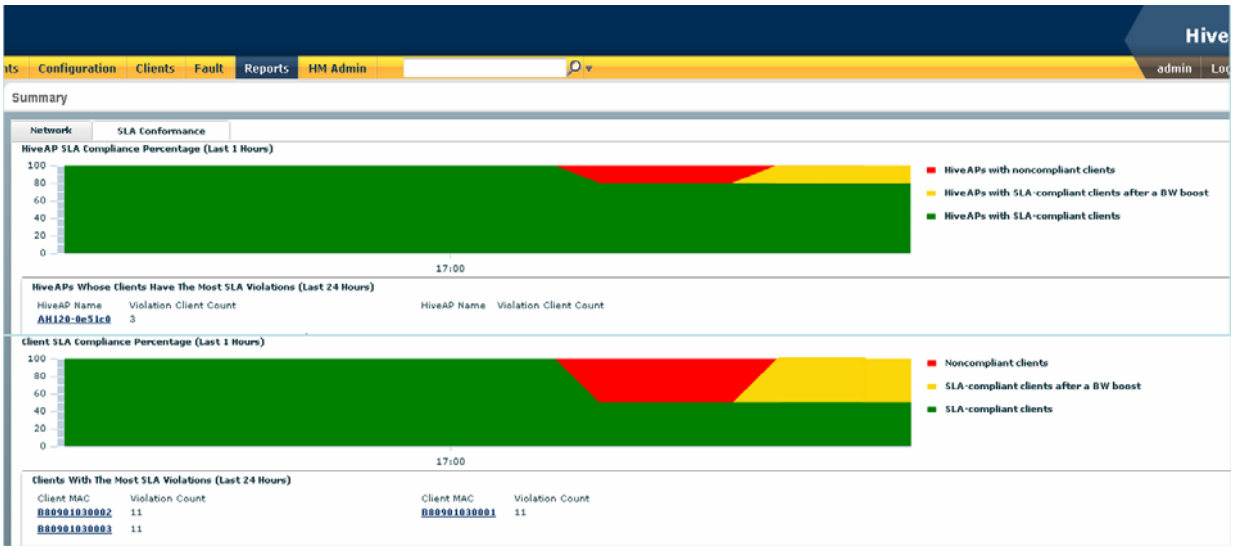
SLA Compliance – How It Works

Aerohive now delivers two industry firsts, introducing a new realm of determinism and network visibility. These two features enable IT, for the first time, to establish, monitor, and deliver throughput guarantees for Wi-Fi clients.

Performance Sentinel

In order to monitor the network, Aerohive has introduced *Performance Sentinel* – a client throughput service level monitoring engine. Performance Sentinel characterizes whole-network performance, from a throughput perspective, and reports on achievement from a single dashboard (e.g. 98% of our clients achieved 3 Mbps throughput or greater for the last 3 months). In Figure 3, HiveManager's SLA reporting shows that 3 clients on a single AP were in violation of the SLA (Red). When Airtime Boost (discussed in the next section) is enabled, reporting shows all clients and APs are SLA-compliant, 3 clients being compliant as a result of the Airtime Boost action (Yellow).

Figure 3: Network Visibility (APs & Clients) – The Dashboard



Performance Sentinel compares client throughput and demand with a predefined throughput SLA level by:

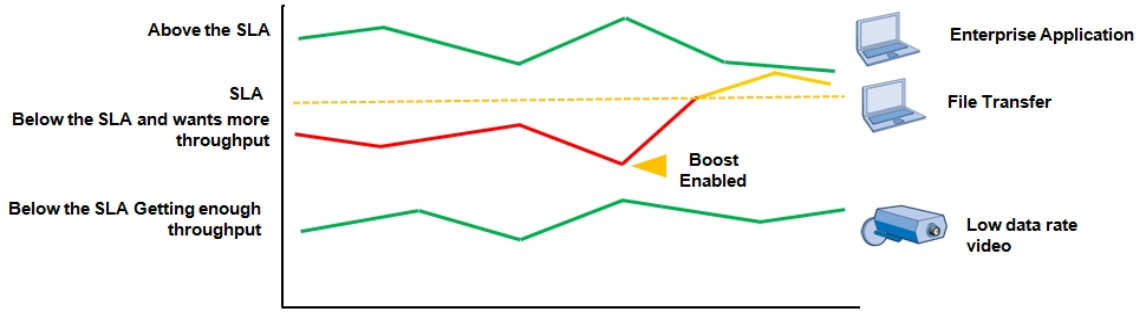
- Using client data statistics to determine client throughput
- Using buffer statistics in the QoS engine to determine if a client is actually trying to download more data

In addition to client-side visibility, APs can also be monitored to pinpoint which had clients with SLA violations, which could be the result of interference or capacity problems.

Airtime Boost

In order to provide automatic recovery action for stations not meeting their SLA, Aerohive has introduced Airtime Boost – a feature built on Aerohive's innovative Dynamic Airtime Scheduling engine that automatically allocates additional airtime to lagging stations. Airtime Boost is the first available among multiple actions that may be taken in an Aerohive system to assist a struggling client in meeting its SLA.

Figure 4: Airtime Boost Functionality

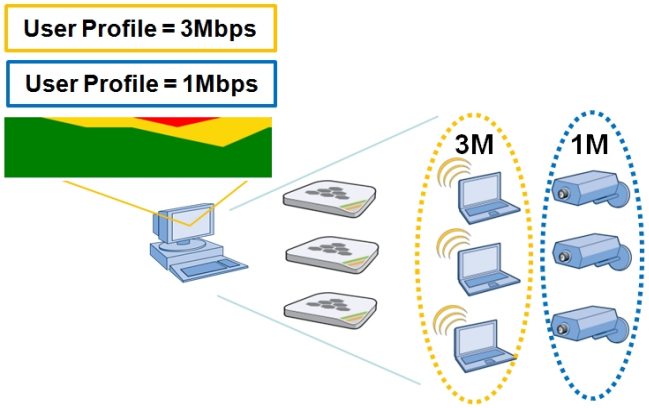


Aerohive's Dynamic Airtime Scheduling feature allows fast clients to achieve high throughput and slow clients to achieve their normal level of throughput without unfairly penalizing either client type. Applying Airtime Boost technology to user profiles allows IT to pre-configure the system to assist particular stations in achieving their SLA when a problem is noted by Performance Sentinel.

Now IT can create different classes of clients (user profiles), give them different SLA levels, and have the system automatically respond if they are not being met. Some examples:

- Medical imaging clients need 6 Mbps throughput to work properly
- Administration clients work fine with 3 Mbps throughput
- Guest clients could be set at 1 Mbps and only logging non-compliance

Figure 5: Airtime Boost: Building on Dynamic Airtime Scheduling



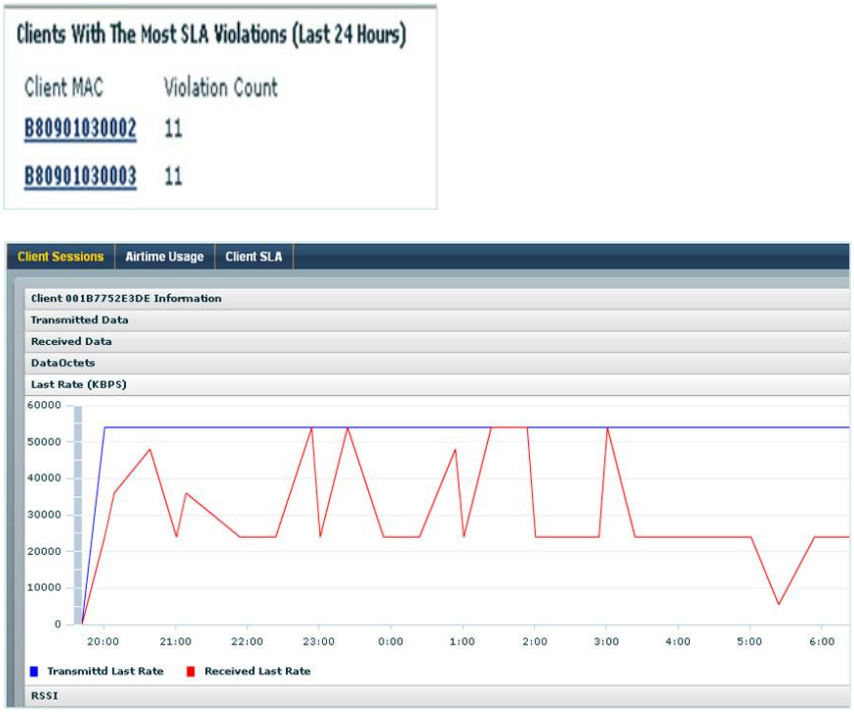
The Drill-Down

IT administrators now have a dramatically-simplified client performance analysis engine that:

- Easily isolates problems to client or AP when there is an SLA violation, before the user has had time to complain
- Provides simple drill-down to a rich set of statistical information on the client or AP, including: identity, data sent/received, data rates, RSSI values, performance, errors, interference, load, and airtime usage

Top offender lists are provided along with compliance history.

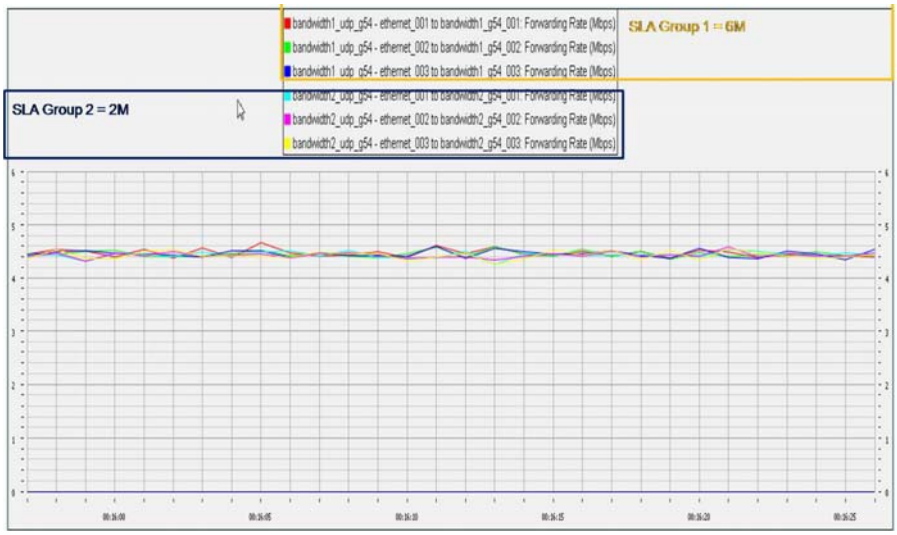
Figure 6: Drilling Down Into Client Sessions



SLA Compliance – Making It Happen

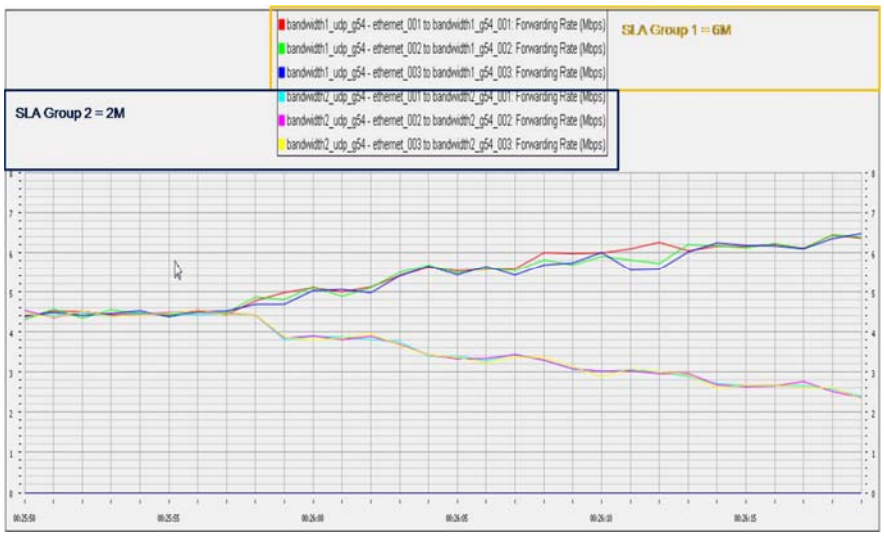
Let's look at an example of the power and usefulness of SLA compliance features. In Figure 7, Group-1 has a client SLA of 6 Mbps, and Group-2 has a client SLA of 2 Mbps, but neither group has any SLA actions set. For that reason, all 6 client devices have similar throughput, although Group-1 clients are in violation of their SLA.

Figure 7: Example 1



In Figure 8, Airtime Boost is enabled. Group-1 clients are automatically given more airtime, which decreases the throughput for the clients in Group-2 but still keeps them performing above their SLA. In this scenario, the actions taken by Airtime Boost allow clients in Group-1 and Group-2 to achieve their SLA throughput levels.

Figure 8: Example 2

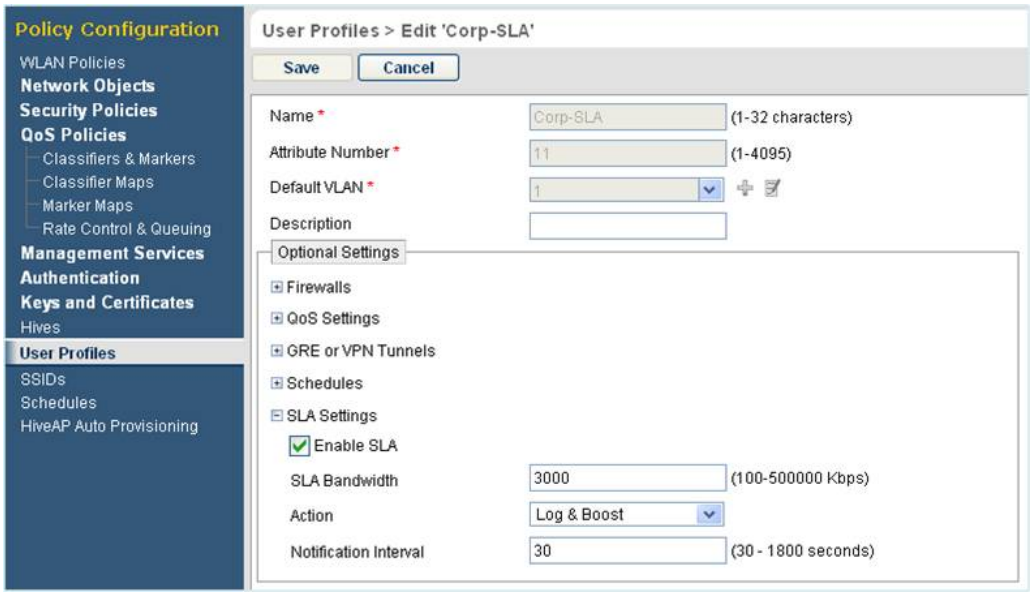


It really is as simple as that. Sure, there's some rocket science behind it, but the administrator will never have to see all of those details. Making the magic happen is *our* job.

Configuration

In HiveManager's User Profile configuration section, it's only a matter of enabling the SLA feature with a click, choosing a bandwidth value, and then choosing your action from the list in the drop-down.

Figure 9: SLA Configuration in HiveManager's User Profile



Again, this is a simple machine. We believe that when it comes to user interfaces, it's a matter of simplify or die.

Conclusion

Aerohive has again innovated to bring its customers market leadership in wireless determinism through performance guarantees, architecture simplification, high-performance, and low cost. The ability to set SLA parameters per user group, to monitor SLA statistics in real-time, and to take significant corrective action when and where needed is an industry first and is included in Aerohive systems at no additional cost. The goal of delivering a level of wireless fidelity that allows applications to be moved from the wire to the air has been achieved. Now wireless can truly become the primary access layer.

