NOMADIX®

LOAD BALANCING WHITE PAPER

OPTIONS FOR HANDLING MULTIPLE ISP LINES AT HOTELS

30851 Agoura Road, Suite 102
Agoura Hills, CA 91301
818-597-1500 Main
818-575-2480 Sales
www.nomadix.com

NOMADIX®

CONTENTS

1. RELATED DOCUMENTS

• Load Balancing Data Sheet

2. GLOSSARY OF TERMS

The following table describes commonly used terms throughout the document.

TERM	DESCRIPTION
DSL	Digital Subscriber Line
ISP	Internet Service Provider
HSIA	High-Speed Internet Access
WAN	Wide Area Network
NSE	Nomadix Service Engine

3. PURPOSE

In this day and age, most hotels can grant their guests the ability to conveniently connect their laptops, smart phones, iPads and other mobile gadgets to high-speed Internet access (HSIA), allowing them to finish emergency work projects, check the scores during the big game or keep in touch with their loved ones. Because of the high-usage traffic, hotels usually opt to use multiple Internet service providers (ISPs) and/or wide area network (WAN) sources to keep the Internet speed fast and dependable—and their guests happy.

In order for this to occur seamlessly, the necessary use of ISP load balancing and/or failover features comes into play. There are several ways for hotels to implement these features, and this document will describe the advantages of each specific option to best suit the needs of an establishment.

4. BACKGROUND

4.1 DEFINITIONS AND CONCEPTS

4.1.1 Load Balancing

The Nomadix service engine (NSE) supports load balancing, which is the process of assigning all HSIA-using guests to any of multiple ISP connections. It's up to the hotel to decide which guests will use which connection, as well as what each connection will allow the users to do.

4.1.2 Link Aggregation

NSE also supports link aggregation, which is the process of channeling all of the different ISP connections to a specific appliance, where all of the users share the resulting bandwidth. This means that each user's access is only as fast as the ISP connection currently in use. For example, a hotel will aggregate five 1.5Mbps (or 1.5 megabits per second) digital subscriber line (DSL) connections together. This means the user community divides the total 7.5Mbps among themselves equally—with each single user receiving a 1.5Mbps maximum speed. Hotels oftentimes achieve the same result with link aggregation as they do with load balancing.

4.1.3 Channel Bonding

Channel bonding occurs when a hotel installs a router that combines several low-speed circuits together to create a single high-speed link. This option was popular among hotels in the past, when telephone circuits like T1 or E1 lines were the only options available for making HSIA available to guests. Where this option is still used, the circuits must be integrated with a switch owned by the ISP. Although some appliances still support this process, NSE does not.

4.1.4 Link Failover

Link failover (or ISP redundancy) means providing a second/additional ISP link to serve as a backup in case the primary ISP link fails. In this case, all user traffic is rerouted to the backup link until the primary link becomes available again. This option ensures that ISP/WAN links don't fail at the same time. All appliances with load-balancing capabilities, including NSE and NITO, support link failover.

4.1.5 Combined Load Balancing and Link Failover

The process of combined load balancing and link failover has been described as the best of both worlds. If several ISP links are in use and some of them fail, all user traffic is automatically rerouted to the links that are still working. When the failed links become available, new connections route to the recovered links until the link loads are balanced again. Most third-party load balancers, as well as NSE, support combined mode.

4.1.6 ISP Link Selection Criteria

If a hotel decides to use a load-balancing option for their HSIA service, it must choose which ISP to select for outgoing traffic. This decision depends on the answers to two questions:

1. Should certain users be steered toward a particular ISP?

2. Should link selection be determined by particular user, website address or session-specific information?

4.1.7 User-Based ISP Selection versus Random ISP Selection

If the hotel chooses for certain users to be steered toward specific links, it will utilize user-based ISP selection. This means that the load balancing depends on each user's identity, like guest-room users or conference-room users. These two groups would use two separate ISP links.

The alternative is to use random ISP link selection, where the load balancer or NSE selects which ISP to use depending on the current load conditions. New traffic would route to the link with fewer users. NSE uses this route by default.

4.1.8 Traffic-Type-Based ISP Selection

Traffic-Type-Based ISP selection occurs when the ISP link selection depends on the type of traffic rather than the identity of the user. Types of traffic are usually defined by Transmission Control Protocol (TCP) or User Datagram Protocol (UDP) port numbers. For example, all Hypertext Transfer Protocol, or HTTP (TCP port 80), subscribers use one link, and all other traffic types use another. Some third-party load balancers can support this option, but NSE does not.

4.1.9 Additional Concepts Regarding ISP Link Selection

In order for a hotel to use a load-balancing solution for its HSIA, it must incorporate Network Address and Port Translation (NAPT) technology. When multiple subscribers use a hotel's HSIA, each user has a unique IP address. NAPT translates these unique addresses to one (or more) public IP addresses provided by the ISP. When multiple ISP links are available, the load balancer or ISP chooses which ISP link (and public IP address) to send converted users to. This depends on the desired load and current traffic conditions.

Every user traffic session (or source to destination IP address pair) needs its own individual NAPT session. There are three options for hotels to choose from when selecting an ISP link for each NAPT session:

1. NAPT sessions from the same source IP (user) always use the same ISP link.

2. NAPT sessions from the same source IP and to the same destination IP use the same ISP link.

3. NAPT sessions from the same source IP can use any ISP link.

If there are a lot of different source IP addresses, then, statistically, each option will load balance equally. When there are only a few IP addresses (which can happen when a gateway is connected to a third-party load balancer), option two or three will provide the most effective load-balancing scenarios.

However, options two and three can sometimes interrupt the normal operation of some applications, such as virtual private networks (VPNs) or specialty apps like video conferencing. This can occur because these apps use multiple TCP and/or UDP sessions that seem to originate from the same source address.

Most third-party load balancers are capable of executing any of these three options. NSE can distinguish between every source IP address, so it only uses option one.

4.1.10 Link-Availability Detection Method and Time

Whether hotels decide to use load balancing or failover, some form of ISP link availability monitoring is necessary. This can be executed in one of two ways:

1. Occasionally checking on link traffic by using HTTP or Internet Control Message Protocol (ICMP) ping requests.

2. Occasional Domain Name System (DNS) queries to the DNS servers provided by each ISP.

The time between each link test is usually set to 30-60 seconds. This time period also represents how long a user will remain connected to a failed ISP connection before getting rerouted to the backup link.

Most third-party load balancers provide only option one, but NSE can use either method. In general, option two is easier to configure, and it provides a more thorough link test (an ISP with a broken DNS will not work).

4.1.11 Traffic Balancing and Weighting

Load balancers "weight" between links to maintain equal user traffic. NSE balances traffic by individual subscriber numbers, which are weighted according to the speed of the ISP connected to each port. For example, if an NSE has 100 active users and two 10Mbps links connected and available, then 50 users would weight to each link. If the ISP links were 10Mbps and 40Mbps, then 20 users would weight to the 10Mbps link and 80 users would weight to the 40Mbps link.

Some third-party load balancers provide more advanced balancing and weighting tools that are more complex to configure.

4.1.12 Load Rebalancing Upon Link Recovery

When the link-availability detection of load balancing and failover is well configured, users are quickly and effectively rerouted in ISP link-failure situations. When a failed ISP link recovers, there are three options for hotels to consider in order to achieve balance once again:

1. Do nothing—the normal coming and going of users will achieve the desired balance.

2. Execute a hard rebalancing of ISP links.

3. Execute a graceful rebalancing of ISP links.

Hotels can implement option one by letting the link loads balance naturally through time; they don't have to interfere in any way. With a relatively short idle timeout, a balance will be reached within a few hours.

Option two directs the load balancer to reassign users to different ISP links in order to achieve an immediate balance (this includes active TCP and UDP sessions, as well as VPN connections). Executing this option may break existing sections, because current NAPT sessions will be terminated when new external source IP addresses are created during this process. Most of the time, this interruption will not be noticed—it only lasts a few seconds.

An immediate rebalance is attempted with option three, but any active TCP or UDP sessions are left intact until they time out naturally. Until the sessions end, some users may experience Network Address Translation (NAT), where they are sent to different ISP links, and will acquire a new IP address.

NSE supports options one and two, and will be able to manage option three in the future.

5. HOTEL REQUIREMENTS AND TYPICAL USE CASES

Before hotels choose a load-balancing or failover solution, they must determine the requirements of their properties (individual and/or as part of a chain), such as local ISP conditions and costs. Questions to answer include:

1. Is load balancing required or just ISP failover?

2. Is aggregation of multiple low-speed links required?

3. How reliable are different local ISP services?

4. What are the relative costs of different ISP services?

5. Must guests and back-office users share ISP links?

6. Should certain users connect to a particular ISP?

1. Is Load Balancing Required or Just ISP Failover?

Sometimes, just a backup failover option to connect to the primary ISP service if the main HSIA ISP fails. Hotels can use a pay-to-use wireless service through a 3G or 4G, or a low-cost, lower-tier service like through a cable modem. This reduced service would only activate if the main HSIA ISP fails.

On the other hand, hotels might want to use multiple ISP links under normal conditions. In this situation, a load-balancing service would be necessary.

NSE supports both of these options.

2. Is Aggregation of Multiple Low-Speed Links Required?

Suitable high-speed Internet services are occasionally unavailable or too expensive. In this case, hotels can aggregate, or combine, multiple lower-cost, lower-speed lines to create one high-speed line. The Nomadix AG2400 and AG5600 can aggregate services from up to three ISP links, and the AG5800 can handle up to five links.

3. How Reliable are Different Local ISP Services?

If a second link is much lower quality than the main ISP link, then it should only be used as a backup link in a failover situation. If the links are the same quality, then load balancing with failover should be used.

4. What are the Relative Costs of Different ISP Services?

If all links have a fixed monthly charge, hotels should ideally use them all in a load-balanced mode to make sure no costly links are sitting unused. If an ISP link has a relatively low monthly charge with high per-megabyte data-usage charges, then hotels should use these links only as backup links in failover mode.

5. Must Guests and Back-Office Users Share ISP Links?

It may be required for guests and back-office users to share ISP links, or enable each network to serve as a failover for the other. NSE can handle either scenario. See examples 5.1.3 and 5.1.4 below.

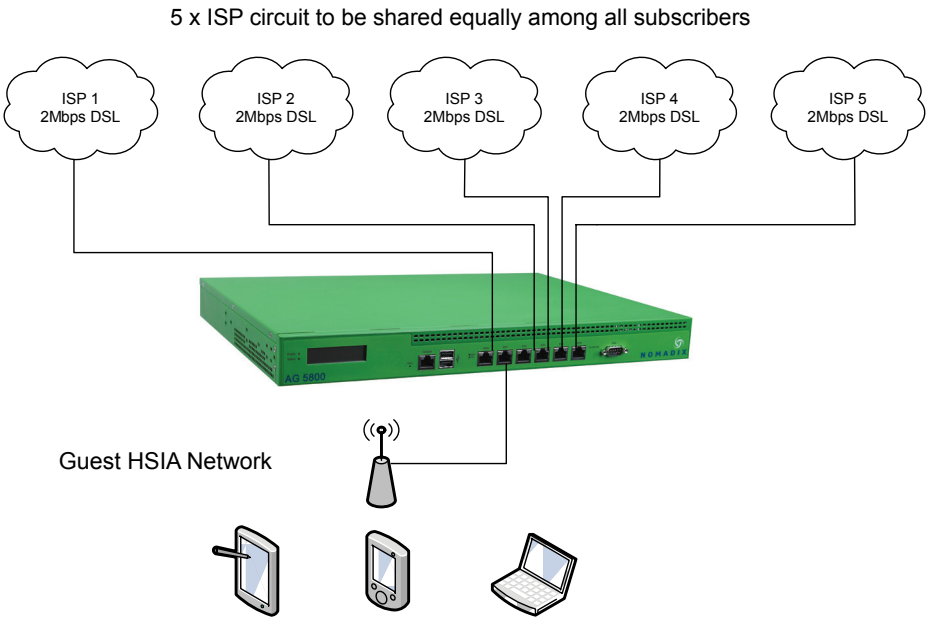
6. Should Certain Users Connect to a Particular ISP?

Hotels may prefer to have certain users connect to particular ISP links. For example, paying users will connect to the more expensive, high-quality link, with non-paying users connecting to a lower-quality link. Hotels can still enable failover between the two links. This can be accomplished through use of a preferred WAN radius attribute, which can be accomplished through above gateway management systems.

5.1 EXAMPLES OF TYPICAL DEPLOYMENT SCENARIOS

5.1.1 Load Balancing Across Multiple Low-Speed Links

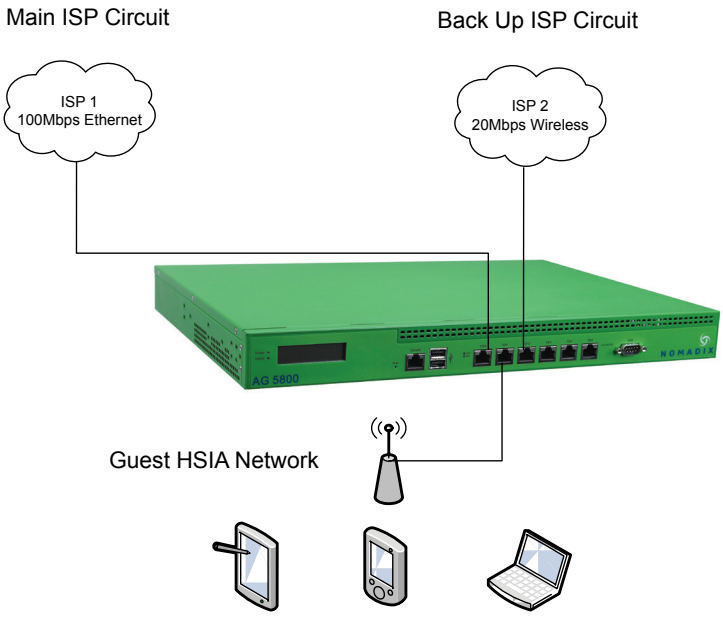
In this example, a hotel has access to only low-speed DLS-based ISP circuits. It wants to aggregate five of these links together to create one high-speed, high-quality link. NSE is configured with load balancing between all links.



5.1.2 Failover to Standby ISP Link

In this example, a hotel has a high-quality 100M Ethernet service. The hotel has a backup ISP service through a low-cost wireless provider that charges on a data-volume basis. Therefore, the hotel only wants to use this link for failover purposes if the primary ISP link is not available.

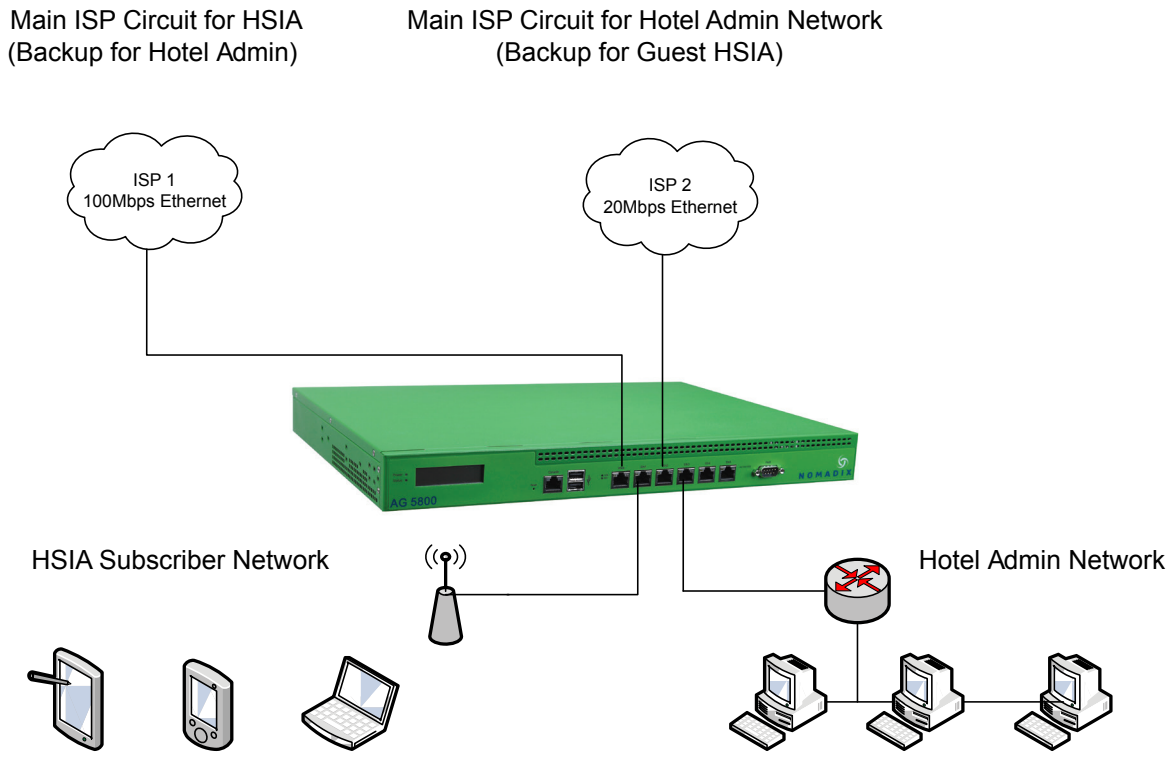
NSE is configured for failover only from the WAN to port Eth 2.



5.1.3 Separate Guest HSIA and Admin ISP Links with Failover Between Each ISP Link

In this example, the hotel has separate HSIA guest and hotel admin ISP circuits. Normally, guests will connect to the guest ISP, and the hotel admin users connect to the admin ISP. If either link fails, failover to the other will occur until the primary link is restored.

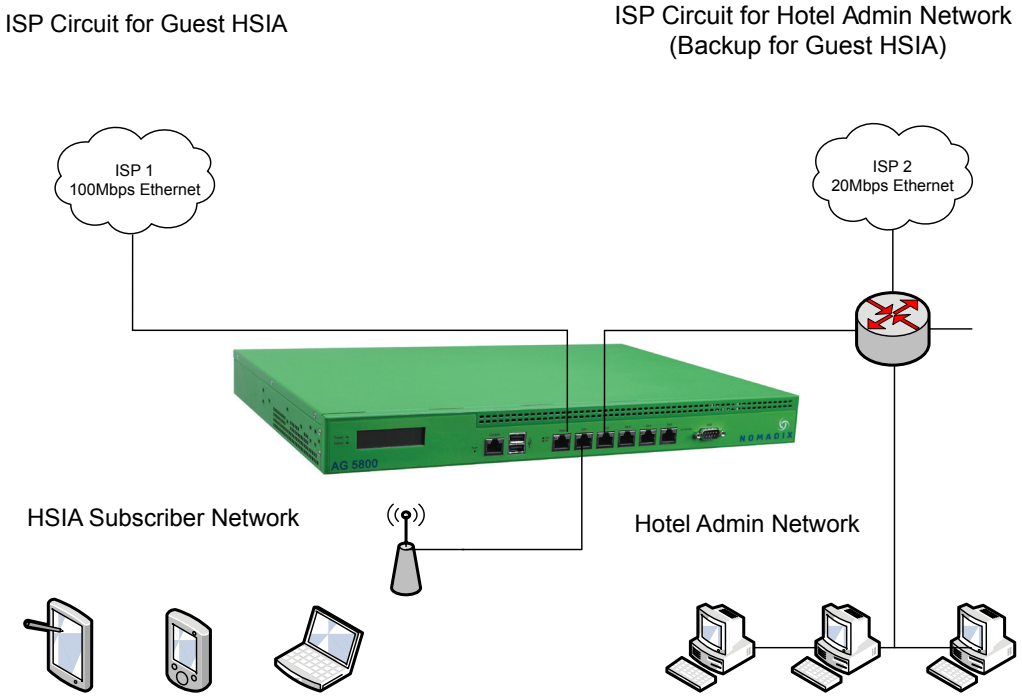
NSE is configured with load balancing and failover. Guests use ISP 1 as the preferred WAN, and the admin router uses ISP 2.



5.1.4 Guest HSIA Failover Only, Moves to Admin Network

In this example, a hotel has separate ISP circuits for the guest HSIA network and the hotel admin network. If the guest HSIA ISP link fails, the admin network link is used in failover mode. However, if the admin link fails, there is no failover backup.

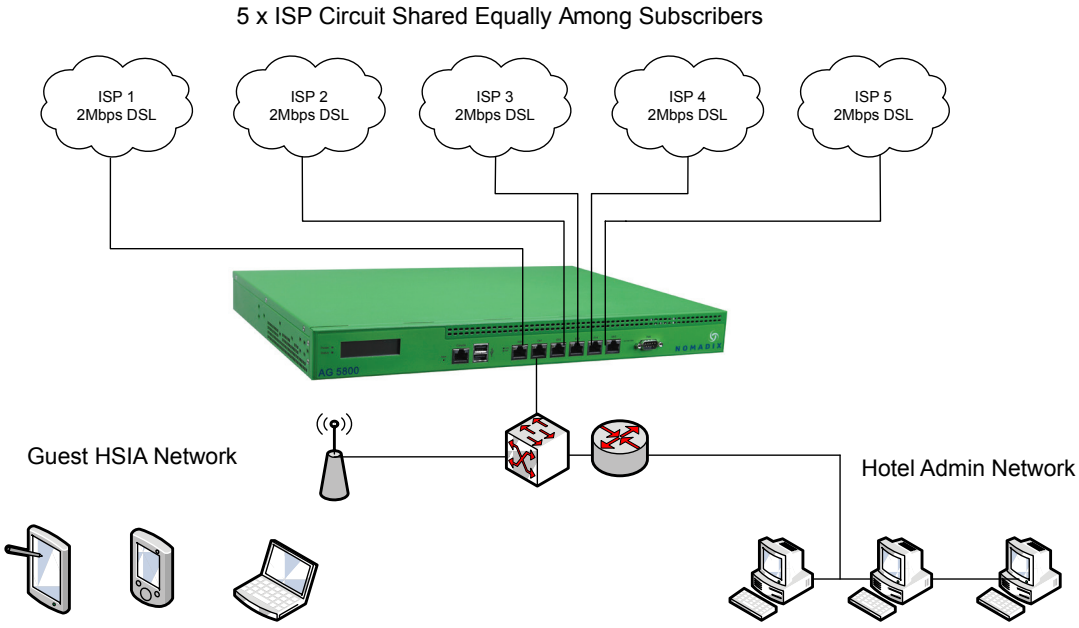
NSE is configured with link failover between the WAN port and port Eth 2, which is connected to the hotel admin network router.



5.1.5 Sharing of Guest HSIA Network and Hotel Admin Network Among Multiple ISP Links

In this example, multiple ISP links are connected to NSE, and the guest HSIA network and the hotel admin network share the aggregate bandwidth between the combined links.

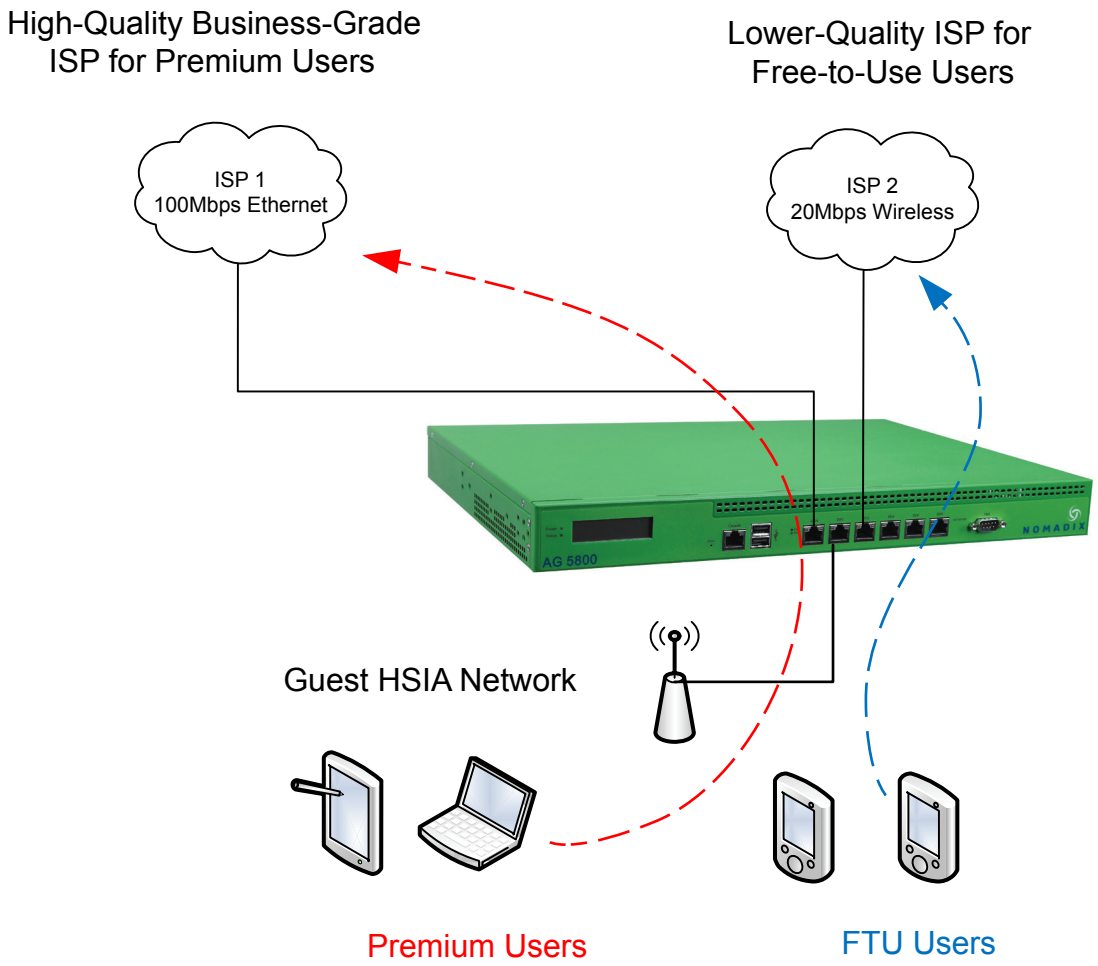
NSE is configured for load balancing, and the back-office router's MAC address is registered as a device in the NSE with an appropriate bandwidth limit.



5.1.6 Load Balancing with Users Connected to a Preferred ISP Link

In this example, the guest HSIA is distributed between two links at a hotel. One is a high-quality, high-cost business grade ISP circuit, and the other is a low-cost, lower-grade domestic service provided by the local cable TV operator. Under normal circumstances, the hotel wants non-paying guests to use the low-cost link, and those guests who pay for premium service will connect to the business grade link. If either link fails, it will failover to the other until the preferred link is available.

NSE is configured with load balancing.



6. SUMMARY AND CONCLUSIONS

With high-availability guest HSIA in high demand, the installation and monitoring of multiple ISP links has become all but a requirement for the hotel industry. With the release of NSE 8.2 software, the integrated load-balancing and failover features have conveniently eliminated the need for third-party appliance installations in most cases.

The Nomadix solution means:

- **Lower cost:** The NSE load-balancing license is much cheaper than a third-party load balancer appliance, saving hotels money.
- **Increased reliability:** The guest HSIA network data path is clearer due to the elimination of network appliance clutter, so overall systems reliability is improved.
- **Easy configuration:** The configuration of a load balancer must match that of the gateway. Nomadix designed its features for easy configuration and monitoring, with testing additional ISP links taking just a few minutes.
- **Continuity of Nomadix "plug and play" features such as INAT:** Nomadix gateway features that ensure trouble-free guest connectivity (such as INAT for VPN use) will not operate correctly when using a third-party load balancer. Using the Nomadix load-balancing feature ensures that these features will work normally.