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APPLICATION NOTE

Intraplex®
HD Link™ Path Redundancy and Backup Profiles

Introduction

With the release of firmware revision 2.2, the Harris Intraplex® HD Link™ provides new features that enhance the transmission robustness of audio and data services over the studio-to-transmitter link (STL) whenever an IP path (one-way or full duplex) is available between the studio and the transmitter site. These new features include:

- Automatic path failover from primary to backup, where the primary can be either the RF or the IP path.
- Support of different capabilities on primary and backup paths using main and backup profiles.
- Adaptive modem attributes to compensate for a degraded RF path.
- Independent path mapping for each of the supported services.

Taken together, these features can provide automatic backup between the RF and IP paths when the IP path is of sufficient quality, and automatic scale back of services on the RF path when environmental or other factors impede the clean reception of the RF STL signal at the transmitter. They also enable the HD Link to provide load sharing between the RF and IP paths.

This Application Note describes how these various features work and what can be done with them. For details on exactly how to set up these features on the HD Link, please consult the **HD Link RF STL Installation and Operation Manual**, v2.2 or higher.

Terminology

Services: There are five services that can be carried on the HD Link:

- Main stereo audio channel 1
- Main stereo audio channel 2 (If present – Not all HD Link models support two main audio programs.)
- Auxiliary mono audio channel 1
- Auxiliary mono audio channel 2
- Ethernet data service (Connects to the HD Ethernet port on the HD Link units – This service typically includes the HD Radio I2E or E2X signal and may also include control and other user data.)

Primary Path: This is the main path for the service and can be set to either RF or IP.

Backup Path: This is the alternate path for the services. If the primary path is RF, the backup path is IP, and vice versa.

RF Path: This is the licensed 950 MHz RF STL Path.

IP Path: This path can be implemented via any technology, as long as it connects to both of the HD Link units via the LAN Ethernet ports.

Forward IP Path: From studio to transmitter – This path can be used to send audio and HD Radio data as well as control signaling.

Return IP Path: From transmitter to studio – For the purpose of this feature, this path enables the HD Link receiver at the transmitter site to send the status of the forward paths back to the HD Link transmitter at the studio site.

Service Path: This defines what path a service takes under normal and path failure scenarios.

Service Profile: HD Link supports two service profiles, main and backup. Each service profile defines the attributes of all the audio and data services being carried on the system. These attributes in turn factor into the total information rate (that is, the total data bandwidth required on the STL).

Configuration Tools

There are two main configuration tools provided by HD Link for use in creating backup scenarios: **Service Profiles** and **Service Paths**.

Service Profiles

The system supports two service profiles: Main and Backup. Within each of these profiles, the attributes of each service is open to user configuration.

- For each main audio channel, you can set
  - The audio sample rate at 32, 44.1, or 48 ksps (the lower the sample rate, the less the required bandwidth).
  - Mono or stereo operation (mono requires half the bandwidth of stereo).
  - On compressed main audio channels, you can also set the sample size to 16-, 20-, or 24-bit (the smaller the sample size, the less the required bandwidth).
  - Turn the channel on or off.
- For each auxiliary audio program, you can turn the channel on or off.
- For Ethernet data, you can set the total data rate from 0 to 1.536 Mbps.

All of these settings contribute to the total data rate required on the transport path. The main and backup service profiles are completely independent. However, the backup profile would normally be set up to use less bandwidth than the main, as its purpose is to enable some or all of the services to remain on the air in some

format when throughput on the primary path is impaired, or when switching to a backup path with lower capacity than the primary. How to configure each profile depends on how much bandwidth (data carrying capacity) is available on each path.

On the RF path, configuration is determined by a combination of the RF bandwidth that is available (HD Link can operate on paths from 200 kHz to 500 kHz in width), and the QAM rate at which the system can run. If there are no external restrictions, such as licensing rules, limiting the QAM rate on a given system, good RF path engineering can ensure that the HD Link units' RF modems can operate up to the maximum rate of 256 QAM. A 500 kHz channel operating at 256 QAM has about 3.1 Mbps of data throughput.

On the IP path, the available bandwidth is determined by the nature and technology of the path being used. To properly configure the HD Link system, you need to know what the minimum guaranteed bandwidth will be on your IP path at all times.

When the IP path is defined as the primary path to be used, HD Link provides an option to keep the transmitter unit's power amplifier in a standby state while the RF path is not in use. If this feature is selected, the system will automatically turn the power amplifier on when the RF path is needed for backup, and turn it off again when the primary IP path is restored. In this case, we recommend that you periodically turn on the power amplifier manually to verify the RF path.

If both paths support the same bandwidth, or they differ in bandwidth support but both paths support more than is required for the main service profile, the backup profile may not be needed. However, it can still be useful to define the backup profile for use in situations where only one path is available and it is subject to environmental or other forms of degradation.

When a service profile is defined, the system will automatically calculate the total data bandwidth requirement for its implementation. If the main or backup service profile is to go over the RF path, the system will check whether the RF bandwidth can accommodate all the desired services before accepting the user settings. There is no capacity check performed for the IP path as its conditions are outside the realm of HD Link control. Instead, the HD Link service setup screen displays the required data rate for each service, as well as the aggregate total for each complete service profile, and you determine whether the available IP path supports this rate.

Having two service profiles enables two types of backup scenarios: one, it allows the system to fail over to a backup path that has less data carrying capacity than the primary path; and two, when only an RF path is available, it allows the system to scale back the services to a minimum during periods of path degradation in order to keep the most essential services on the air until normal conditions are restored. Note that this latter case still requires some degree of IP connectivity on the return path in order that the HD Link at the transmitter site can keep the HD Link at the studio apprised of the quality of its RF reception and coordinate the switch to the backup profile.

Note that use of the backup profile should be coordinated with the use of the various types of service paths. When a switch from the main to the backup service profile requires changing the attributes of a main audio channel, a noticeable delay and audible artifact may be heard on that channel until the new settings are synchronized between the two ends. If a use case scenario can be satisfied by changing a service path configuration, this is preferable as the transition is audibly smoother.

Service Paths

While the service profiles define the attributes of the various audio and data services, the service path configuration defines how each of those services should be transported. At a system level, both the service profiles and the service path configuration work together to provide automatic adjustment of the total STL data rate and path switching.

Each service can be set to one of these path settings:

RF Only: With this setting, the service is sent only over the RF path. If the RF path is not available, it is not carried at all.

IP Only: When this setting is selected, the service is sent only over the IP path. If the IP path is not available, it is not carried at all. This setting, in combination with the **RF Only** setting, can be used for load balancing over dual paths without failover capability.

RF, failover to IP: This setting is applicable only when the primary path is RF and the backup path is IP. This indicates that the service will switch to the IP path when the RF path fails. On a main audio program, a slight and very brief hiccup in the audio will occur when the switch takes place.

IP, failover to RF: This setting is applicable only when the primary path is IP and the backup path is RF. This setting indicates that this service will switch to the RF path when the IP path fails. On a main audio program, a slight and very brief hiccup in the audio will occur when the switch takes place.

RF and IP: This setting indicates that the service is continuously sent over both RF and IP paths at all times. The receiver will normally take the service from whichever is designated as the primary path and will switch to using the feed from the backup path if the primary path fails. This setting provides the least interruption in services during a switch between the two paths as the switch itself is near-instantaneous and almost hitless. However, this setting means that the full bandwidth for this service will be occupied on both paths at all times.

IP, drop if RF fails: This setting is used when RF is the primary path but you wish to send a service over the IP path to relieve the loading on the main RF path. It would generally be used for a low priority service, when the higher priority services are set to **RF, failover to IP**. This configures the low priority service to operate on the IP path on condition that, if the RF path fails, the low priority service stops using the IP path, thus freeing up IP bandwidth for the higher priority services.

RF, drop if IP fails: This setting would be used when IP is the primary path and provides a parallel function to **IP, drop if RF fails**. Take care when using this setting, because the RF path's modem parameters are dynamically set based on the required information rate. Therefore, the services that would be stopped due to this setting should be higher in bandwidth than the higher priority services that will take over their capacity. Generally, when using the IP path as primary and the RF path as a backup, it is safer to use a separate backup profile which becomes active when the services switch to the RF path. The system then performs the necessary checks to assure the entire backup profile fits on the RF path.

Use Case Scenarios

This section describes some common deployment scenarios along with recommendations on the optimum settings for path redundancy. As a reference, Figure 1 shows the network model with two paths (RF and IP) with all supported services.

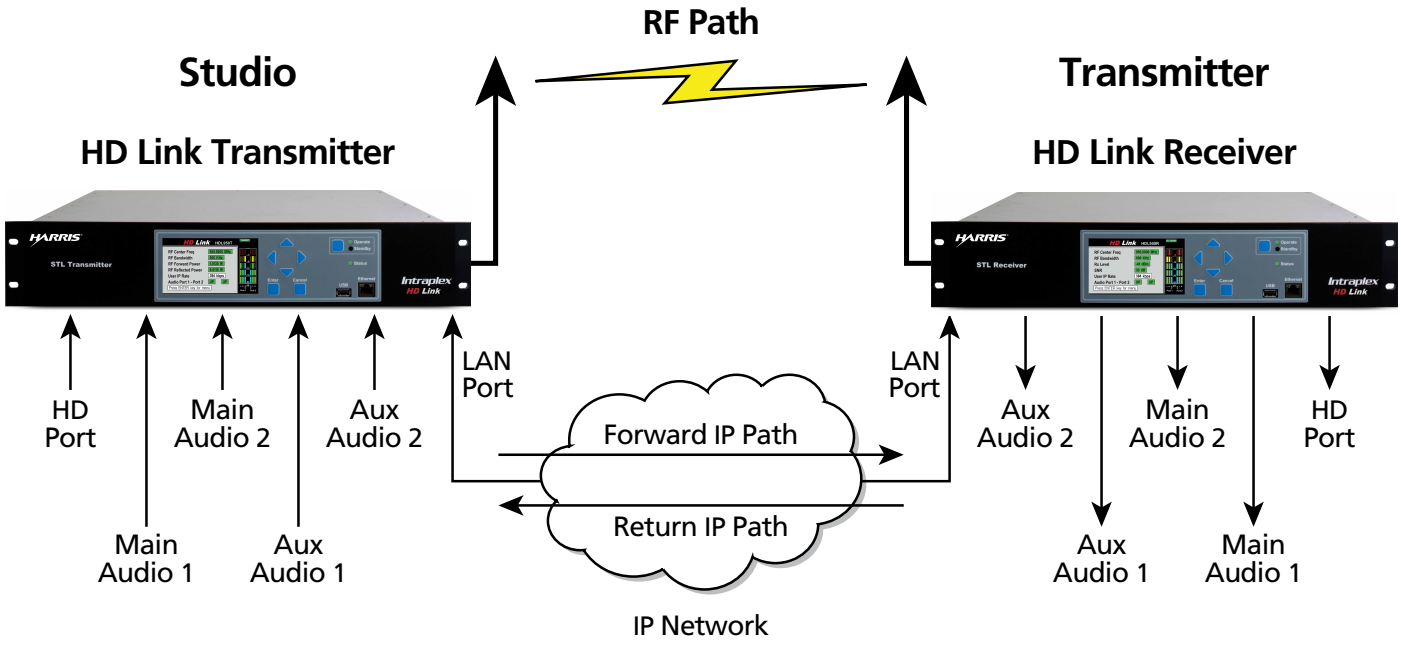

Figure 1: Network Model

Scenario 1: RF Only, IP Return Path Is Available

In this scenario, an IP path is available but cannot be used for service transport due to bandwidth limitations or unreliability. In this case, we can still use the return path to provide the status of the RF path. The HD Link receiver can be set up to report degradation of the RF receive signal at the transmitter site, which enables the HD Link transmitter to switch to the backup profile. The HD Link transmitter then signals the HD Link receiver to switch as well, ensuring that the backup profile is implemented.

For this example, we reduce the bandwidth in the backup profile by turning off the aux audio programs, switching one of the main audio programs from stereo to mono, and reducing the bandwidth of Ethernet traffic to be carried. We assume that the Ethernet data stream is normally running at 512 kbps, carrying the HD Radio E2X signal at 320 kbps bandwidth, with the remainder used for control and LAN data. We can set the backup profile to carry only the critical 320 kbps of HD Radio data and drop the rest.

Reducing the amount of bandwidth to be transported relieves the load on the RF link, thus enabling a reduction in the QAM level in order to stabilize the path. (See **Service Profiles** for details on main and backup service profiles.)

Figure 2 shows how this type of fallback operation using main and backup profiles would work. Note that, in this and all the other use case scenarios, the services being fed into the HD Link at the studio do not change during backup. All the changes take place inside the two HD Link units; nothing needs to be reconfigured external to them.

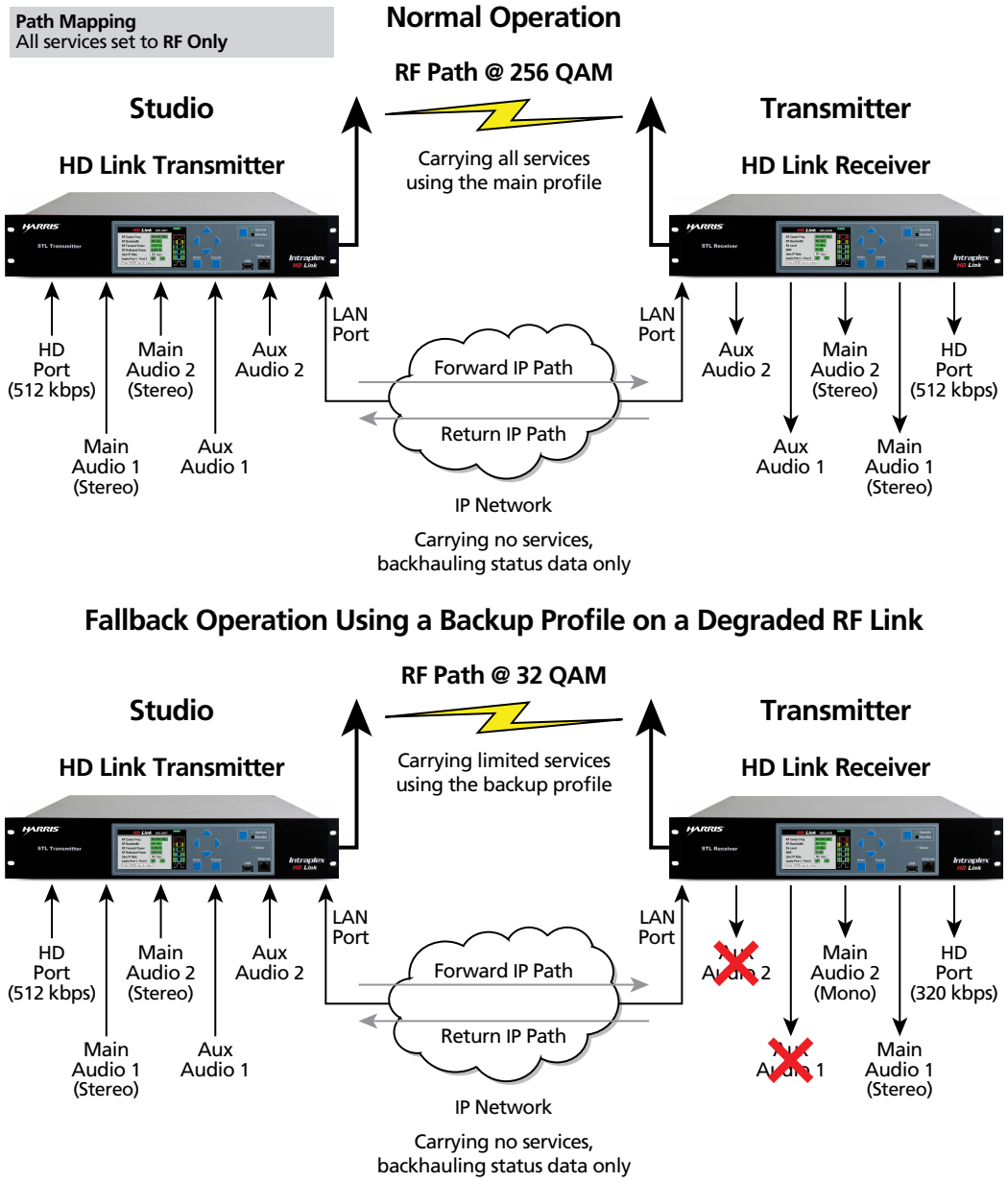

Figure 2: Use of a Backup Profile During RF Path Degradation

Scenario 2: Complete Failover to Backup Path

In this scenario, the backup path has at least as much bandwidth available as the primary path so that all services can fail over to the backup path without the need to use the backup profile or individual service path mapping for reconfiguration.

The most common situation here would probably be that where you have a licensed RF STL primary path along with a wideband IP path for backup. In that case, set all services to either **RF, failover to IP** or **RF and IP**.

Alternatively, if IP is selected as the primary path and RF as the backup, set all services to either **IP, failover to RF** or **RF and IP**.

Figure 3 shows a scenario where RF is the primary path but a wideband IP path is available and all services are backed up to IP in case of an RF path failure. This could also be the reverse, where all services are normally on IP and switch to RF upon IP failure.

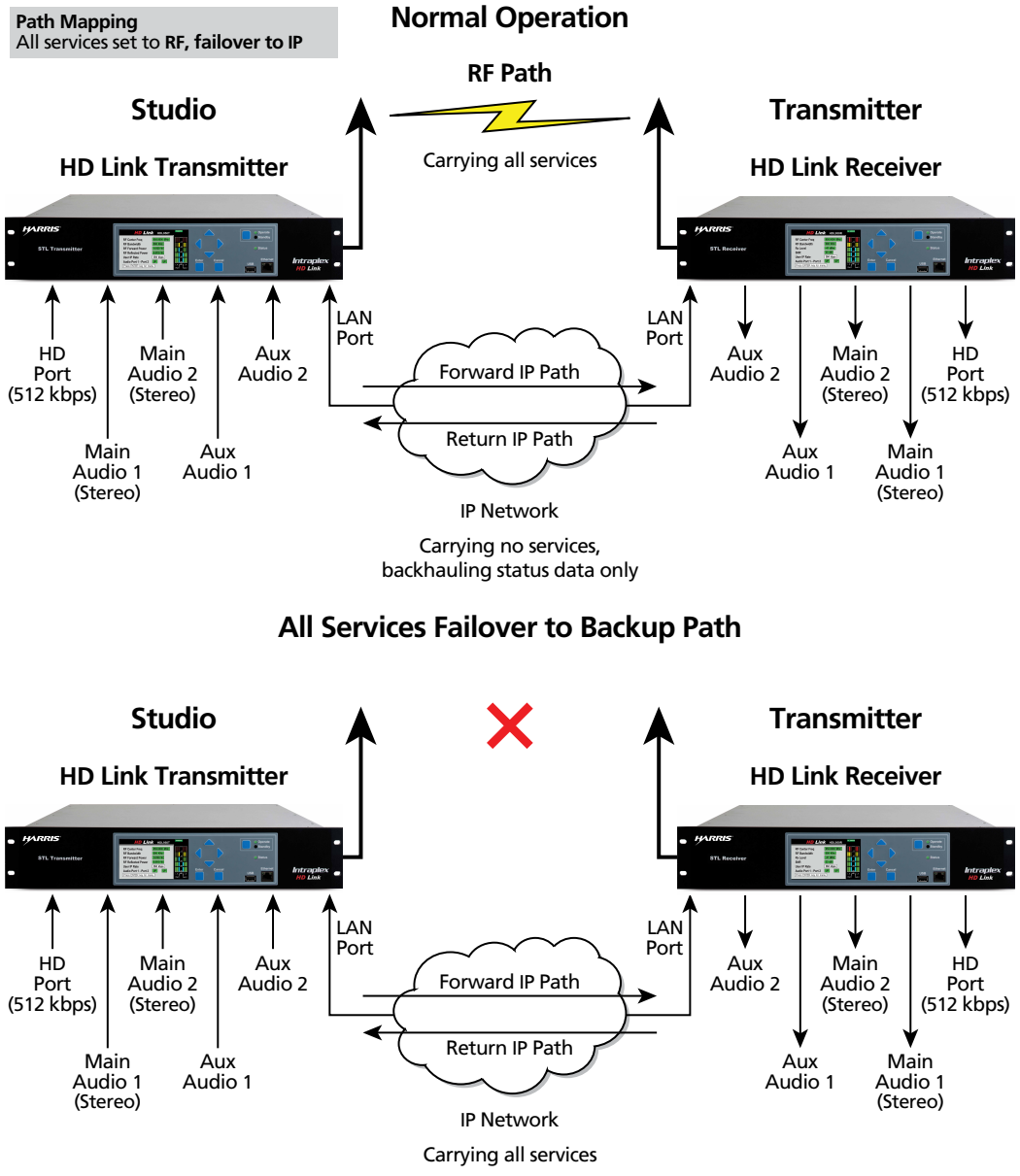

Figure 3: Backup of All Services During Primary Path Failure

Scenario 3: Backup of Critical Services Only to Backup Path

In this scenario, the primary path (RF or IP) has enough bandwidth to carry all the desired services during normal operation, but the backup path has more limited bandwidth and as such is able to carry only the most critical services when the primary path is down.

In that case, if the primary path is RF, set each of the critical services to use either **RF, failover to IP** or (if the IP path has sufficient bandwidth to support the service at all times), **RF and IP**. Set the non-critical services to use **RF Only**.

Alternatively if the primary path is IP, set each of the critical services to use either **IP, failover to RF** or (if the RF path has sufficient bandwidth to support the service at all times), **RF and IP**. Set the non-critical services to use **IP Only**.

Figure 4 shows a scenario where the primary path is IP, and RF link has less bandwidth than the IP, so only the most critical services are carried during backup. This fallback scenario is to continue carrying the two main audio programs in their normal configuration but to drop the two auxiliary audio programs and the Ethernet data stream. This could also happen in reverse, where RF is the primary path and only the most critical services are backed up to IP during RF path failure.

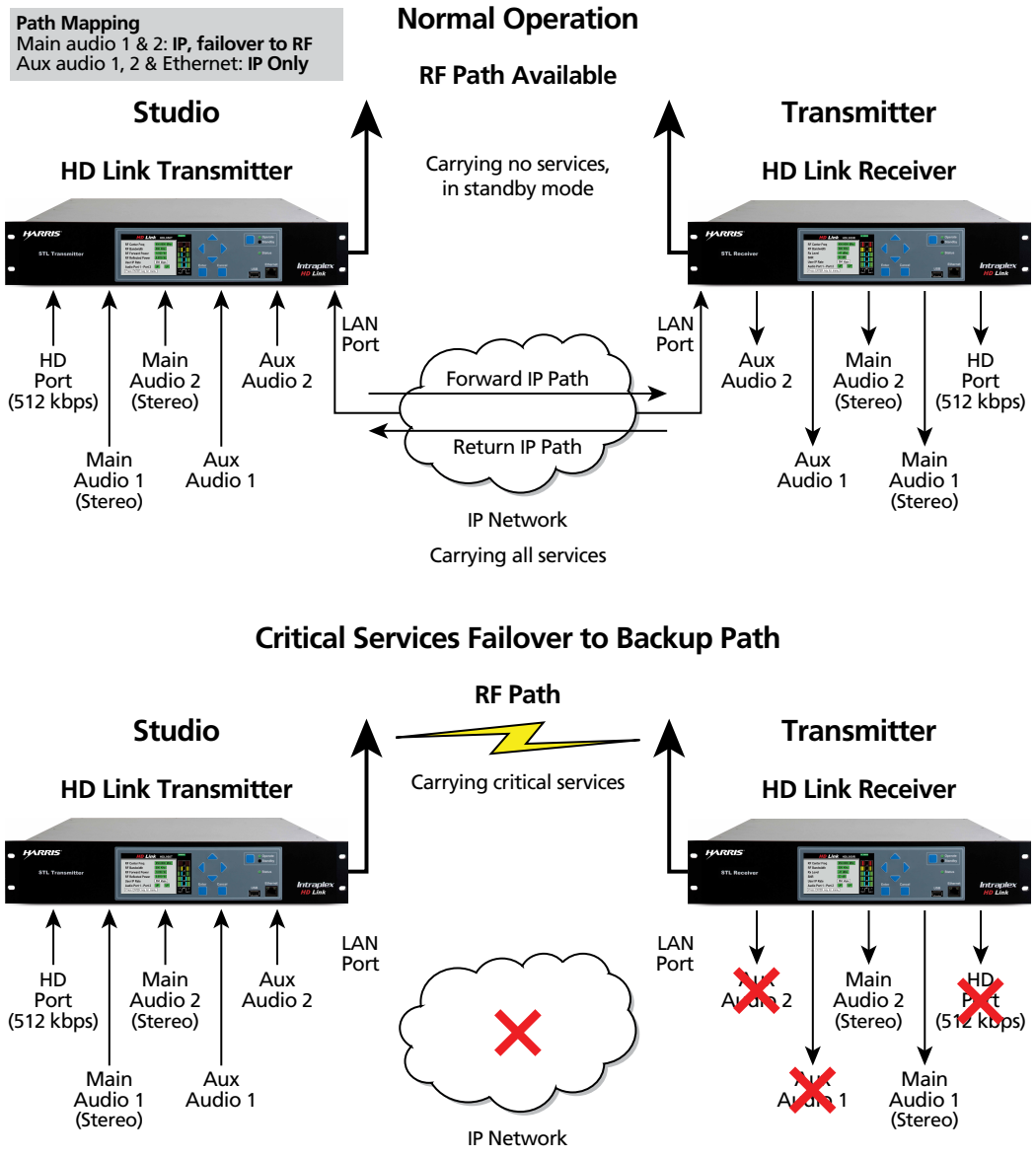

Figure 4: Backup of Critical Services Only During Primary Path Failure

Scenario 4: Load Sharing with Only Critical Services Backed Up

In this scenario, neither the RF nor the IP path has sufficient bandwidth to carry all the desired services. Under normal circumstances, Main Audio 1, Aux Audio 1, and Ethernet Data are carried on the RF path, and Main Audio 2 and Aux Audio 2 are carried on the IP path. RF is set as the primary path, with IP as the backup.

In case the primary RF path fails, only the two main audio programs are backed up onto the IP path. This is the service path setup for the scenario:

- Set Main Audio 1 to **RF, failover to IP**
- Set Main Audio 2 to **IP Only**
- Set Aux Audio 1 to **RF Only**
- Set Aux Audio 2 to **IP, drop if RF fails**
- Set Ethernet data to **RF Only**

Figure 5 shows how this scenario would work.

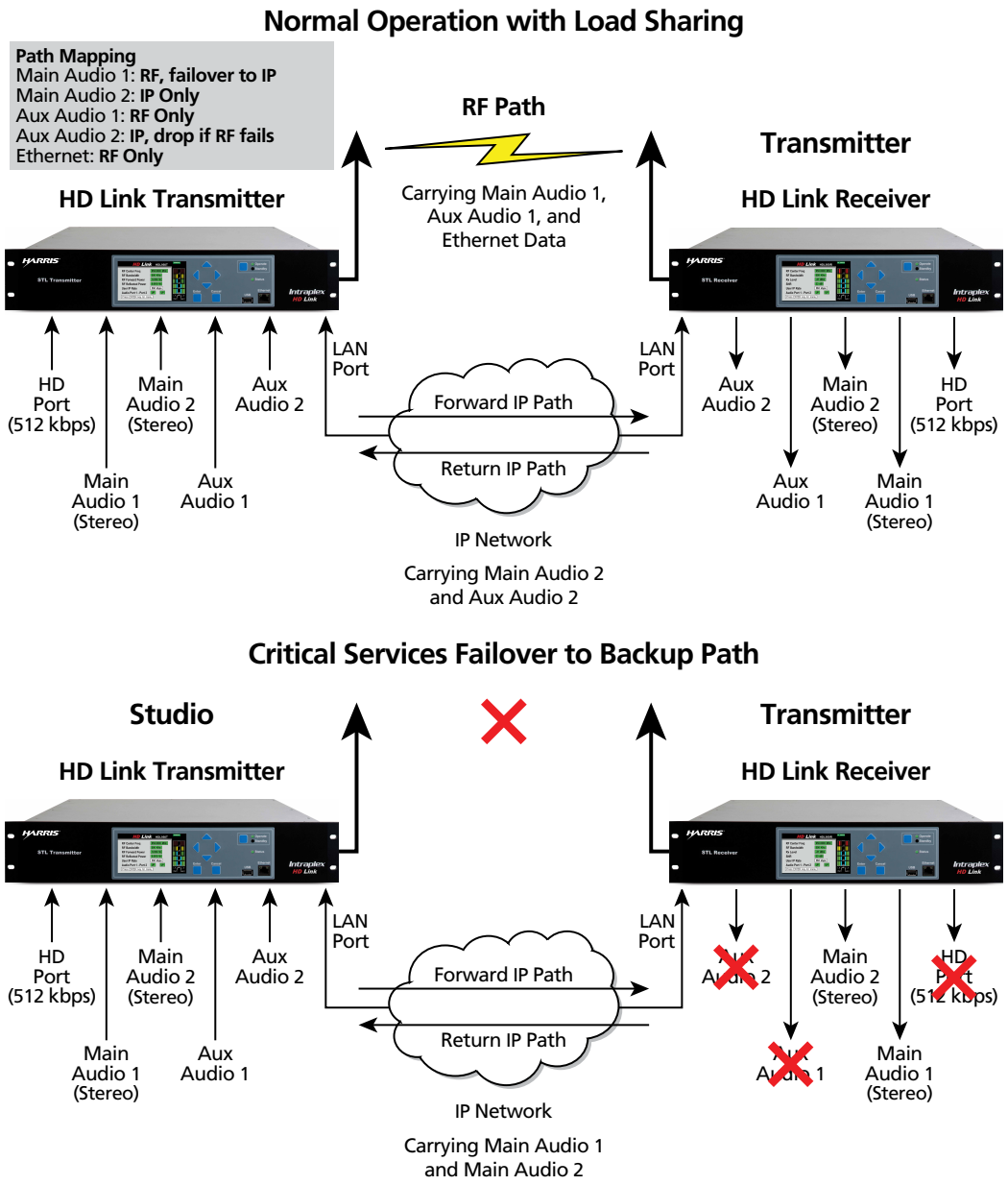

Figure 5: Load Sharing with Backup of Critical Services Only

Scenario 5: Use of a Backup Profile on a Backup Path

Here we look at a situation where the primary path has enough bandwidth to carry all the desired services under normal conditions and a backup path exists that has less bandwidth available. The desire is to still carry all services in the event of a switch to the backup path but to reduce the bandwidth by using a backup profile that scales back the service configuration.

The biggest change we can make in the backup profile is to reconfigure both of the main audio programs from stereo to mono. Also, if either of them is being sampled at 44.1 or 48 ksps, we can reduce the sample rate(s) to 32 ksps.

Here again, we assume that the Ethernet data stream is normally running at 512 kbps, carrying the HD Radio E2X signal at 320 kbps bandwidth. We can set the backup profile to carry only the critical 320 kbps of HD Radio data, and drop the rest.

In this setup, assuming that the primary path is RF and the backup path is IP, we would set the path mapping for all services to **RF, failover to IP** and activate the backup configuration profile. Figure 6 shows how this would play out in the event of a primary path failure.

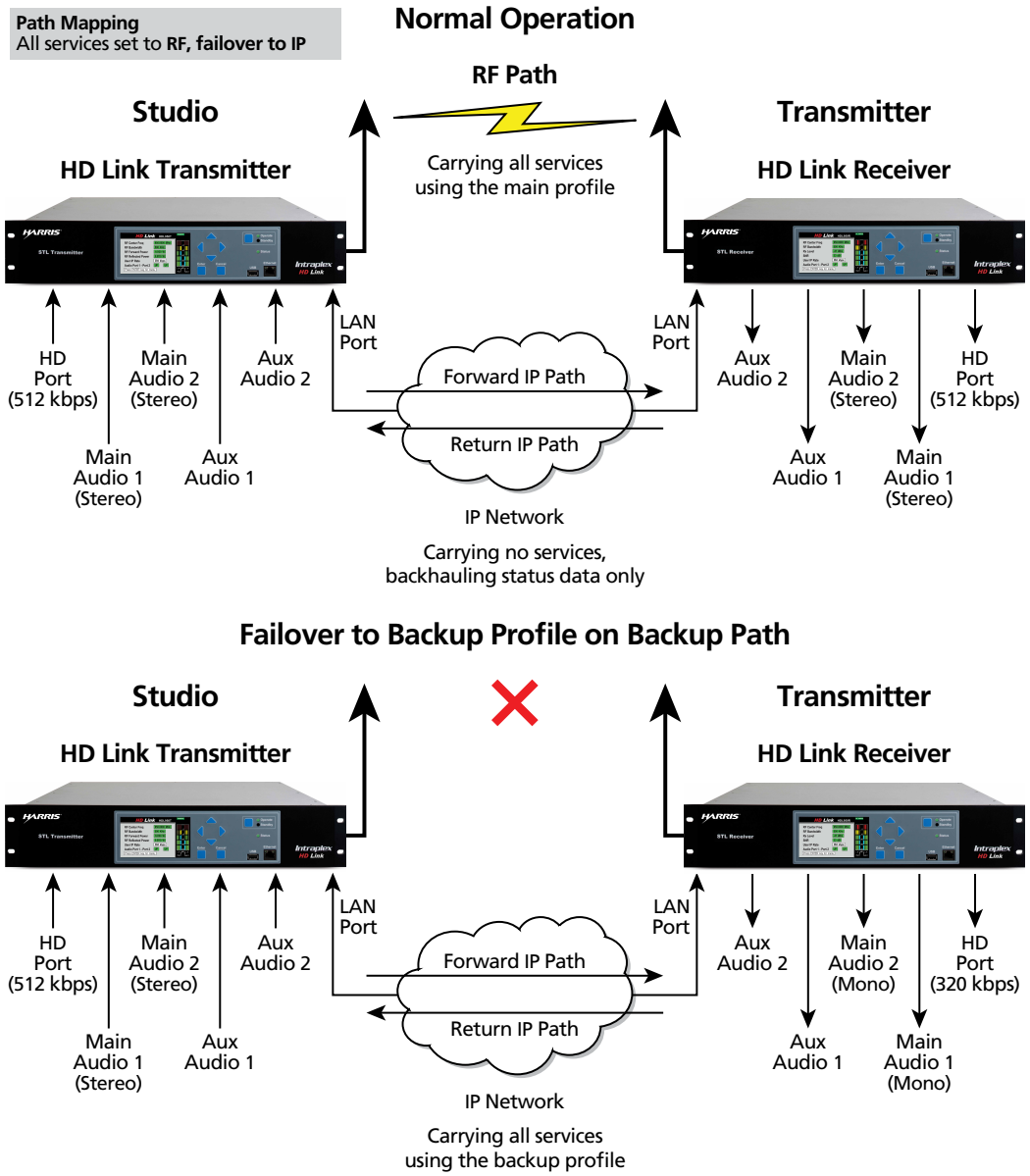

Figure 6: Use of a Backup Profile on a Backup Path

Interworking with Repeater Systems

The backup features described in this Application Note are designed to work not just in point-to-point scenarios but also in multi-hop systems using HD Link repeaters. All of the same service path settings are possible, including the use of main and backup profiles. However, using these backup features on systems that include repeaters requires some adjustment to the units. For details, see the section in the HD Link operating manual titled **Path Redundancy Interworking with Repeater Systems.**

Interworking with Redundant Units (Tx and Rx)

These backup features can also be used in systems set up with hardware redundancy incorporating the HD Link Main/Alt Controller at the studio site and audio and data switching at the transmitter site. For a description of the special settings required in this type of setup, see the section in the HD Link operating manual titled **Path Redundancy Interworking with Redundant Transmitter and Receiver Units.**

For more information, please visit broadcast.harris.com/Intraplex

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