

HX System: Geographic Hub Redundancy and Diversity

Enterprise users demanding high Quality of Service (QoS) together with high network availability rely on satellite broadband solutions from Hughes. To ensure the highest level of network availability, the Hughes HX satellite broadband system can be configured with a redundant hub which is geographically separate from the primary hub and operating either in a hot standby or in a load sharing (diversity) mode. This paper describes the two available modes of implementing geographic hub redundancy.

This geographic redundancy is above and beyond the full and automatic component redundancy designed into the HX hubs. The redundancy features discussed in this paper address potential network problems, such as significant rain fade at the hub station itself; failure of the hub station RFT equipment; or even catastrophic loss of the entire hub teleport. The essence of these redundancy features is to utilize geographical diversity of the hub stations to ensure continuous operation in the event of either rain fade or a catastrophic failure at one of the hub stations.

Modes of Operation

The modes for enabling geographic redundancy are:

- **Automated Hub Redundancy (AHR).** This mode of redundancy calls for two identically configured hubs, one operating “online” (supporting all the network traffic) and the other operating “offline” (in hot standby). In the event of rain fade or even catastrophic failure at the online hub, the offline hub is quickly activated and assumes all traffic load for the network.
- **Hub Diversity.** This mode of redundancy calls for two hubs to be simultaneously operational and sharing the network traffic. Remote terminals can be configured to “prefer” one of the two hubs and are entitled to move to the alternate hub in the event of a failure at the preferred hub. Lower value remote terminals can be assigned to operate exclusively on only one of the hubs.

It is important to note that these modes are mutually exclusive and cannot coexist. In either case, after a remote terminal is switched from one hub to the other, it can be activated immediately on the new hub without the need for ranging and commissioning.

The HX System has been designed to support mission critical services where the network reliability, security and Quality of Services are needed in a multiservice-multitask architecture (voice, data, video, mobility).

The HX System is built with specialty hardware and software products to design specific network architectures to achieve a highest performance and non-stop (Fault Tolerant) system operation with high quality service end-to-end.

Automated Hub Redundancy

AHR is the mode where two hubs are installed in geographically separate locations. At any point in time, one of the hubs is online and the other is offline. In the event of a failure (or impending failure) at the online hub (for example, due to rain fade), the operator may initiate a switch to the offline hub to allow network operations to continue. Figure 1 illustrates the AHR setup.

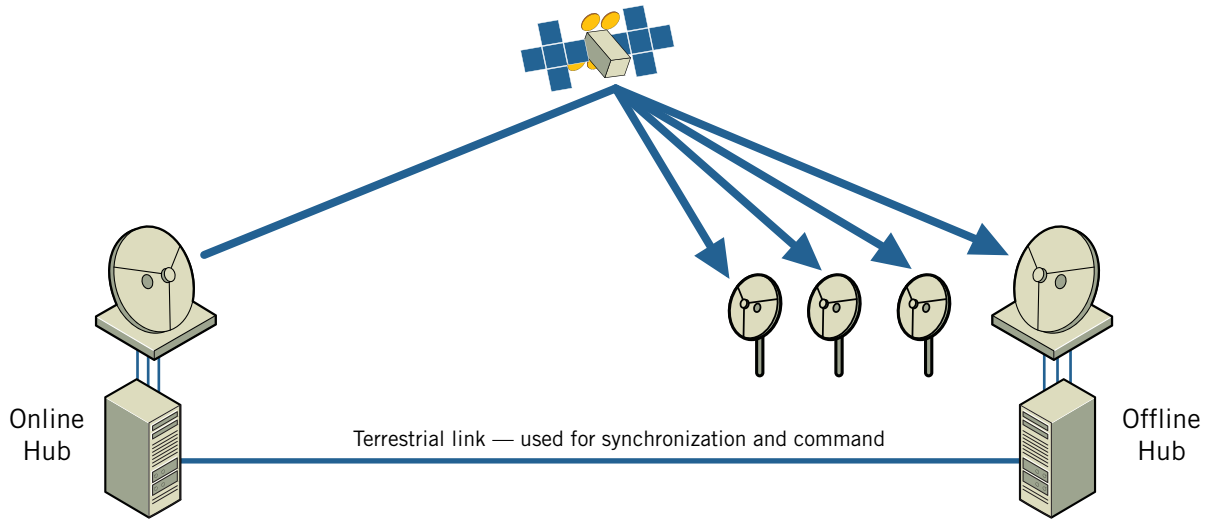


Figure 1. Automated Hub Redundant Configuration

The two hubs are identical with respect to all their baseband and IF equipment and are functionally identical with respect to their RFT equipment. Identical configurations are used so that both hubs are capable of being fully operational without sacrificing traffic quality or requiring reconfiguration of the hub equipment.

A terrestrial link between the two hubs is used for the command to activate the redundancy switchover. The terrestrial link also enables the synchronization of the databases so that changes made to the online hub are synchronized with the offline hub.

The time for completing the redundancy switchover is approximately 10 minutes. The process of hub redundancy switchover involves the following sequence of actions:

- Online hub goes offline
- Remote terminals lose the outbound channel offline hub goes online
- Remote terminals acquire the outbound channel TCP sessions are restored

In addition to the normal mode of AHR for rain fade conditions, the capability exists to force switchover in the event of a catastrophic loss of the online hub. This “failover functionality” allows the offline hub to be independently switched into active operation.

Hub Diversity

The Hub Diversity mode (sometimes referred to as “NOC Diversity”) allows two simultaneously active hubs to co-exist and manage a single Hughes HX network. The remote terminals in the network will be configured to prefer one hub or the other and may be configured to switch to the other hub in the event of a hub or transport failure. Remote terminals considered to be relatively low value can be configured to operate on only one hub and not be allowed to switch. Figure 2 shows the network layout for Hub Diversity.

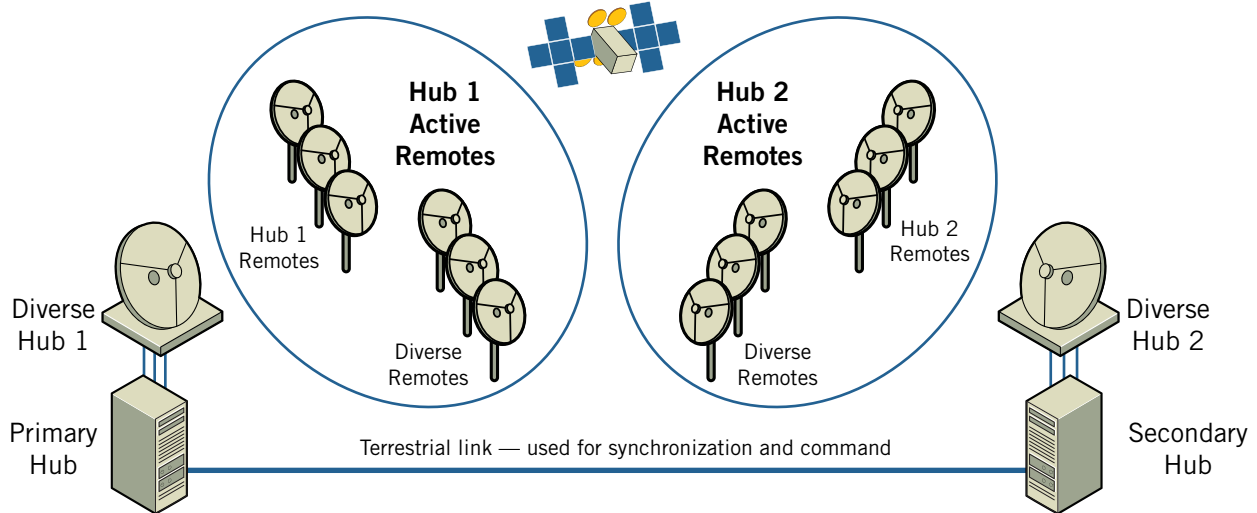


Figure 2. Hub Diversity

When employing the Hub Diversity feature, the primary and secondary hub roles are fixed at the time of installation, and all terminal configurations are performed through the primary hub.

Remote terminals may be designated as one of the following:

- Assigned exclusively to the primary hub
- Assigned exclusively to the secondary hub
- Diverse (able to connect either to the primary or secondary hub)

Diverse remote terminals typically can switch to the alternate hub within approximately _ minutes, during which time connectivity is lost.

In summary, Hub Diversity in the Hughes HX System enables satellite broadband operators to provide their customers with a premium offering of remote terminals that are diversity-capable.

Implementation Details

Both the Automated Hub Redundancy and the Hub Diversity modes require a terrestrial redundant LAN connection between the hubs in order to synchronize the databases. Automated Hub Redundancy also requires the oracle Enterprise Edition to synchronize the databases.

The table below lists the HX System releases supporting redundancy features:

| Feature | HN System Release |
|--------------------------|-----------------------|
| Automated Hub Redundancy | UEM 9.0.2.18_or later |
| Hub Diversity | UEM 9.0.2.18_or later |

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| Solution Includes | Description | Scope of Work |
|------------------------------|--|--|
| HX NOC | Primary HX NOC Secondary HX NOC IPGW, DNCC, CDS, TG2 With Hughes software | Hughes installs, configures both NOCs to be able to work on any of both modes: ■ Automated Hub Redundancy (AHR) or ■ Hub Diversity |
| Antenna | 6m, 7m, 9m, or 11m | Antenna Ku-band and installation |
| HX NMS | Enterprise edition in both NOCs | Installation and configuration enterprise edition in both NOCs to share databases |
| HX Remotes (Option) | HX50L, HX90, HX200, HX260 and/or HX280 | NOC configuration profiles to support AHR mode or diverse remotes |
| LAN Switch & Router (Option) | Optional if customers require more robust LAN core in both NOCs using | Supervisor card for LAN SW |
| Additional Services | Optional extended warranty of the system | Electronic equipment |

HUGHES is the only qualified supplier to ensure the AHR and/or diversity mode operates correctly by supplying an integrated solution with HN or HX technology with third-party equipment and make sure when the terminal diverse between the NOCs, the terminal does not need to range and commission again due to satellite foot print and difference in RFT characteristics.

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| Feature | Automated Hub Redundancy | Hub Diversity |
|---|---|---|
| Switchover | <ul style="list-style-type: none"> ■ Operator initiated ■ All terminals switchover ■ Requires connectivity between active and backup hubs for normal switchover ■ If redundancy connectivity is lost between the hubs, failover capability exists, however, this will require manual resynchronization of the databases once both hubs are restored | <ul style="list-style-type: none"> ■ Automatic (by remote terminal) ■ Selective terminals switchover (by configuration) ■ Does not require connectivity between primary and secondary hubs (at time of switchover) |
| Switchover Time | ~10 minutes | ~10 minutes |
| Commissioning | <ul style="list-style-type: none"> ■ Performed on active hub ■ Commissioning always available | <ul style="list-style-type: none"> ■ Performed on primary hub only ■ Commissioning unavailable if primary hub is out of service |
| Satellite Bandwidth | Common outroute and inroute group is managed between active and backup hubs | <ul style="list-style-type: none"> ■ Primary and secondary hubs have separate outroute and inroute groups ■ Remote terminal switches outroute on failover |
| Configuration | Supported on active hub | <ul style="list-style-type: none"> ■ Supported on primary hub only ■ Configuration unavailable if primary hub is out of service |
| VAD | Supported on active hub | Supported on both hubs |
| Feature Incompatibility (capabilities NOT supported with feature) | <ul style="list-style-type: none"> ■ Hub diveristy ■ Local NMS redundancy | <ul style="list-style-type: none"> ■ Geographical hub redundancy ■ Local NMS redundancy ■ Transponder moving ■ Automatic global resource allocation |
| Redundancy Link Requirement | 1 Mbps (Although this may need to be adjusted for larger size databases) | 1 Mbps (Although this may need to be adjusted for larger size databases) |
| Database Synchronization | 10 minutes (typical) | ___ minutes (typical) |

Proprietary Statement

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