Professional Digital Two-Way Radio System

*MOTO***TRBO**™

MOTOTRBO Application Note

IP Site Capacity Plus

MOTOROLA

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Overview

This paper shows how the trunking capabilities of Capacity Plus can be combined with the multi-site capabilities of IP Site Connect to enable an elementary multi-site trunking capability where designated wide area calls can be bridged across multiple trunking sites.

This solution is targeted at trunking systems where the majority of all subscriber radio calls are local area (on-site) and only a small minority of subscriber radio calls are required to be wide area (across all sites). Each subscriber radio operates on a given Capacity Plus site, where (on-site) calls are setup and received in the normal manner. However there are 2 group calls which are designated wide area calls. When either of these designated wide area calls are setup by a subscriber radio, the IP Site Connect system is used to bridge the call across all Capacity Plus sites thereby enabling all subscriber radios belonging to the given group to participate in the call irrespective of which Capacity Plus site they are operating on.

Since it is not possible to link Capacity Plus and IP Site Connect repeaters directly via the IP backbone, then a number of bridges (each consisting of a Capacity Plus mobile radio linked via a simple bridging cable to a an IP Site Connect mobile radio) are used to bridge the Capacity Plus sites to the IP Site Connect system.

From a user perspective there is no difference between the way in which local and wide area calls are managed – if a call corresponds to one of the 2 designated wide area group calls then the system automatically bridges it across all sites, otherwise the call is setup on a single site only.

System Architecture

The basic 'IP Site Capacity Plus' system architecture outlined in this paper is shown below:
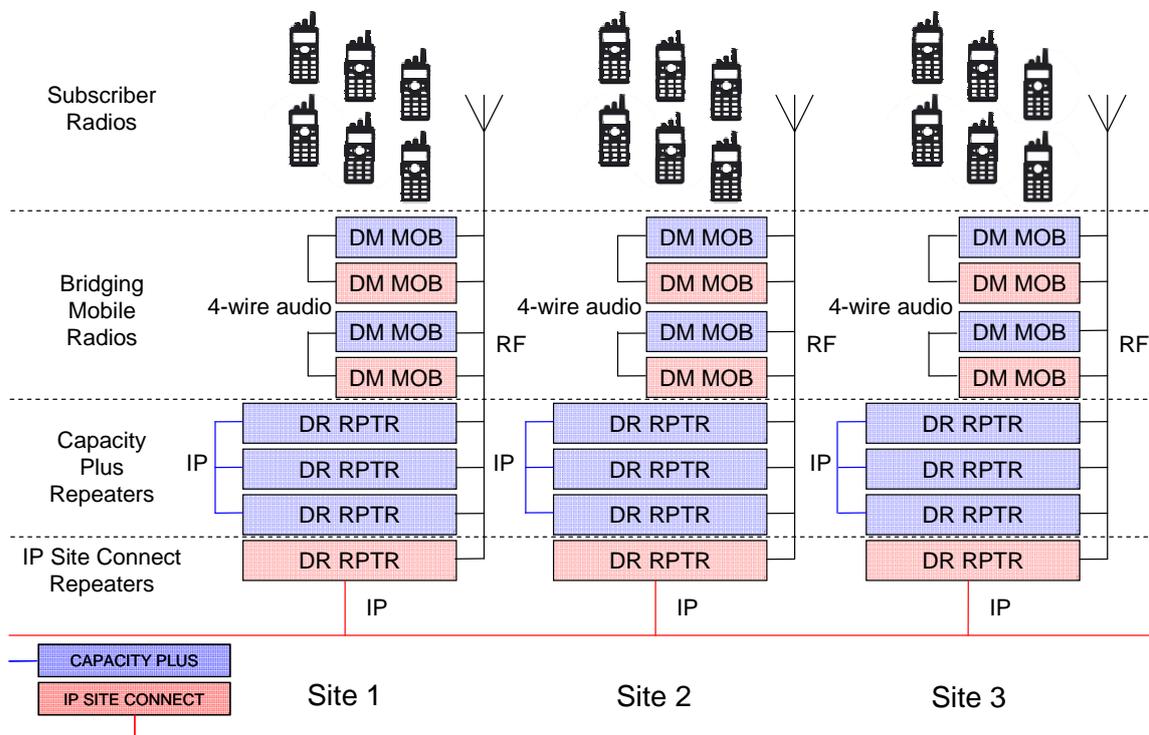

Figure 1: Basic System Architecture

System Description

Each site contains a number of MOTOTRBO DR Series 'Capacity Plus' repeaters plus a single MOTOTRBO DR Series 'IP Site Connect' repeater. The Capacity Plus repeaters at a given site are linked together via an IP backbone while the IP Site Connect repeaters across all sites are linked together via another IP backbone. Each site also contains a pair of bridges where each bridge consists of a MOTOTRBO DM Series 'Capacity Plus' mobile radio and a MOTOTRBO DM Series 'IP Site Connect' mobile radio. The Capacity Plus and IP Site Connect mobile radios are linked together via a simple (4 wire audio) bridging cable.

The IP Site Connect system provides two wide area channels which used in conjunction with the pair of bridges at each site enable two group call IDs to be designated "wide area" and automatically bridged across all Capacity Plus systems. The Capacity Plus bridging mobile radios operate on the Capacity Plus channels at their respective sites (in accordance with the Capacity Plus rules) while the IP Site Connect bridging mobile radios operate on their respective IP Site Connect channel.

All bridges on a given wide area channel are configured to manage a common designated group call ID such that when a subscriber radio sets up this designated group call on one of the Capacity Plus systems, the respective bridge at that Capacity Plus system bridges the call to its wide area channel, and the other bridges on that same wide area channel then bridge the call to their respective Capacity Plus systems. These bridges also enable subscriber radios participating in the designated wide area group call to talk back across all Capacity Plus systems.

Bridging Cable Construction

The previously mentioned bridging cable links the 'Rx Audio' pin on each bridging mobile radio to the 'Tx Audio' pin on the other bridging mobile radio and the 'PL/Talkgroup Detect' pin on each bridging mobile radio to the 'PTT Input' pin on the other bridging mobile radio.

Radio Configuration

Each subscriber radio is configured with a single Capacity Plus personality for its respective Capacity Plus system and where a subscriber radio is required to participate in wide area communication, it is configured to be able to setup and receive either one or both of the designated wide area group calls.

Each bridging mobile radio is configured to setup and receive one of the designated wide area group calls. Additionally, the 'PL/Talkgroup Detect' output is configured to be made available on the appropriate GPIO pin for the bridging cable.

Call Management

All calls are setup and received on the subscriber radio's Capacity Plus personality. Where a user wishes to initiate a wide area communication, he simply sets up one of the designated wide area group calls which is then automatically bridged across all Capacity Plus systems. All subscriber radios belonging to this wide area group call (across all sites) may then participate in the group call.

Roaming

As a subscriber radio moves from one site to another it is not possible for the subscriber radio to automatically roam between Capacity Plus systems. However it is possible for each Capacity Plus system to be configured as a separate personality and for the user to manually switch between Capacity Plus systems. It is also possible for the user to switch to a conventional personality which corresponds to one of the wide area (IP Site Connect) channels and for the subscriber radio to automatically roam between IP Site Connect sites

thereby enabling the subscriber radio to always be able to setup and receive the designated wide area group call on the best site.

Limitations

- There is a slight degradation in audio quality for wide area calls.
- Wide area calls take slightly longer to setup.
- There is a slight increase in 'end to end' audio delay for wide area calls.
- There is no arbitration between sites for wide area calls so there will be situations where two users press their PTTs within a short window of each other and both think they have the floor.
- Even if the wide area resource is available, there is still no guarantee that a wide area transmission will get bridged to all sites since a Capacity Plus channel might not be available at any given site.
- The bridges are only able to bridge group calls, so wide area individual calling is not possible.
- The PTT ID feature will not work across sites, so it will not be possible for subscriber radios on one site to identify which subscriber radios are transmitting in a wide area group call on a different site.

Additional Wide Area Calling Capability

If additional wide area group (and individual) calling capability is required, the previously described system architecture can be enhanced by the addition of a 3rd party application (in place of the bridging cable) as shown below:
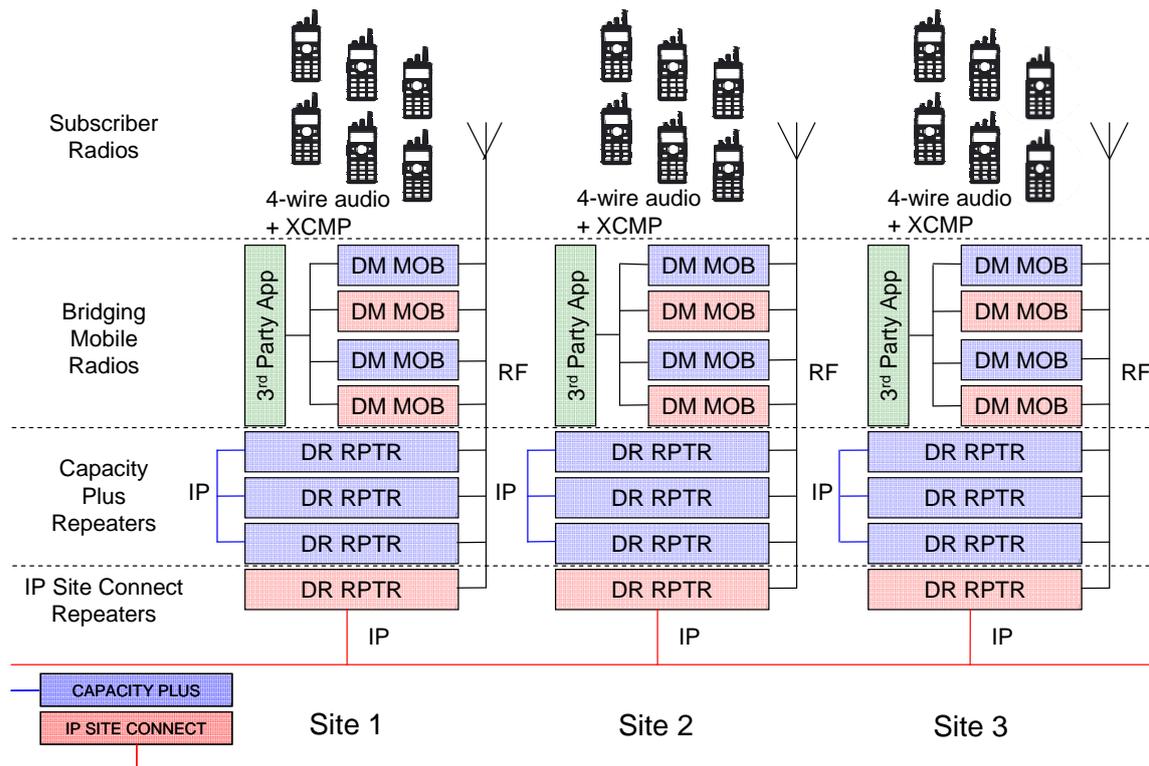

Figure 2: Enhanced System Architecture

The role of the 3rd party application is to determine (from an IP Site Connect bridging mobile radio) when a wide area group call has been setup on the IP Site Connect system and to replicate the same wide area group call (using the Capacity Plus bridging mobile radio) on a Capacity Plus system.

Note: The limiting factor for the number of different wide area group call IDs that can be bridged across the IP Site Connect and Capacity Plus systems is determined by the number of different groups the bridging mobile radios can belong to.

For this solution, when a user wishes to initiate a wide area communication he first of all needs to switch to a personality which corresponds to one of the wide area (IP Site Connect) channels. He could in theory initiate a wide area communication directly from the Capacity Plus system, but then he wouldn't know if the wide area resource (i.e. the bridges and wide area channel) was already in use with a previous wide area call. So essentially the user would be initiating a wide area communication without really knowing whether or not it was being bridged to the other sites. By switching to the wide area channel the user can see (via channel busy indication) whether the wide area resource is available. If the wide area channel is busy the user should try the other wide area channel and if both wide area channels are busy the user should wait until one of the channels becomes free.

Note: The 3rd party applications should not allow wide area group calls setup directly from the Capacity Plus systems to be bridged across to the other Capacity Plus systems, however once a wide area group call has been setup (from the wide area channel), the 3rd party applications should allow subscriber radios to talkback from the Capacity Plus systems.

The bridges are only able to manage group calls and so it is not possible to directly call a subscriber radio on another site individually. However, it is possible to call a subscriber radio on another site using one of its group addresses, request that the user switch manually to one of the wide area channels and then set up an individual call between the two subscriber radios on the wide area channel.