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**802.11 Network Upgrade to 802.11n  
with Intelligent Endpoints  
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## Introduction

In 2011 3D-P introduced to our customers the 802.11n equipped Intelligent Endpoint product line, along with the Motorola 7181 802.11n Access Point. The combination of these products can provide mobile networks with data rates up to 300Mbps, and complete mine-wide coverage. In order to achieve these benefits, a complete re-design/new deployment of the networks wireless infrastructure is required.

The upgrade path to such an infrastructure can be considered a process, and completed in a manner as to reduce the impact on clients currently using the wireless network. This is a multi-stage process with varying configurations of both the network infrastructure and client radios during the upgrade.

## The objective, a network with both high throughput and availability

In order to obtain the high throughputs available from an 802.11n outdoor network, the infrastructure must be deployed within the guidelines of a careful network design. Zones of coverage must be designed and created in order to allow each client a clearly chosen AP to communicate with. Overlap from other zones must be reduced or eliminated in order to reduce the noise floor and ensure minimal dropped packets from interference. This is done through the proper deployment of mobile access points, power settings on the access points, utilizing terrain shadowing, and proper antenna selection, to include electrical down tilt. It is also very important the client devices in the network utilize proper antennas. Utilizing high gain antennas on clients can have adverse effects as it increases the noise to other Access Point zones. Reference the 3D-P Document “112911-Network Design” for more information.

Most pre-existing outdoor networks have been designed with coverage as the main design goal. The connectivity management of most off the shelf client radios is not designed with mobility in mind, but is designed to establish a connection to an access point, and maintain that connection as long as possible. When that connection is dropped, a new connection is sought. In mobile environments that new connection will typically be with a stronger access point in the new coverage area.

Designing for maximum throughput requires a different algorithm for the connectivity manager. While connectivity can be maintained at very weak signal strengths, high throughputs are only obtained at strong signal strengths. Therefore, a connection manager must be utilized to check the availability of stronger access points frequently and providing a re-association with higher throughput available access points when preferable.

If the network has been designed/deployed with connectivity in mind (ie. access points at high locations where they can see much of the coverage area), without much thought to developing proper coverage zones, a connection manager that is weighted towards throughput can be forced to frequently switch access points, to the point client performance is degraded. This due to the fact that so many access points overlap, and all typically with poor throughput or signal strengths available. However, the connection manager that is designed with coverage as a priority typically can maintain coverage in this environment fairly well, although throughputs are severely limited.

A properly designed network, with coverage and overlap zones can provide both high throughput and high availability to a client device that includes an appropriate connection manager.

3D-P's 802.11 network designs include the Motorola 7181 Access Point. The 7181 has some highly desirable features available to outdoor networks. First, the radio has the capability of allowing the user to control the output power, as well as utilizing electrical down tilt. Both features allow the user to create appropriate coverage zones within a network. The 7181 also incorporates the Adept™ antenna system which makes 802.11n dual data streams possible in an outdoor environment with limited multi-path. Even with these technical advantages, obtaining a high throughput network with a high percentage of coverage is only possible through proper network design and deployment.

## The upgrade path

Where there is an existing 802.11 network, and existing clients, it can be advantageous to upgrade the network over time, minimizing the downtime to the clients. There are several methodologies which can be followed in performing this upgrade. They all must accomplish the following tasks:

1. Replace existing Infrastructure with Motorola 7181 Access Points
2. Re-design/re-deploy the infrastructure with access point zones and overlap areas as a primary goal.
3. Replace clients with clients utilizing throughput weighted connection management (ie. 3D-P Intelligent Endpoints)
4. Replace high gain client antennas with low gain antennas designed to utilize access point zones. (Can include addition of horizontal antenna to client for 802.11n utilization).

Below are two examples of a few upgrade methodologies:

### Example 1.

1. Over time, replace existing clients with Intelligent Endpoints, configured with connection management designed for a “coverage weighted” network (ie. low throughput expected). These clients work on the pre-existing infrastructure.
2. Deploy 7181 infrastructure with “Zones of Coverage” as the primary Design Goal.
3. Remove old infrastructure.
4. Re-Configure Intelligent Endpoints, with “throughput weighted” connection management. Ensure “Horizontal” antenna is installed for 802.11n connectivity.

### Example 2.

1. Deploy 7181 infrastructure with “Zones of Coverage” as the primary Design Goal. This infrastructure is configured to allow legacy clients, as well as IEPs communication.
2. Remove old infrastructure.
3. Over time, replace existing clients with intelligent Endpoints, configured with “throughput weighted” connection management.

Regardless of the methodology utilized, it is important that the new 7181 network infrastructure not be deployed using the same network design as the pre-existing infrastructure. Deploying a 7181 network in a “coverage weighted” philosophy can potentially increase coverage within the network coverage area. However, it might just as easily cause new problem zones. The 7181 is a high power radio. Just as deploying additional infrastructure of any brand in an already noisy environment can cause new problems to appear, deploying the 7181 in the same locations as pre-existing infrastructure may cause new problems with increased noise floor, etc., unless the power is turned down.

At the same time, it is important to note that during the period of time when the new 7181 network is deployed, and the old infrastructure is removed, the noise floor will be increased, and coverage/throughput problems may increase. These problems should be eliminated when the pre-existing infrastructure is removed. Adjusting the power down, and in some cases removing the pre-existing infrastructure as the 7181 network is deployed in each area of the network is often a good idea.

## Summary

Upgrading your existing wireless network to a higher throughput capable 802.11n mobile network is now possible, through the use of the 3D-P Intelligent Endpoint, and Motorola 7181 Access Point. Following the procedures outlined in this document can make the upgrade a manageable process, with limited downtime.



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