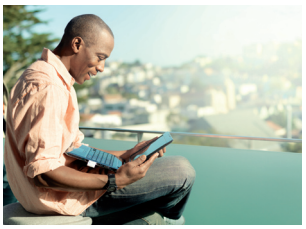
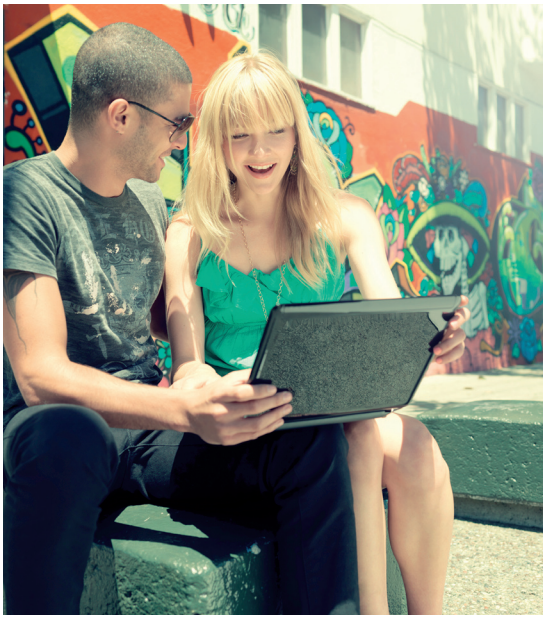


AP 7181 ADEPT ANTENNA

ELEVATING BANDWIDTH TO THE n^{th} POWER

TRANSFORMING OUTDOOR MESH NETWORKS WITH INNOVATIVE ANTENNA DESIGN

Municipalities and large enterprise customers are deploying mesh networks to provide wireless broadband connections across cities or within campus environments. Today, these networks support many different types of applications -- including video surveillance, meter reading and traffic control -- and have demonstrated mesh networks' ability to deliver a compelling return on investment and enable new services.



The adoption of 802.11n WiFi in both the enterprise and consumer markets is quickly gaining ground, as many are upgrading older indoor networks to meet 'next generation' standards. Such new high-capacity networks promise to deliver substantial cost-savings, not only in infrastructure and operations, but also in end-user productivity and efficiency gains.

Based on current network configurations and emerging ROI models, the potential benefits of this next generation "n" technology are dramatic. Since the specific capabilities of 802.11n applied to outdoor networks differ significantly from common indoor network configurations, network planners and operators must understand the technology enhancements 802.11n brings -- along with the unique environmental challenges of outdoor deployments -- to leverage the full advantages of 802.11n technology.

Building a robust, reliable outdoor broadband network is a challenging proposition. However, a new class of Multiple Input Multiple Output (MIMO) capable products promises to change that. New integrated, intelligent outdoor antenna systems designed to work with 802.11n MIMO technology are emerging to deliver substantial benefits including enhanced coverage, capacity and cost-effective deployments. Also, achieving the benefits of MIMO in an environment where 802.11a/b/g legacy protocols are still widely used requires system designs that go beyond traditional configurations, enhancing the benefits of 802.11n and delivering future scalability and a lower Total Cost of Ownership (TCO).

Introducing Motorola's 802.11n game changer: the Mesh Wide Area Network (MWAN) AP 7181 with the ADvanced Element Panel Technology (ADEPT) antenna system.

THE TIME TO MOVE NETWORK COVERAGE OUTDOORS IS NOW:
THE MWAN AP 7181

The Mesh Wide Area Network (MWAN) AP 7181 is a best-in-class, high power, multi-radio outdoor 802.11n access point with ADEPT (ADvanced Element Panel Technology) integrated antenna technology. It offers the highest mesh capacity to support the long-term wireless network needs of both municipal and enterprise customers. As one of the leading, high performance, outdoor 802.11n access points on the market, the AP 7181 delivers outstanding network capacity and a maximum data rate of 300 Mbps.

The AP 7181 has been engineered from the ground up to take advantage of the full benefits offered by 802.11n technology. The ADEPT Antenna system of the AP 7181 is a key example of this. By embracing the standard and optimizing radio hardware and software components, maximum throughputs and connections for mesh networking are realized. The AP 7181 delivers fast, stable connections and allows 802.11n technology to be easily deployed outdoors.

ADEPT DELIVERS WHEREVER 802.11n DEMANDS

Mesh Wide Area Networks can achieve maximum data rates by leveraging ADEPT antenna technology. This advanced system, harnessing the full capabilities of MIMO, is a defining feature of the AP 7181. Designed specifically for this addition to the Motorola MWAN portfolio, the integrated ADEPT antenna system overcomes the limitations of multiple vertical dipole antennas (sticks) often used in combination with many access point technologies.

The 802.11n technology standard offers a variety of physical layer diversity mechanisms for achieving higher throughput and improved packet reception capability. Each 802.11n radio can have multiple transmit antennas and paths. Multiple spatial data streams can be transmitted at the same time, on the same channel, but by different antennas. The data streams can be combined from multiple receivers using advanced signal processing. When discussing 802.11n or MIMO networks, three numbers are typically referenced – the first is the number of transmit antennas, the second is the number of receive antennas and the third is the number of spatial streams. For example, a 3x3:2 system has three transmit signals, three receive signals and two spatial streams. AP 7181 has 3 inputs and 3 outputs, typically represented as 3x3. Why is this important? Some alternative competitive products do not support a true 802.11n MIMO scheme, but rather a Single Input and Multiple Output, or SIMO, configuration. As a result, this will prevent capacity benefits being realized in these products.

Most wireless 802.11 a/b/g access points today transmit using vertical dipole antennas (sticks). These antennas use only vertically polarized transmissions, effectively limiting the access point to a single spatial stream. With a 3x3 dual radio AP, up to 12 stick antennas would be required to achieve optimal coverage, creating aesthetic as well as potential signal shadowing issues. Motorola's ADEPT antenna system contains a total of 8 antenna arrays per band that are individually connected to the RF hardware. A dual band 2.4 GHz and 5.8 GHz system contains 16 antenna arrays that are packed into 4 panels surrounding the 802.11n enclosure.

ADEPT antenna technology enables outdoor APs to leverage the full high bandwidth advantage of the 802.11n standard. By providing breakthrough mesh performance in every band, it assures predictable coverage and fast client connections; stable, high performance intra-mesh links; and a compact, aesthetic product that offers more choices for mounting locations than traditional "stick" antennas.

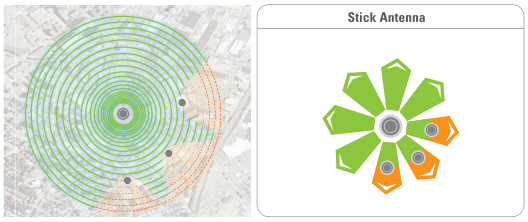
THE ADEPT ADVANTAGE

SELF-SHADOWING AVOIDANCE

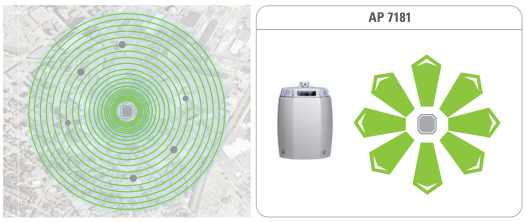
ADEPT delivers uniformed gain, even after losses from multiplexing and beam tilting are taken into account. Motorola's solution, ADEPT, incorporates both horizontally and vertically polarized antennas for every radio. This allows ADEPT to deliver higher data rates and greater range compared to other systems. There are no coverage gaps from multi-antenna "shadowing" or "notching" unlike traditional OMNI stick-based access points. OMNI sticks produce a "self shadowing" coverage pattern, where nearby antennas shade or "notch" the desired OMNI-directional antenna pattern and lead to unpredictable coverage holes. The innovative engineering and seamless coverage delivered by ADEPT technology eliminates holes or gaps. The result is true OMNI-directional coverage for predictable deployments and reliable connections.

STICK ANTENNA vs. ADEPT AP 7181

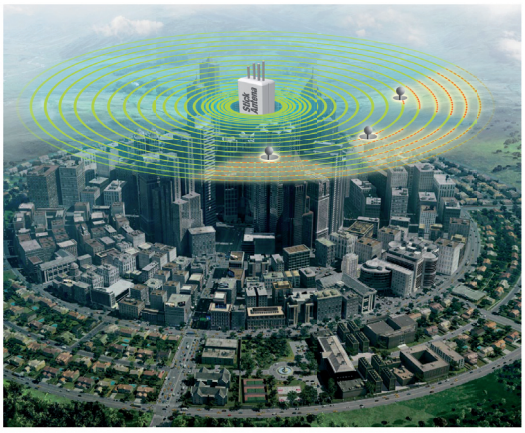
Self Shadowing

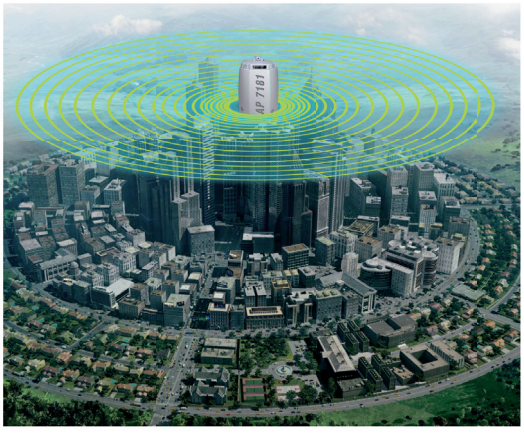


Nearby antennas "shade" or "notch" the desired omni-directional antenna pattern leading to unpredictable coverage holes.



AP 7181 provides true omni-directional coverage for predictable deployments and reliable connections.





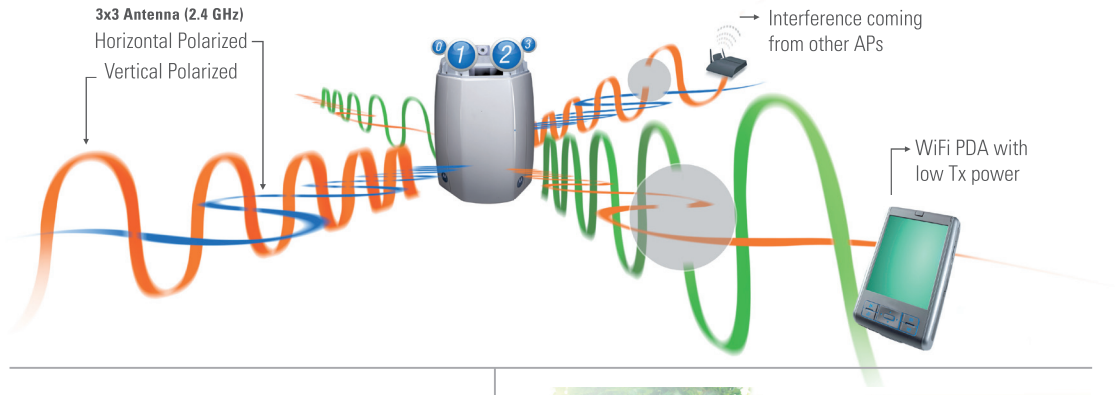
DYNAMIC INTERFERENCE AVOIDANCE

This feature of the AP 7181 enhances 802.11n's MRC (Maximal Ratio Combining) capabilities for superior receiver sensitivity. MRC utilizes multiple receive antennas to reconstruct signals, reducing error probabilities and re-transmissions and allowing clients to be "heard" better. By combining all three receiver chains per the MRC, an 802.11n based AP will achieve better receiver sensitivity by ignoring substandard receiver chains and listening to quality chains. The AP 7181 takes advantage of MRC by enhancing its receiver combining properties. The AP 7181's ADEPT system is comprised of 4 antenna panels (facing north, south, east and west), and each dual polarized panel uses MRC to combine both the vertical and horizontal polarized receive signals of each antenna panel as well as the individual antenna panels themselves. The combination of all these receivers maximizes overall receiver sensitivity for each chain.

Spatial Multiplexing allows data to be split and transmitted via two independent data streams using spatial separation of signals by antennas, effectively doubling the throughput of a wireless channel. Using different signals mitigates interference and improves throughput. However, the capability to send parallel data streams depends on the environment. Indoor 802.11n gains from Spatial Multiplexing use multi-path from the building walls to achieve a very high spatial separation when the signals arrive at the receiver out of phase. However, in outdoor environments it is difficult to create enough separation among the antenna signals to provide parallel data streams to support Spatial Multiplexing.

If interference affects one chain, the Motorola AP 7181 will maximize the receiver on the other chains, resulting in better RF reception. If vertically polarized interference is received, the AP 7181 will maximize the receivers on all horizontally polarized panels. If interference is received on a particular panel antenna, the AP 7181 will maximize the receiver capabilities on the remaining panels. This allows the AP 7181 to mitigate interference whether it originates on a particular stream, a direction or polarization and deliver higher data rates and greater range.

DYNAMIC INTERFERENCE AVOIDANCE FOR CHAINS

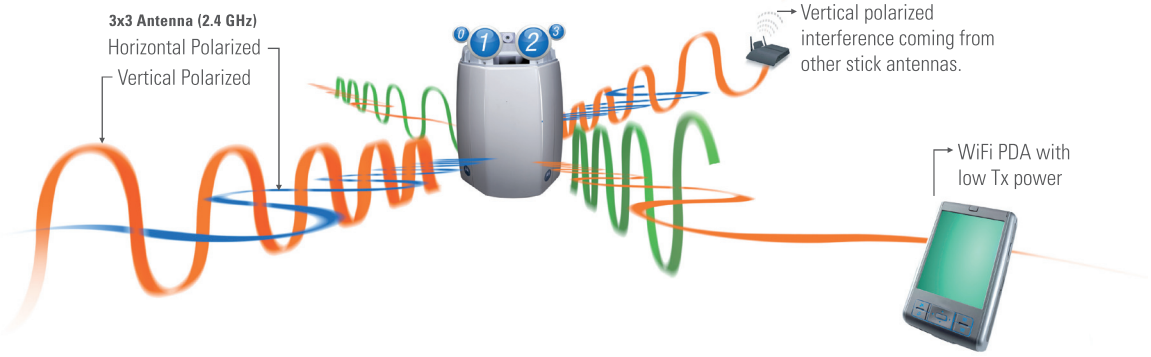


Chain 1
Chain 2
Chain 3

Panel Antenna Numbers:

The Result: The AP 7181 will maximize Rx on chain 3 while ignoring interference on chains 1 & 2. This is done on a per packet basis and allows for better receiver sensitivity to low powered WiFi devices like PDAs.

DYNAMIC INTERFERENCE AVOIDANCE FOR POLARIZATION



Chain 1
Chain 2
Chain 3

Panel Antenna Numbers:

The Result: AP 7181 will maximize Rx on horizontal polarized antennas while rejecting the vertical polarized interference. This is done on a per packet basis and allows for better receiver sensitivity to low powered WiFi devices like PDAs.

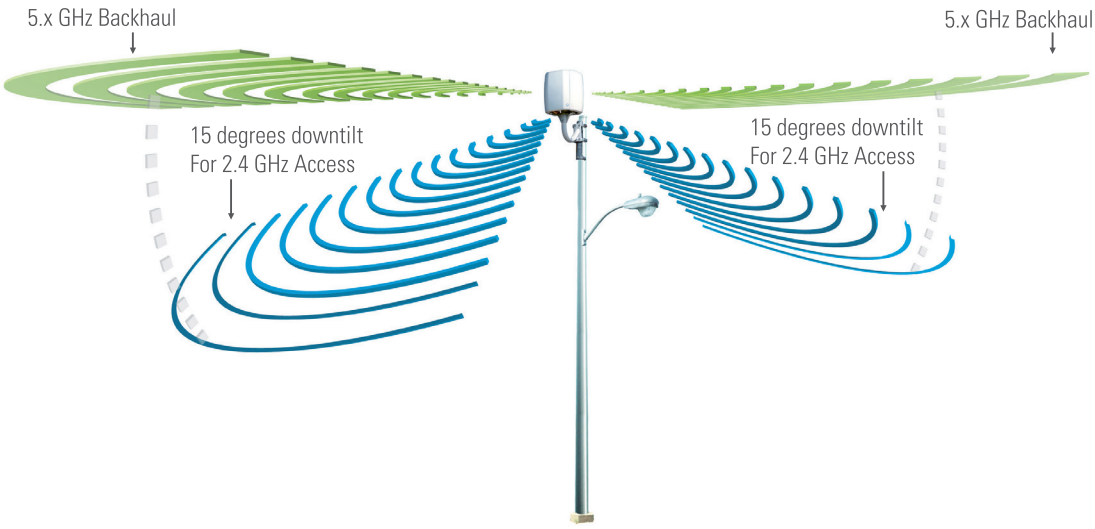
For optimal coverage, each radio in an access point would have multiple transmit and receive antennas, with both vertical and horizontal polarization. With three radios, and three antennas per radio, there potentially could be nine antennas sticking out of the node. With ADEPT, Motorola developed a way to combine 24 antennas, using no external dipole sticks.

SOFTWARE DOWN-TILT

The ADEPT antenna system features a software controlled electronic down-tilt for the 2.4 GHz radio, allowing coverage to be modified by electronically widening and tilting the beam to reduce radiated signals into the horizon to deliver optimized range and capacity where and when it is needed. The electronic down-tilt can be remotely adjusted up or down 15 degrees via the AP 7181 web console, saving the time and expense required to adjust fixed antenna beam patterns, and secure bucket trucks and technician labor to facilitate antenna replacement.

The diagram below highlights the advantages of software enabled down-tilt in a network. The example demonstrates a deployment in a dense urban environment with narrow streets where a customer has deployed Wi-Fi enabled parking meters.

MOTOROLA WIRELESS BROADBAND ADEPT ANTENNA



The AP 7181 provides optimal coverage, increased data rates, improved ROI and lower system TCO with ADEPT's programmable radio software.

BETTER COVERAGE, HIGHER CAPACITY AND GREATER ROI

The number of devices required to cover an area and the overall cost to deploy a network are important criteria as CIOs and IT managers calculate their potential return on the network, as well as its TCO. Increasing the transmit power will lower the number of access points required per square mile and will decrease deployment as well as ongoing operational costs. Additionally, designing networks for multiple uses enables costs to be shared among many different departments over the long-term.

The cost for deploying an access point varies greatly depending on the environment. As an example, for a two-person crew to install a typical access point takes 15-20 minutes when using a photo cell adapter, and 45 minutes to an hour when wiring is required from an external power source. The time varies depending on the environment, i.e. suburban, urban, etc.

The installation process includes many steps and its complexity depends on a number of factors. First, the ability to get a bucket truck to the location to allow access. Second, the time to block off the street when necessary in an urban setting, as well as time to put down outriggers to secure the bucket truck must be considered. Finally, the tools and time to mount the bracket and the access point must also be factored into the total costs. This entire process equals approximately two hours per AP from start to completion, amounting to 4 to 5 access points installed per working day per crew. When analyzing the costs, a $1,000 bucket truck cost per day equals $200 to $250 per access point. The cost of the crew per day is often more than twice the cost of the bucket truck. From an installation point of view, a product that uses new technology can increase ROI if improved coverage and capacity can be delivered using fewer access points -- even if the hardware cost per access point is higher.

STATE-OF-THE ART TECHNOLOGY SETS AP 7181 WITH ADEPT APART FROM THE COMPETITION

The powerful combination of ADEPT and stable mesh routing makes the AP 7181 a powerful and cost-effective outdoor wireless network solution. Leveraging Motorola's intelligent antenna design and leading routing technology, MeshConnex™, the AP 7181 is able to offer robust data connections throughout the network. The Opportunistic Radio Link Adaptation (ORLA) is a key decision-making element within MeshConnex, designed to select data rates that will provide the best throughput at any given time.

Motorola's MWAN AP 7181 with ADEPT antenna technology offers an integrated, well-designed network solution with proven outdoor performance. High powered radios with intelligent antenna technology allow IT to do more with less, reliably expanding outdoor network coverage – and ensuring future scalability -- without the expense of added access points.

The advanced management features, including software-controlled electronic down-tilt, saves ongoing labor and infrastructure expenses, making the AP 7181 a smart investment with the power to impact network capacity and Total Cost of Ownership well into the future.

ABOUT MOTOROLA

WIRELESS NETWORK SOLUTIONS

Motorola delivers seamless connectivity that puts real-time information in the hands of users, giving customers the agility they need to grow their business or better protect and serve the public. Working seamlessly together with its world-class devices, Motorola's unrivaled wireless network solutions include indoor WLAN, outdoor wireless mesh, point-to-multipoint, point-to-point networks and voice over WLAN solutions. Combined with powerful software for wireless network design, security, management and troubleshooting, Motorola's solutions deliver trusted networking and anywhere access to organizations across the globe.

MOTOROLA

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