# Table of Contents

Notice ........................................................................................................................................... iv
Introduction .................................................................................................................................. 1
Canopy System Overview ........................................................................................................... 2
The Canopy Portfolio of Products ............................................................................................... 3
Canopy Configurations ................................................................................................................ 4
    Point-to-Point System .............................................................................................................. 4
        Throughput & Range ........................................................................................................... 5
    Point-to-Multipoint System .................................................................................................. 5
    Metro WiFi Infrastructure ....................................................................................................... 8
        Canopy System Throughput & Range ............................................................................... 9
Components .................................................................................................................................. 11
    Access Point (AP) Cluster ...................................................................................................... 12
        900 MHz Advantage Access Point (Integrated) .............................................................. 14
        Connectorized Access Points .......................................................................................... 15
        Adjustable Power .......................................................................................................... 16
    Subscriber Module (SM) ....................................................................................................... 17
    Power Supplies ..................................................................................................................... 18
    Surge Suppressors ............................................................................................................... 18
    Mounting Brackets .............................................................................................................. 19
    Backhaul (BH) Module ......................................................................................................... 19
        10 and 20 Mbps Backhaul Module .................................................................................. 21
        30, 60, 150 and 300 Mbps Backhaul Module .................................................................. 21
    Element Management System ............................................................................................ 23
        Prizm Element Management System (PrizmEMS™) ..................................................... 23
        Bandwidth and Authentication Manager (BAM) ............................................................ 25
Ancillary Products ....................................................................................................................... 28
    T1/E1 Multiplexer ................................................................................................................. 28
    Cables ...................................................................................................................................... 30
Demonstration Kits ...................................................................................................................... 30
Starter Kits ..................................................................................................................................... 30
    900 MHz Starter Kit ............................................................................................................ 32
    2.4 GHz Starter Kits ............................................................................................................ 32
    5.1, 5.2, 5.4 & 5.7 GHz Starter Kits .................................................................................... 32
Canopy MOTOBUNDLES ........................................................................................................... 33
ILLUSTRATIONS

List of Tables

Table 1. Throughput and Range for Canopy Point-to-Point Configurations ........................................ 5
Table 2. Throughput and Range for Canopy Point-to-Multipoint Configurations .............................. 9
Table 3. A Comparison of Latency & Upgradeability ........................................................................ 11
Table 4. Canopy Point-to-Point Modules Throughput & Range ...................................................... 20
Table 5. Example of Service Tiers .................................................................................................. 27
Table 6. Distances and Throughputs for Canopy Starter Kits ......................................................... 30

List of Figures

Figure 1. The Canopy System Serves Diverse Customer Requirements .......................................... 2
Figure 2. Canopy System Modules and Typical Applications ............................................................ 3
Figure 3. The Canopy System in a 10 & 20 Mbps Point-to-Point Configuration ................................ 4
Figure 4. The Canopy System in a Point-to-Multipoint Configuration ............................................. 6
Figure 5. A Deployment View of the Canopy Advantage Platform .................................................... 7
Figure 6. Canopy Network as a Mesh Network Infrastructure .......................................................... 8
Figure 7. HotZone Zone Point Installed on a Light Pole ................................................................. 8
Figure 8. The Canopy System ......................................................................................................... 12
Figure 9. The Canopy System Showing the AP Cluster, CMM and GPS ......................................... 13
Figure 10. The Canopy 900 MHz Access Point with Integrated Antenna ........................................ 15
Figure 11. The Canopy 900 MHz Access Point (AP) Module with External (Connectorized) Antenna ......................................................................................................................... 16
Figure 12. The Canopy Subscriber Module (SM) ............................................................................ 17
Figure 13. The Canopy 900 MHz Subscriber Module with Connectorized Antenna .......................... 18
Figure 14. The Canopy Backhaul (BH) Modules ............................................................................. 19
Figure 15. The Canopy 30, 60, 150 or 300 Mbps Backhaul (BH) Module with Integrated Antenna ......................................................................................................................... 22
Figure 16. The Canopy 45 Mbps BH with Connectorized Antenna ................................................... 23
Figure 17. PrizmEMS Interface ........................................................................................................ 24
Figure 18. PrizmEMS Interfaces with an NMS Through a Northbound Interface ............................... 24
Figure 19. Enterprise or Central Office to Branch Office ................................................................. 28
Figure 20. Mobile Switching Office to Cellular Base Station ......................................................... 29
ACRONYMS

ACSP ................................. Authorized Canopy Solution Provider
AP ....................................... Access Point
BAM ..................................... Bandwidth and Authentication Manager
BH ....................................... Backhaul
CIR ....................................... Committed Information Rate
CMM ..................................... Cluster Management Module
CMMmicro ......................... Cluster Management Module micro
CPE ....................................... Customer Premise Equipment
DFS ....................................... Dynamic Frequency Selection
FCC ....................................... Federal Communications Commission
GPS ....................................... Global Positioning System
GUI ....................................... Graphical User Interface
LAN ..................................... Local Area Network
LOS ..................................... Line of Sight
MDU ....................................... Multiple Dwelling Unit
MIR ..................................... Maximum Information Rate (MIR)
NLOS ................................... Non Line of Sight
OFDM ................................... Orthogonal Frequency Division Multiplexing
POP ....................................... Point of Presence
RF ....................................... Radio Frequency
SM ....................................... Subscriber Module
S0HO ................................. Small Office Home Office
TDD ....................................... Time Division Duplex
VOIP ................................. Voice over IP
NOTICE

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Each configuration tested or described may or may not be the only available solution. This test is not a determination of product quality or correctness, nor does it ensure compliance with any federal, state or local requirements. Motorola does not warrant products other than its own strictly as stated in Motorola’s product warranties.

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INTRODUCTION

The Motorola Canopy™ wireless platform is a broadband communication system that supports high-speed access to business and residential customers. The system is available in a variety of configurations and is simply one of the best solutions for providing high-speed wireless broadband access. This document provides a brief overview of the Canopy system and details the configurations and their associated components. Deployment rules and installation guidelines are further discussed in the publications entitled:

- Canopy System User Guide
- Canopy Bandwidth and Authentication Manager User Manual
- Canopy T1/E1 Multiplexer User Guide
- Canopy Network Management with MRTG Application Note
- The Canopy System Application Note: Requirements for Shielded Cable
- The Canopy System Application Note: Same Band & Cross Band Installations
- The Canopy System Application Note: Canopy Subscriber Module Lightning Protection Guidelines
- The Canopy System Application Note: Wind Loading

Additional information is available from the Canopy system library at www.motorola.com/canopy.
CANOPY SYSTEM OVERVIEW

The Canopy system, Motorola’s innovative wireless broadband solution, is the ideal technology for developing, enhancing and extending advanced broadband networks and services. The Canopy family of products is comprehensive in nature — includes products in the 900 MHz, 2.4, 5.1, 5.2, 5.4 and 5.7 GHz frequency bands — and makes the delivery of high-demand services like broadband Internet access, voice over IP (VoIP), video services, security surveillance and T1/E1 capabilities both much quicker and much less expensive to deploy.

Figure 1 depicts how the Canopy system can be configured to serve geographically diverse regions — from densely populated urban centers with multiple dwelling units (MDUs) to remotely located towns and villages with high degrees of foliage — with wireless broadband services under a single network. Motorola recommends selecting products in the 5.2 and/or 5.7 GHz frequency band to serve as the network backbone and augmenting the system with products in the 900 MHz and 2.4 GHz frequency bands to extend coverage in difficult to reach areas.

Canopy wireless broadband technology combines exceptional performance, security, ease-of-use and cost effectiveness. All Canopy modules significantly reduce the time to design and deploy new commercial and enterprise broadband networks. Canopy modules also seamlessly integrate with existing network systems and management tools to make extending and augmenting existing service simpler and less cost-intensive.
THE CANOPY PORTFOLIO OF PRODUCTS
The Canopy portfolio of products includes modules with different performance capabilities to meet the end customers’ service requirements. Canopy products provide bandwidth that can be used to support voice, IP video and data services for a wide range of customers. Canopy Advantage Subscriber Modules provide higher throughput and lower latency which serve the needs of enterprise and large bandwidth consumers. Canopy Lite Subscriber Modules provide a low cost solution that provides voice and data services that meets the needs of smaller bandwidth consumers, such as residential users.

<table>
<thead>
<tr>
<th>Product</th>
<th>Typical Application</th>
<th>Features</th>
</tr>
</thead>
<tbody>
<tr>
<td>Canopy Advantage SM</td>
<td>• Enterprise broadband services</td>
<td>• 14 Mbps maximum throughput to a single user</td>
</tr>
<tr>
<td>Canopy SM</td>
<td>• Residential and/or enterprise broadband services</td>
<td>• 7 Mbps maximum throughput to a single user • Upgradeable to Advantage SM capabilities to offer more bandwidth as demand grows</td>
</tr>
<tr>
<td>Canopy Lite SM</td>
<td>• Emerging markets or for residential broadband services</td>
<td>• Entry level pricing for emerging markets • 512 kbps maximum throughput to a single user • Throughput upgrades to 1, 2, 4, 7 Mbps throughput</td>
</tr>
</tbody>
</table>

*Figure 2. Canopy System Modules and Typical Applications*

All Canopy system modules are based on software defined radio technology that removes the constraints imposed with traditional hardware designs or chip sets. As requirements change and standards evolve, the Canopy portfolio of products can support new functionality and enhancements via software upgrades. The Canopy Advantage platform will continue to provide the industry’s highest level of interference tolerance, security, scalability, signal reliability and ease of installation and also enables:

- **Fast Speeds:** Delivers sustained data rates up to 14 Mbps to meet customer demand.
- **High Performance:** Provides low latency service enabling VoIP and IP video services.
- **True Quality of Service:** Enables operators to provide differentiated levels of service and manage bandwidth using Committed Information Rate (CIR) and Maximum Information Rate (MIR).
- **Comprehensive Multi-Services Platform:** An ATM frame structure uses small frame sizes which reduce retransmission times and provides for low latency - a critical component for delivering high quality services such as VoIP and online gaming. This may not always be possible with other services that are based on
the 802.11 standard and use a smart polling scheme for delivering priority services. These polling schemes limit users to a small number who can take advantage of high priority services such as VoIP. The Canopy protocol ensures that any user in a sector can be a VoIP customer.

• **Seamless Integration:** All subscriber modules currently in the field can easily be upgraded, via software download, to take advantage of the benefits of the Canopy Advantage platform.

• **Software Upgrades:** All subscriber modules currently being shipped can have Advantage Subscriber Module capability added through software upgrades.

**CANOPY CONFIGURATIONS**

The Motorola Canopy wireless broadband access platform is available in two baseline configurations – point-to-point and point-to-multipoint. The following sections detail these baseline configurations.

**Point-to-Point System**

The Canopy wireless broadband platform can be configured to form a point-to-point network connection, as shown in Figure 3, for use in wireless backhaul, bridging, channelized T1 (voice & data) and other data applications. A point-to-point configuration can span distances up to 40 miles (64 kilometers). In the 10 and 20 Mbps backhaul systems, a reflector kit may be used to significantly reduce external interference issues as it is a six-degree antenna beam as opposed to a 60-degree beam used in the point-to-multipoint configuration. Greater distances can be achieved by daisy chaining backhaul modules together. Point-to-point solutions are available in 2.4 GHz (10 & 20 Mbps), 5.1 GHz (10 & 20 Mbps), 5.2 GHz (10 & 20 Mbps), 5.4 GHz (10 & 20 Mbps) and 5.7 GHz (10, 20 & 45 Mbps).

![Figure 3. The Canopy System in a 10 & 20 Mbps Point-to-Point Configuration](image)


**Throughput & Range**

Table 1 details the throughput and range for the Canopy systems in point-to-point configurations. Operating range and data throughput of wireless communications are dependant on terrain, foliage and background RF energy, among other conditions. Motorola strongly recommends network operators perform a physical and radio frequency site survey to take these factors into account.

<table>
<thead>
<tr>
<th>Canopy Product</th>
<th>Modulation Rate</th>
<th>Aggregate Throughput</th>
<th>Range Without Reflector</th>
<th>Range With Reflector</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.4 GHz BH</td>
<td>10 Mbps</td>
<td>7.5 Mbps</td>
<td>5 miles (8 kilometers)</td>
<td>35 miles (56 kilometers)</td>
</tr>
<tr>
<td></td>
<td>20 Mbps</td>
<td>14 Mbps</td>
<td>3 miles (5 kilometers)</td>
<td>35 miles (56 kilometers)</td>
</tr>
<tr>
<td>5.1 GHz BH</td>
<td>10 Mbps</td>
<td>7.5 Mbps</td>
<td>2 miles (3.2 kilometers)</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>20 Mbps</td>
<td>14 Mbps</td>
<td>2 miles (3.2 kilometers)</td>
<td>N/A</td>
</tr>
<tr>
<td>5.2 GHz BH</td>
<td>10 Mbps</td>
<td>7.5 Mbps</td>
<td>2 miles (3.2 kilometers)</td>
<td>N/A</td>
</tr>
<tr>
<td>5.2 GHz Extended Range BH</td>
<td>10 Mbps</td>
<td>7.5 Mbps</td>
<td>N/A</td>
<td>10 miles (16 kilometers)</td>
</tr>
<tr>
<td>5.2 GHz Extended Range BH**</td>
<td>20 Mbps</td>
<td>14 Mbps</td>
<td>N/A</td>
<td>5 miles (8 kilometers)</td>
</tr>
<tr>
<td>5.4 GHz BH</td>
<td>10 Mbps</td>
<td>7.5 Mbps</td>
<td>2 miles (3.2 kilometers)</td>
<td>10 miles (16 kilometers)</td>
</tr>
<tr>
<td></td>
<td>20 Mbps</td>
<td>14 Mbps</td>
<td>1 mile (1.6 kilometers)</td>
<td>5 miles (8 kilometers)</td>
</tr>
<tr>
<td>5.7 GHz BH</td>
<td>10 Mbps</td>
<td>7.5 Mbps</td>
<td>2 miles (3.2 kilometers)</td>
<td>35 miles (56 kilometers)</td>
</tr>
<tr>
<td></td>
<td>20 Mbps</td>
<td>14 Mbps</td>
<td>1 mile (1.6 kilometers)</td>
<td>35 miles (56 kilometers)</td>
</tr>
<tr>
<td></td>
<td>45 Mbps</td>
<td>33.6 Mbps*</td>
<td>40 miles** (64 kilometers)</td>
<td>N/A</td>
</tr>
</tbody>
</table>

**Notes:**
- * The Canopy 45 Mbps Backhaul Link Calculator can be used to more accurately estimate performance in a given situation.
- ** Data rates are dynamically variable with modulation from 3 to 33.6 Mbps (aggregate)

**Point-to-Multipoint System**

The point-to-multipoint system enables the delivery of broadband access to multiple locations from a single AP module. The system, as shown in Figure 4, was developed to optimize its performance in high and low-density environments in the presence of
external interference sources. Because of these design characteristics, a Canopy point-to-multipoint configuration can be deployed in both rural and metropolitan environments.

![Figure 4. The Canopy System in a Point-to-Multipoint Configuration](image)

The Canopy point-to-multipoint system is configurable using the 900 MHz, 2.4, 5.1, 5.2, 5.4 and 5.7 GHz frequency bands. A wireless AP Cluster can contain anywhere from one to six AP modules. Each Canopy AP module can deliver up to 6+ Mbps (900 MHz delivers up to 4 Mbps) of effective data throughput with connectivity to a maximum of 200 subscribers.

The Canopy Advantage AP delivers 7 Mbps of effective data throughput. In addition, when the Canopy Advantage access point is coupled with the Canopy Advantage subscriber module the throughput essentially doubles to 14 Mbps for those users located closest to the AP.

Figure 5 depicts a deployment view of the Canopy Advantage platform. As you can see in the figure, network operators can offer approximately double the throughput to network users at approximately up to the inner half of the range of the Canopy platform.
The 2.4, 5.4 and 5.7 GHz point-to-multipoint configurations can support a SM with the reflector kit (27RD). The reflector kit increases transmit and receive gain of the SM, thereby increasing the range between the AP module and the SM. Six AP modules in a cluster can deliver 360-degree varying degrees of coverage based on the frequency range and use of reflector.

- 900 MHz: >40 miles line of sight (64 kilometers)
- 2.4 GHz: @100 milliwatts 1.2 miles (2 kilometers)
- 2.4 GHz: @ 2 watt 5 miles (8 kilometers) to 15 miles (24 kilometers) with reflector
- 5.1 GHz: 2 miles (3.2 kilometers)
- 5.2 GHz: 2 miles (3.2 kilometers)
- 5.4 GHz: 2 miles (3.2 kilometers) to 10 miles (16 kilometers) with reflector
- 5.7 GHz: 2 miles (3.2 kilometers) to 10 miles (16 kilometers) with reflector

Please note a reflector is not permissible on 5.1 and 5.2 GHz Canopy point-to-multipoint systems.
Metro WiFi Infrastructure

The Canopy system can also be used as an infrastructure for a metropolitan WiFi network. Canopy HotZone modules can be installed in urban areas to provide 2.4 GHz public access to broadband services. In these applications, the Canopy system is used as an infrastructure to provide broadband access to the elements of the HotZone mesh network.

HotZone 3210 products are indoor products and HotZone 5210 Zone Points are outdoor elements that can be attached to light poles or other structures to provide public access mesh networks. Zone Points are available with a variety of antennas and cables to meet the specific needs of the network operator. Detailed information on HotZone products is available on the Canopy web site.
Canopy System Throughput & Range

Table 2 details the throughput and range for the Canopy systems in a point-to-multipoint configuration. When access points and subscriber modules from the Canopy Advantage platform are installed in a network, operators can provide up to twice the throughput to users located near the AP location. Network operators can now offer 4 Mbps of throughput at 900 MHz and 14 Mbps of throughput at 2.4, 5.1, 5.2, 5.4 and 5.7 GHz. This throughput is fully configurable to offer balanced up/down service or service at a ratio tailored to meet customer requirements. As shown in Table 2, this high throughput is available to Advantage SMs located close to the AP location. A good rule of thumb is that the throughput performance is doubled within the first half of the normal operating range for the frequency and configuration. Outside of this range the Canopy Advantage will perform in the same fine manor as the original Canopy platform.

Table 3 shows a comparison of latency and upgradeability between the standard Canopy and the Canopy Advantage platforms. Operating range and data throughput of wireless communication are dependant on terrain, foliage and background RF energy, among other conditions. Motorola strongly recommends network operators perform a physical and radio frequency site survey to take these factors into account.

Table 2. Throughput and Range for Canopy Point-to-Multipoint Configurations

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Canopy Platform</th>
<th>Modulation Rate</th>
<th>Aggregate Throughput</th>
<th>Range Without Reflector</th>
<th>Range With Reflector</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>900 MHz</strong></td>
<td>Advantage (AP &amp; SM)</td>
<td>6 Mbps</td>
<td>4 Mbps</td>
<td>20 miles (32 kilometers)</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 Mbps</td>
<td>40 miles (64 kilometers)</td>
<td></td>
</tr>
<tr>
<td><strong>2.4 GHz @100 Milliwatts</strong></td>
<td>Canopy</td>
<td>10 Mbps</td>
<td>6 Mbps</td>
<td>1.2 miles (2 kilometers)</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Advantage AP</td>
<td></td>
<td>7 Mbps</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Advantage AP &amp; SM</td>
<td>20 Mbps</td>
<td>14 Mbps</td>
<td>0.6 miles (1 kilometer)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>7 Mbps</td>
<td>1.2 miles (2 kilometers)</td>
<td></td>
</tr>
<tr>
<td><strong>2.4 GHz @2 Watts</strong></td>
<td>Canopy</td>
<td>10 Mbps</td>
<td>6 Mbps</td>
<td>5 miles (8 kilometers)</td>
<td>15 miles (24 kilometers)</td>
</tr>
<tr>
<td></td>
<td>Advantage AP</td>
<td></td>
<td>7 Mbps</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Advantage AP &amp; SM</td>
<td>20 Mbps</td>
<td>14 Mbps</td>
<td>2.5 miles (4 kilometers)</td>
<td>7.5 miles (12 kilometers)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>7 Mbps</td>
<td>5 miles (8 kilometers)</td>
<td>7 miles (24 kilometers)</td>
</tr>
<tr>
<td><strong>5.1 GHz</strong></td>
<td>Canopy</td>
<td>10 Mbps</td>
<td>6 Mbps</td>
<td>2 miles (3.2 kilometers)</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Advantage AP</td>
<td></td>
<td>7 Mbps</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Configuration Guide

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Canopy Platform</th>
<th>Modulation Rate</th>
<th>Aggregate Throughput</th>
<th>Range Without Reflector</th>
<th>Range With Reflector</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.2 GHz</td>
<td>Advantage AP &amp; SM</td>
<td>20 Mbps</td>
<td>14 Mbps</td>
<td>1 mile (1.6 kilometers)</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>7 Mbps</td>
<td>2 miles (3.2 kilometers)</td>
<td></td>
</tr>
<tr>
<td>5.4 GHz</td>
<td>Canopy</td>
<td>10 Mbps</td>
<td>6 Mbps</td>
<td>2 miles (3.2 kilometers)</td>
<td>N/A</td>
</tr>
<tr>
<td></td>
<td>Advantage AP</td>
<td>10 Mbps</td>
<td>7 Mbps</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Advantage (AP &amp; SM)</td>
<td>20 Mbps</td>
<td>14 Mbps</td>
<td>1 mile (1.6 kilometers)</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>7 Mbps</td>
<td>2 miles (3.2 kilometers)</td>
<td></td>
</tr>
<tr>
<td>5.7 GHz @ 1 Watt</td>
<td>Canopy</td>
<td>10 Mbps</td>
<td>6 Mbps</td>
<td>2 miles (3.2 kilometers)</td>
<td>10 miles (16 kilometers)</td>
</tr>
<tr>
<td></td>
<td>Advantage AP</td>
<td>10 Mbps</td>
<td>7 Mbps</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Advantage (AP &amp; SM)</td>
<td>20 Mbps</td>
<td>14 Mbps</td>
<td>1 mile (1.6 kilometers)</td>
<td>5 miles (8 kilometers)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>7 Mbps</td>
<td>2 miles (3.2 kilometers)</td>
<td>10 miles (16 kilometers)</td>
</tr>
</tbody>
</table>

900 MHz calculations are based on line of sight
Canopy 900 MHz access points that are deployed in the field today can be easily upgraded to the Advantage capabilities by installing the Canopy Release 6.0. This release is available at no charge to Canopy customers. All other Canopy field deployed SMs can also be upgraded to Canopy Release 6.0 and when coupled with an Advantage AP can take advantage of the increased throughput and reduced latencies.
Table 3. A Comparison of Latency & Upgradeability

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Canopy SM Platform</th>
<th>Software Upgradeable for New Features</th>
<th>Latency</th>
</tr>
</thead>
<tbody>
<tr>
<td>900 MHz</td>
<td>Canopy</td>
<td>No</td>
<td>40 Milliseconds</td>
</tr>
<tr>
<td></td>
<td>Advantage</td>
<td>Yes</td>
<td>14 Milliseconds</td>
</tr>
<tr>
<td>2.4 GHz</td>
<td>Canopy</td>
<td>No</td>
<td>20 Milliseconds</td>
</tr>
<tr>
<td></td>
<td>Advantage</td>
<td>Yes</td>
<td>5 to 7 Milliseconds</td>
</tr>
<tr>
<td>5.2 GHz</td>
<td>Canopy</td>
<td>No</td>
<td>20 Milliseconds</td>
</tr>
<tr>
<td></td>
<td>Advantage</td>
<td>Yes</td>
<td>5 to 7 Milliseconds</td>
</tr>
<tr>
<td>5.7 GHz</td>
<td>Canopy</td>
<td>No</td>
<td>20 Milliseconds</td>
</tr>
<tr>
<td></td>
<td>Advantage</td>
<td>Yes</td>
<td>5 to 7 Milliseconds</td>
</tr>
</tbody>
</table>

**COMPONENTS**

The Motorola Canopy system is a family of flexible products that deliver outstanding performance in a wide variety of scenarios. As shown in , the Canopy system has seven main components:

- The Access Point (AP) Cluster
- Subscriber Module (SM)
- Backhaul (BH) Module
- Cluster Management Module (CMM)
- Prizm Element Management System (PrizmEMS™)
- Bandwidth and Authentication Manager (BAM)
- Surge Suppressor
The AP modules are listening. This synchronization also ensures that when the SMs are transmitting, all of the AP modules transmit at the same time while all SMs are in a listen mode. The synchronization of the AP transmission along with the specially designed Canopy Time Division Duplex (TDD) air interface ensures that all AP modules transmit at the same time while all SMs are in a listen mode. This synchronization also ensures that when the SMs are transmitting, all of the AP modules are listening. The Canopy System

Figure 8. The Canopy System

The Canopy and Canopy Advantage 900 MHz, 2.4, 5.2 and 5.7 GHz radios are approved by the United States Federal Communication Commission (FCC) Part 15, Class B, and RSS-210 of Industry Canada (IC). The Canopy 2.4 and 5.4 GHz products are approved by European Telecommunications Standards Institute (ETSI). The Access Point (AP), Subscriber Module (SM), Backhaul (BH) Module and surge suppressors are all UL approved. Not all frequencies are available for wireless broadband usage in every country. For further details, please consult with the appropriate regulatory agency in the specific country to determine if products in a particular frequency are approved for wireless broadband usage.

Access Point (AP) Cluster

The AP Cluster is a base station that incorporates between one and six AP modules and up to two Backhaul (BH) modules. Each AP module operates with a 60-degree directional antenna to provide coverage to a single sector. The AP can support up to a maximum of 200 subscriber modules on a single AP. Keep in mind, however, that the bandwidth is shared among all subscribers. Therefore, it is important to determine the level of service desired for subscribers and apply the appropriate traffic engineering guidelines to obtain that level of service. Figure 9 shows the Canopy AP Cluster.

One of the unique capabilities of the Canopy system is its ability to synchronize the transmission timing of the AP modules in all of the AP Clusters. The Global Positioning System (GPS) receiver in the Cluster Management Module (CMM), shown in Figure 9, is the key to delivering this system level synchronization. The synchronization of the AP transmission along with the specially designed Canopy Time Division Duplex (TDD) air interface ensures that all AP modules transmit at the same time while all SMs are in a listen mode. This synchronization also ensures that when the SMs are transmitting, all of the AP modules are listening.
Enabled by the CMM, synchronization ensures that the Canopy system does not interfere with itself, since the AP modules do not interfere with each other and the SMs do not interfere with each other. This unique characteristic enables the operator to effectively scale the network without requiring complex system planning. Canopy AP Clusters can be easily added to the network to improve system coverage or capacity without increasing system interference.

The AP modules in the 2.4, 5.1, 5.2, 5.4 and 5.7 GHz frequency bands are equipped with integrated antennas. All of the Canopy AP modules are available in the standard Canopy platform as well as the Advantage platform with the exception of the 900 MHz products. In addition, the Canopy 900 MHz and 5.7 GHz access points are available in two versions: connectorized (external antenna) and integrated (built-in antenna).
Each AP requires a 24-volt power source and uses a single 10/100 BaseT half/full duplex connection to interface into the CMM or appropriate network connection. The AP Cluster has eight configurable ports and contains five main components:

- Cluster Management Module (CMM)
  - GPS Receiver
  - Hardened Ethernet Switch
  - Power Supply
- AP Modules (A cluster can support up to six APs)
- Surge Suppressor (A single cluster requires one surge suppressor to protect the network connection to the CMM when the BH module is not used with the CMM. When the CMM is installed indoors, Motorola recommends that a surge suppressor should be installed on the outside of the building for each module connected to the CMM to provide protection.)
- BH Modules
- Power Source (the AP Cluster is powered by the CMM which requires a 110 or 220 VAC or 24 VDC power source)

Details for throughput and range of the AP modules are contained in the sections of this document entitled *Canopy Configurations* and *Throughput & Range*.

**900 MHz Advantage Access Point (Integrated)**

The 900 MHz integrated access point is built on the Canopy Advantage platform (9000AP/9001AP). As shown in Figure 10, the 900 MHz integrated AP has a different form factor than the Canopy access points in the 2.4, 5.1, 5.2, 5.4 and 5.7 GHz frequency bands. The 900 MHz integrated access points include a higher gain antenna (12 dBi) than the connectorized module and are horizontally polarized with a 3 dB beam width (35 degrees vertical and 60 degree horizontal).

The 900 MHz integrated APs are also available with bandpass filters already built into the module (9000APF/9001APF) to mitigate interference from other 900 MHz systems operating in the same area. Further details are available in the *Canopy System User Guide*.
Connectorized Access Points

The Canopy and Canopy Advantage access point modules, as shown in Figure 11, are available with a connectorized antenna option in the 900 MHz (9000APC/9001APC). 5.7 GHz connectorized access point modules are also available in the UK (5750APC, 5700APC & 5701APC). The connectorized modules have a 16-inch (approximately 40 centimeter) cable with a male N-type connector for connecting to an external antenna.

Motorola offers an external antenna for the 900 MHz connectorized products. The AN900 is a 9 dBi external antenna that can be either vertically and horizontally polarized with a 3 dB beam width (60 degrees vertical and 60 degree horizontal). Motorola has also certified additional antennas for use with the 900 MHz access point. These antennas may be purchased through Authorized Canopy Solution Providers (ACSPs).

For the connectorized access points in the 5.7 GHz frequency range, Motorola recommends the use of sector antennas. It is important to note, when using any connectorized antenna the configuration must be verified with all local, state and national regulatory requirements.
While the Canopy system is extremely easy to set-up, the installation of external antennas requires a professional installer. The installer is responsible for:

- Selection of an antenna approved for use with the Canopy 900 MHz & 5.7 GHz products by the national regulatory agency;
- Setting of the gain consistent with the antenna and within regulatory limits; and
- Use of moisture sealing tape or wrap to increase long-term reliability of the connectors.

The 900 MHz connectorized APs can be used with bandpass filters to help in mitigating interference from other 900 MHz systems operating in the same area. These filters are an orderable option that is installed at the factory.

The heavy duty Universal Mounting Bracket (SMMB2) should be used to hold the connectorized products (antenna and radio). The Universal Mounting Bracket (SMMB1) may also be used with the system, however, it was not designed to support both the AP module and a connectorized antenna. Therefore, if the SMMB1 is used with the connectorized modules, two SMMB1 mounting brackets are required – one for the antenna and one for the radio. Further details are available in the Canopy System User Guide.

**Adjustable Power**

The Canopy 2.4GHz, 5.7 GHz and 900 MHz systems support adjustable power and can be tuned in one-decibel increments to meet the specific requirements of the installation. Details the part numbers for both the adjustable power radios.
**Subscriber Module (SM)**

The Canopy SM, as shown in Figure 12, is the subscriber termination unit or the Customer Premise Equipment (CPE) and consists of a single module that operates with an integrated 60-degree antenna.

![Figure 12. The Canopy Subscriber Module (SM)](image)

Each SM can communicate to a single AP module at any given time. SM synchronization and control is accomplished via the received AP signal. SMs are typically located outdoor and Line of Sight (LoS) from the APs. Once an SM is initialized, it scans the Radio Frequency (RF) channels and automatically registers with the appropriate AP.

Each SM requires a Category 5 cable for its Ethernet connection to the premise IP equipment with DC power supplied to the SM through that same cable. The connectorized 900 MHz (9000APC/9001APC) and 5.7 GHz (5750SMC, 5700SMC, 5701SMC, 5751 SMC) subscriber modules also have a 16-inch (approximately 40 centimeter) cable with a male N-type connector for linking to an external antenna.

A connectorized Canopy SM with external antenna is shown in Figure 13. A professional installer is required for the connectorized SMs. The same guidelines and performance apply for the 900 MHz subscriber module as those shown in the connectorized access point. As always, when using a connectorized antenna verify that the configuration meets local, state and national requirements.
Figure 13. The Canopy 900 MHz Subscriber Module with Connectorized Antenna

Power Supplies

The SM power supply is installed at the subscriber location. This power supply is equipped with an industry standard RJ-45 connector to provide power to the SM via power over Ethernet, so there is no additional cable installation required to provide power connection. Canopy power supplies are available that are compliant with Reduction of Hazardous Substances (RoHS) requirements and meet country specific requirements.

Table 4. Power Supplies

<table>
<thead>
<tr>
<th>Part Number</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ACPS81W</td>
<td>100-240 VAC/50-60 Hz 100 W Power Supply for CMM3 (North America Line Cord)</td>
</tr>
<tr>
<td>ACPS81W-02</td>
<td>100-240 VAC/50-60 Hz 100 W Power Supply for CMM3 (No Line Cord)</td>
</tr>
<tr>
<td>ACPS110-03</td>
<td>110 VAC Single XCVR Power Supply - U.S., NOM &amp; Canada</td>
</tr>
<tr>
<td>ACPSSW-09A</td>
<td>ACPSSW-09A Power Supply 90-240 VAC, 50-60 Hz Power Supply (+US, Euro, UK adaptors)</td>
</tr>
<tr>
<td>ACPSSW-10A</td>
<td>90-240VAC / 50-60Hz Power supply (+ Argentina Adaptor)</td>
</tr>
<tr>
<td>ACPSSW-11A</td>
<td>90-240VAC / 50-60Hz Power supply (+ Australia adaptor)</td>
</tr>
<tr>
<td>ACPSSW-12A</td>
<td>90-240VAC / 50-60Hz Power supply (+ China Adaptor)</td>
</tr>
</tbody>
</table>

Surge Suppressors

Motorola strongly recommends using a Canopy Ethernet Surge Protector (300SS) mounted at the Ethernet entry point on the outside wall of the premises. These are available in bundle packs of 25 and 100 surge suppressors.
Mounting Brackets

The Universal Mounting Brackets are available for mounting the SM to the customer site. One mounting bracket is required for each SM. 900 MHz Integrated SMs come with the mounting bracket included.

- The Universal Mounting Bracket (SMMB1) is designed to hold one 2.4, 5.2, 5.4 or 5.7 GHz subscriber module. These are available in bundle packs of 25 and 100 mounting brackets.
- The heavy duty Universal Mounting Bracket (SMMB2) is designed to support the 900 MHz connectorized Subscriber Modules or both a subscriber module and a connectorized antenna. These are available in bundle packs of 25 and 100 mounting brackets.

Backhaul (BH) Module

The Canopy BH module is a point-to-point radio that carries traffic between two points. In the Canopy system a backhaul link is used to provide bandwidth to and from AP Clusters. A set of point-to-point BH modules can also be used as a low latency Ethernet bridge between any two networks or between a network and a single remote computer. In the event a convenient fiber or cable connection is not available for IP connectivity to an AP Cluster a set of BH modules can be used.

Figure 14. The Canopy Backhaul (BH) Modules

The Canopy Backhaul portfolio has an array of modules that enable network architects to meet service requirements at the lowest cost. The Canopy 30/60 and 150/300 Mbps OFDM Backhaul Radios complement the Canopy 10/20 Backhaul and Canopy Point to Multipoint (PMP) product line (900MHz, 2.4, 5.2, 5.4 and 5.7 GHz) to allow network operators a variety of solutions so that the network can be tailored to meet specific requirements.
## Signaling Rate and Range

### Table 4. Canopy Point-to-Point Modules Throughput & Range

<table>
<thead>
<tr>
<th>Backhaul Radio Frequency</th>
<th>Channel Width</th>
<th>Aggregate Ethernet Throughput (roundtrip Latency)</th>
<th>Non-Overlapping Channels</th>
<th>Range without Reflector</th>
<th>Range with Reflector part #</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.4 GHz 10 Mbps</td>
<td>20 MHz</td>
<td>7.5 Mbps (5.0ms)</td>
<td>3</td>
<td>5 miles (8 kilometers)</td>
<td>35 miles (56 kilometers)</td>
</tr>
<tr>
<td>2.4 GHz 20 Mbps</td>
<td>20 MHz</td>
<td>14.0 Mbps (5.0ms)</td>
<td>2</td>
<td>2 miles (3.2 kilometers)</td>
<td>35 miles (56 kilometers)</td>
</tr>
<tr>
<td>5.2 GHz 10 Mbps</td>
<td>20 MHz</td>
<td>7.5 Mbps (5.0ms)</td>
<td>2</td>
<td>2 miles (3.2 kilometers)</td>
<td>N/A</td>
</tr>
<tr>
<td>5.2 GHz ER 10 Mbps</td>
<td>20 MHz</td>
<td>7.5 Mbps (5.0ms)</td>
<td>N/A</td>
<td>10 miles (16 kilometers)</td>
<td>N/A</td>
</tr>
<tr>
<td>5.2 GHz ER 20 Mbps</td>
<td>20 MHz</td>
<td>14.0 Mbps (5.0ms)</td>
<td>N/A</td>
<td>5 miles (8 kilometers)</td>
<td></td>
</tr>
<tr>
<td>5.4 GHz 10 Mbps</td>
<td>20 MHz</td>
<td>7.5 Mbps (5.0ms)</td>
<td>2</td>
<td>2 miles (3.2 kilometers)</td>
<td>10 miles (16 kilometers)</td>
</tr>
<tr>
<td>5.4 GHz 20 Mbps</td>
<td>20 MHz</td>
<td>14.0 Mbps (5.0ms)</td>
<td>1</td>
<td>1 mile (1.6 kilometers)</td>
<td>5 miles (8 kilometers)</td>
</tr>
<tr>
<td>5.7 GHz 10 Mbps</td>
<td>20 MHz</td>
<td>7.5 Mbps (5.0ms)</td>
<td>2</td>
<td>2 miles (3.2 kilometers)</td>
<td>35 miles (56 kilometers)</td>
</tr>
<tr>
<td>5.7 GHz 20 Mbps</td>
<td>20 MHz</td>
<td>14.0 Mbps (2.5ms)</td>
<td>1</td>
<td>1 mile (1.6 kilometers)</td>
<td>35 miles (56 kilometers)</td>
</tr>
<tr>
<td>5.7 GHz 30 Mbps*</td>
<td>12 MHz</td>
<td>1.5 Mbps – 21 Mbps (≤ 7.0ms)</td>
<td>DFS</td>
<td>N/A</td>
<td>nLoS: Up to 6 miles (10 kilometers)</td>
</tr>
<tr>
<td>5.7 GHz 60 Mbps*</td>
<td>12 MHz</td>
<td>3.0 Mbps – 43 Mbps (≤ 7.0ms)</td>
<td></td>
<td>DFS</td>
<td>NLoS: Up to 25 miles (40 kilometers)</td>
</tr>
<tr>
<td>5.7 GHz / 150 Mbps*</td>
<td>30 MHz</td>
<td>7.2 Mbps – 15.01 Mbps (≤ 2.0ms)</td>
<td></td>
<td>DFS</td>
<td>LoS: Up to 124 miles (200 kilometers)</td>
</tr>
<tr>
<td>5.7 GHz / 300 Mbps*</td>
<td>30 MHz</td>
<td>14.4 Mbps – 300.2 Mbps (≤ 2.0ms)</td>
<td></td>
<td>DFS</td>
<td></td>
</tr>
</tbody>
</table>

Notes: * Data rates are dynamically variable with modulation. Use OFDM BH Link calculator tool to provide accurate link performance estimates.
Motorola’s Canopy System provides carrier, service provider and enterprise network operators with a robust wireless broadband portfolio of products to deliver proven, cost-effective, secure, carrier-grade broadband access exactly when and where it is needed.

**The Backhaul Portfolio includes two series of Canopy backhaul technology:**
- The Canopy 10 and 20 Mbps Backhaul Radios
- The Canopy 30/60 and 150/300 Mbps Backhaul Radios
Both deliver enterprise users, service providers and carriers highly reliable and secure point-to-point wireless backhaul links for bandwidth-intense and latency sensitive applications.

**10 and 20 Mbps Backhaul Module**
Canopy 10 and 20 Mbps Backhaul Radios are designed for Line-of-Sight (LoS) applications with low latency (under 5ms roundtrip) and high reliability for low cost deployment worldwide in five unlicensed frequencies. (2.4, 5.1, 5.2, 5.4 & 5.7GHz).

Each 10 and 20 Mbps BH module, illustrated in Figure 14, communicates to another BH module using a highly directional antenna. The 10 Mbps BH module operates with a raw data bit rate of 10 Mbps with an aggregate throughput of 7.5 Mbps and has a maximum range of approximately 35 miles (56 kilometers) when using the reflector. The 5.2 GHz Extended Range 20 Mbps BH module provides an aggregate throughput of 14 Mbps when using the reflector. Details for throughput and range of the BH modules are contained in the sections of this document entitled *Canopy Configurations* and *Throughput & Range*.

The uplink/downlink bandwidth ratio for a single BH link is configurable by the operator (i.e. 75 percent downlink and 25 percent uplink or 50 percent uplink and 50 percent downlink – set at timing master). When two BH pairs are configured back-to-back in a daisy chain configuration, they each need to be configured for symmetrical load with 50 percent allocated for uplink and downlink. Each BH module receives its 24 VDC power from Canopy power supply. The BH module can also be connected to the CMM, which will supply power to the BH module and networking with the AP modules at the AP Cluster.

**30, 60, 150 and 300 Mbps Backhaul Module**
The Canopy 30/60 & 150/300 Mbps OFDM BH Radios are designed for LoS, nLoS & NLoS applications with low latency (<7ms for 30/60; <1ms for 150/300) and high reliability for deployment worldwide in the 5.7GHz unlicensed band. The radios are offered in two versions, with a choice of - Integrated and Connectorized antennas - providing the operator with the flexibility to establish challenging links over water, through trees, over hills and around buildings using the small integrated antenna form factor or by using higher gain flat or parabolic antennas with the Connectorized version.

Just like the other Canopy Backhaul solutions, the Canopy 30/60 and 150/300 Mbps OFDM Backhaul solutions are designed to easily deploy in a matter of hours and to
operate for years in extreme weather conditions from -40 to +60 C. Each solution in the Canopy Backhaul portfolio offers high carrier-to-interference (C/I) ratio, which enables exceptional performance in high interference environments. The OFDM Backhaul Radios include additional interference mitigation techniques as well - DFS, Adaptive Modulation, Transmit Diversity - improving performance and uptime in challenging nLoS and NLoS applications. By providing a secure, high throughput short-range NLoS or long-range LoS connection, the Canopy system 30/60 or 150/300 Mbps OFDM Backhaul solution provides a wireless alternative to remove network bottlenecks at a fraction of the cost of wire line alternatives.

Figure 15. The Canopy 30, 60, 150 or 300 Mbps Backhaul (BH) Module with Integrated Antenna

Unlike other Canopy backhaul modules, the 30, 60, 150 and 300 Mbps BH modules are sold in pairs and do not support the use of a reflector. To ensure a secure connection, each pair of modules is preset with its own built-in IP address. The backhaul modules also contain the corresponding MAC address for its mate. The preset addresses enable the system’s security features and ensure that the two backhaul modules can communicate only with one another.

The 30, 60, 150 and 300 Mbps BH combines multi-beam antennas, space/time coding, Orthogonal Frequency Division Multiplexing (OFDM), adaptive modulation and Dynamic Frequency Selection (DFS) to deliver a robust backhaul solution in a small-integrated package. Encryption is provided via a built-in proprietary scheme.

To accurately estimate throughput based on topographic features and obstructions, Motorola recommends use of the backhaul link estimator to accurately gauge the
system’s performance in certain situations. This link estimator is available on the Motorola Canopy web site.

Each 30, 60, 150 and 300 Mbps integrated BH includes integrated antennas, indoor power unit, mounting hardware, quick start guide and CD containing user guide and software. The 45 Mbps connectorized BH contains all of the same elements as the integrated with the exception of the antennas. When using a connectorized antenna verify that the configuration meets local, state and national requirements.

![The Canopy 45 Mbps BH with Connectorized Antenna](image)

**Figure 16. The Canopy 45 Mbps BH with Connectorized Antenna**

**Element Management System**

A centralized view of a broadband wireless network is required for operators to manage resources efficiently. With this in mind, the Motorola Canopy system is enhanced with element management tools that improve the installation process, security management and network operations.

**Prizm Element Management System (PrizmEMS™)**

The Canopy PrizmEMS is designed to enable service providers to keep the Canopy network operating at maximum efficiency. As shown in Figure 17, the element
management system uses a Graphical User Interface to enable operations center technicians to quickly access the information they need.

PrizmEMS supports open interfaces. The system is extremely flexible and can operate as a stand-alone system or integrate seamlessly with other Network Management Systems (NMS) such as HP OpenView.

PrizmEMS is a concentrator or aggregator of Canopy element information and provides auto discovery, network monitoring, fault management, and element management capabilities on the Canopy network. In addition, the PrizmEMS provides users a range of tiered permission levels to grant and block access to the data so that an appropriate balance between efficiency and security can be maintained in network operations.

PrizmEMS covers five main management areas:

- **Fault Management**: Focuses on the identification, isolation and correction of network problems. In addition, the PrizmEMS can perform remote diagnostics and repair without requiring visits to the field.
• **Configuration Management.** Provides for the installation, loading, modifying and tracking of the configuration parameters for network hardware and software. The system can interact with RADIUS servers and provide centralized provisioning and control.

• **Accounting Management:** Enables service providers to establish varies tiers of service by managing bandwidth allocations, details logging of activity and serves as a central point for analysis and reporting.

• **Performance Management:** Proactively monitors the network performance to ensure that it is operating at optimum levels. Through the use of PrizmEMS, the network operator will have access to statistics that indicate when, for example, additional access points are required to support growth or when the bandwidth limits of backhaul links have been maximized and additional capacity should be added. Once a particular threshold is reached the network operator is notified before problems are realized.

• **Security Management:** Manages access to the network, maintains confidentiality and ensures data integrity.

**Bandwidth and Authentication Manager (BAM)**

The Bandwidth and Authentication Manager (BAM) augments the Canopy systems embedded encryption capabilities as well as the PrizmEMS. The BAM contains additional layers of security to restrict access to system data. It is the central point of authentication for subscribers. Through the effective use of the BAM in a network, operators can successfully:

• **Offer Tiered Services:** Apportioning bandwidth to businesses, Small Office Home Office (SOHO) and residential customers based on demand.

• **Increase Security Levels:** Requiring positive authentication from a central control point.

• **Manage Network Assets Efficiently:** Controlling license management from a central location.

**Special Features**

The BAM supports a number of unique features:

• **Allocation of Bandwidth:** Through the use of the BAM, operators can allocate sustained uplink, uplink burst, sustained downlink, downlink burst and Committed Information Rate (CIR).

• **Provide Floating Licenses of Advantage Software Upgrades:** The license manager in the BAM can allocate Canopy Advantage capabilities to Subscriber Modules in the network.

• **Support for A Variety of Databases:** The BAM supports RADIUS, Postgres and MySQL databases.
• **Management of Server Based Licenses:** Allows network providers to control Canopy software upgrades and license management from a central location.

• **Control of Subscriber Status:** Enables operators to suspend individual subscriber modules without deleting them from the database.

**Functionality**

The BAM has a web based interface and supports the following functionality:

• Adding Subscribers
• Modifying Subscribers
• Deleting Subscribers
• Changing Typical Subscriber Settings

Examples of levels of service that vary by Maximum Information Rate (MIR) settings are provided in Table 5. Further information on the features of the Canopy BAM can be found in the user manuals at [www.motorola.com/canopy](http://www.motorola.com/canopy).
### Table 5. Example of Service Tiers

<table>
<thead>
<tr>
<th>AP</th>
<th>Canopy</th>
<th>Canopy Advantage</th>
<th>Canopy Advantage</th>
<th>Canopy Advantage</th>
</tr>
</thead>
<tbody>
<tr>
<td>SM</td>
<td>Canopy</td>
<td>Canopy Standard</td>
<td>Canopy Standard</td>
<td>Canopy Advantage</td>
</tr>
<tr>
<td>Operation</td>
<td>1X</td>
<td>1X</td>
<td>2X</td>
<td>2X</td>
</tr>
<tr>
<td>Maximum Burst</td>
<td>4.4 Mb</td>
<td>5 Mb</td>
<td>10 Mb</td>
<td>10 Mb</td>
</tr>
</tbody>
</table>

#### Example Service Settings

<table>
<thead>
<tr>
<th>Service Type</th>
<th>Premium</th>
<th>Regular</th>
<th>Basic</th>
<th>Premium</th>
<th>Regular</th>
<th>Basic</th>
<th>Premium</th>
<th>Regular</th>
<th>Basic</th>
<th>Premium</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sustained Downlink Data Rate</td>
<td>5250 Kbps</td>
<td>1000 Kbps</td>
<td>256 Kbps</td>
<td>5250 Kbps</td>
<td>1000 Kbps</td>
<td>256 Kbps</td>
<td>5250 Kbps</td>
<td>1000 Kbps</td>
<td>256 Kbps</td>
<td>2000 Kbps</td>
</tr>
<tr>
<td>Sustained Uplink Data Rate</td>
<td>1750 Kbps</td>
<td>500 Kbps</td>
<td>128 Kbps</td>
<td>1750 Kbps</td>
<td>500 Kbps</td>
<td>128 Kbps</td>
<td>1750 Kbps</td>
<td>500 Kbps</td>
<td>128 Kbps</td>
<td>20000 Kbps</td>
</tr>
<tr>
<td>Downlink Burst and Uplink Burst Allocations</td>
<td>500000 Kb</td>
<td>80000 Kb</td>
<td>40000 Kb</td>
<td>500000 Kb</td>
<td>80000 Kb</td>
<td>40000 Kb</td>
<td>500000 Kb</td>
<td>80000 Kb</td>
<td>40000 Kb</td>
<td>500000 Kb</td>
</tr>
</tbody>
</table>

#### Example Download Times: (in seconds)

<table>
<thead>
<tr>
<th>Web page</th>
<th>5 MB</th>
<th>20 MB</th>
<th>50 MB</th>
<th>300 MB</th>
</tr>
</thead>
<tbody>
<tr>
<td>&lt;1</td>
<td>9</td>
<td>36</td>
<td>91</td>
<td>545</td>
</tr>
<tr>
<td>&lt;1</td>
<td>8</td>
<td>470</td>
<td>320</td>
<td>2320</td>
</tr>
<tr>
<td>&lt;1</td>
<td>8</td>
<td>470</td>
<td>320</td>
<td>480</td>
</tr>
<tr>
<td>&lt;1</td>
<td>4</td>
<td>470</td>
<td>320</td>
<td>2320</td>
</tr>
<tr>
<td>&lt;1</td>
<td>4</td>
<td>470</td>
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<tr>
<td>&lt;1</td>
<td>4</td>
<td>470</td>
<td>320</td>
<td>2320</td>
</tr>
</tbody>
</table>

Note: The download times shown are examples. Actual download times may be longer due to use of the bandwidth by other subscribers modules, congestion on the local network, congestion on the internet, capacity of the serving computer, or other network limitations.
ANCILLARY PRODUCTS

T1/E1 Multiplexer

The cost of leased lines is a substantial recurring expense for service providers and enterprise customers alike. The economic benefit of replacing leased lines with a Canopy T1/E1 Multiplexer and wireless backhaul translates into cost savings for the enterprise and a business opportunity for the service provider. The ease and speed of deploying the one to four T1/E1 links across the Canopy family of backhaul solutions is a significant advantage over the time it takes to order and provision wired T1/E1 services.

The T1/E1 Multiplexer is a layer 2 device that prioritizes T1/E1 traffic to ensure minimal latency for transporting mission-critical voice traffic. The remaining bandwidth for LAN data retains the prioritization set by the LAN router so that prioritized IP traffic is preserved. The Motorola T1/E1 Multiplexer is sold in pairs and is available in two models:

- T1/E1 Multiplexer One Port (Part Number: BP1101TE-2)
- T1/E1 Multiplexer Four Port (Part Number: BP1104TE-2)

Figure 19 shows how an enterprise or service provider can quickly deploy the Canopy T1/E1 Multiplexer with the Canopy family of backhaul products to aggregate anywhere from one to four T1/E1’s with remaining bandwidth available for data.

![Figure 19. Enterprise or Central Office to Branch Office](image)

Service providers can also use the T1/E1 Multiplexer, as shown in Figure 20, as a cellular base station backhaul to cost-effectively backhaul traffic with the Canopy family of backhauls.
The Canopy T1/E1 Multiplexer is comprised of a master and slave modules that are placed on each end of a backhaul link. The back of the unit is equipped with six connections:

- Four RJ-45 T1/E1 port connections to PBX
- RJ-45 Ethernet LAN port connection to LAN switch or router
- RJ-45 Ethernet Canopy port connection to Canopy backhaul

Global power plugs are shipped with the unit to conform to the various international markets where this product will be deployed.

The Canopy T1/E1 Multiplexer features are:

- Multi-port design upgrades one-port at a time up to a total of 4 T1’s or E1’s without new hardware.
- Dedicated T1/E1 service with remaining bandwidth available for data.
- Voice and LAN data aggregation of one to four T1/E1’s over Canopy point-to-point backhauls.
- Transparent T1/E1 line extension over Ethernet (TDMoE).
- Optimized for latency sensitive voice traffic over the Canopy point-to-point wireless backhauls.
- Table top or 19 inch rack mountable.
- Software configurable for T1 or E1 configuration and port additions.
- Secure communication using Canopy point-to-point backhaul solutions.

The T1/E1 Multiplexer connects via 10/100 Ethernet to the Canopy backhaul modules. The multiplexer unit is completely plug and play with Canopy backhaul solutions and has an easy to use software Graphical User Interface (GUI) to quickly change configuration options.
Cables

The Canopy system requires UV protected cables for use outdoors in temperature ranges between -30° C to +55° C. Motorola has designated Best-Tronics Manufacturing as an authorized dealer of cables that meet our rigorous specifications. Visit their website today at www.best-tronics.com/motorola to take advantage of their aggressive pricing; custom cable lengths and one-day order turn around.

Demonstration Kits

Motorola offers point-to-multipoint demonstration kits for evaluation, demonstration and training of the Canopy system. The kits include a baseline configuration of one Advantage AP and two SMs, which consist of one Advantage SM and one Canopy SM.

The kits also include two training CDs that are designed to introduce both the sales/marketing and technical aspects of the Canopy system. The Canopy Sales Overview (CPT001-CD03EN) contains the contents of Motorola’s Canopy system sales and marketing class. This CD is for a general audience interested in gaining an understanding of the Canopy system from a feature/benefit perspective as well as methods for positioning the Canopy system against competitive technologies and fixed wireless offerings. The Canopy Technical Overview (CPT002-CD03EN) contains the content of Motorola’s technical class and is for system designers, installers, operations engineers and support teams.

Starter Kits

Motorola offers point-to-multipoint Starter Kits for the Canopy system in the 900 MHz, 2.4, 5.1, 5.2, 5.4 and 5.7 GHz frequency bands. The main difference in the Starter Kits, apart from the frequencies in which they operate, is their range and the quantity of items within the kit. All of the Canopy Starter Kits include Canopy Advantage access points for a point-to-multipoint system and deliver 7 Mbps\(^1\) of throughput, with burst rates up to 14 Mbps to a single subscriber with only 5 to 7 milliseconds of latency. Table 6 details the distances and throughputs for the Starter Kits.

<table>
<thead>
<tr>
<th>Frequency</th>
<th>Canopy Platform</th>
<th>Modulation Rate</th>
<th>Aggregate Throughput</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>900 MHz</td>
<td>Advantage (AP &amp; SM)</td>
<td>6 Mbps</td>
<td>4 Mbps</td>
<td>20 miles (32 kilometers)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>2 Mbps</td>
<td>40 miles (64 kilometers)</td>
</tr>
<tr>
<td>2.4 GHz @100 Milliwatts</td>
<td>Advantage AP</td>
<td>10 Mbps</td>
<td>7 Mbps</td>
<td>1.2 miles (2 kilometer)</td>
</tr>
</tbody>
</table>

\(^1\) The Canopy Advantage 900 MHz access points deliver 4 Mbps of throughput for customers within 20 miles of the access point with 14 milliseconds of latency.
<table>
<thead>
<tr>
<th>Frequency</th>
<th>Canopy Platform</th>
<th>Modulation Rate</th>
<th>Aggregate Throughput</th>
<th>Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.4 GHz @2 Watts</td>
<td>Advantage AP</td>
<td>10 Mbps</td>
<td>7 Mbps</td>
<td>5 miles (8 kilometers)</td>
</tr>
<tr>
<td>5.1 GHz</td>
<td>Advantage AP</td>
<td>10 Mbps</td>
<td>7 Mbps</td>
<td>2 miles (3.2 kilometers)</td>
</tr>
<tr>
<td>5.2 GHz</td>
<td>Advantage AP</td>
<td>10 Mbps</td>
<td>7 Mbps</td>
<td>2 miles (3.2 kilometers)</td>
</tr>
<tr>
<td>5.4 GHz</td>
<td>Advantage AP</td>
<td>10 Mbps</td>
<td>7 Mbps</td>
<td>2 miles (3.2 kilometers)</td>
</tr>
<tr>
<td>5.7 GHz @ 1 Watt</td>
<td>Advantage AP</td>
<td>10 Mbps</td>
<td>7 Mbps</td>
<td>2 miles (3.2 kilometers)</td>
</tr>
</tbody>
</table>

Each of the Starter Kits can support growth up to 200 subscribers per AP module. Keep in mind, however, that the bandwidth is shared among all subscribers. Therefore, it is important to determine the level of service desired and apply the appropriate traffic engineering guidelines to obtain that level of service. The Canopy subscriber modules are included with each of the kits. The Subscriber Modules in these Starter Kits can be upgraded to add Canopy Advantage capabilities. The Canopy Advantage subscriber modules can be purchased separately and are not included in the kits.
900 MHz Starter Kit

The Starter Kits for the Canopy 900 MHz are comprised of one kit for the integrated modules with bandpass filters (TK10190) as well as the connectorized modules (TK10190C) and deliver a point-to-multipoint system. Each kit contains three access points and 20 subscriber modules. Additional APs and SMs can be ordered separately to form a full AP Cluster. The 900 MHz kits also contain: CMMmicro, surge suppressors for the SMs, Canopy Quick Start Guide and Canopy User Guides. The 900 MHz connectorized (TK10190C) kit also contains a 60 degree 9 dBi antenna as well as 20 heavy-duty (SMMB2) universal mounting brackets for supporting the subscriber modules and their associated antennas on the same bracket.

2.4 GHz Starter Kits

There are two Starter Kits for the 2.4 GHz Canopy products:

- Adjustable Power Set to Low (TK10150)
- Adjustable Power Set to High (TK10151)

These configurations provide a complete AP Cluster with six Canopy Advantage AP modules, a CMMmicro and 30 SMs. This configuration provides 360-degree coverage for approximately 1.2 miles (2 kilometer) for the low power 2.4 GHz system and 5 miles (8 kilometers) for the high power system. A reflector can be added to the high power (TK10151) systems to increase the range to 15 miles. A point-to-point backhaul link can also be added to connect the AP Cluster to an Internet Point of Presence (POP). These kits also include the necessary CMM and surge suppressors for the SMs. Thirty SMMB1 universal mounting brackets are also included for mounting the SMs to the end customer’s site.

5.1, 5.2, 5.4 & 5.7 GHz Starter Kits

The 5.1 GHz (TK10153), 5.2 GHz (TK10152), 5.4 GHz (TK10154) and 5.7 GHz (TK10157) Starter Kits provide a complete AP Cluster with six AP modules, a CMM and 30 SMs. A point-to-point backhaul link can also be added to connect the AP Cluster to an Internet POP. These kits also include the necessary CMM, surge suppressors and power supplies for the SMs. Thirty SMMB1 universal mounting brackets are also included for mounting the SMs at the customer’s location. In addition, the kits include the Canopy Quick Start Guide and Canopy User Guides. A reflector can be added to the 5.7 GHz (TK10157) systems to increase the range to 10 miles.
**CANOPY MOTOBUNDLES**

Motorola offers bundle packaging for customers who wish to purchase larger quantities of the Canopy products and realize additional cost savings. MOTOBUNDLES are available for: subscriber modules, backhaul modules, software, T1/E1 multiplexers, antennas, mounting brackets, surge suppressors and reflector kits. Please note the Canopy 45 Mbps backhaul is included in the MOTOBUNDLES section as they are only sold in pairs. All MOTOBUNDLES are available only as a drop ship item directly to single end user customers.