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APPLICATION BULLETIN

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MDS Orbit MCR Series

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MCR-900 Throughput and Packets Per Second Analysis

Introduction

For packet radio networks, such as the Orbit MCR-900, throughput is the rate of successful data delivery over the radio communication channel. Throughput is a common metric used to determine the performance of a communications system. An additional performance metric of importance is Packets Per Second, the number of packets of data per second that can be processed before dropping of data.

Scope

This bulletin is intended for system engineers and end users who are interested in knowing the expected performance of an Orbit MCR-900 series radio.

Terms

- **Throughput**: The rate of successful data delivery.
- **Bit Rate:** The number of bits that are processed per unit time. Quantities can be in single bits per second (bps), kilobits (kbps) for 1,000 bit/s, or mega-bits (Mbps) for 1,000,000 bit/s.
- **Packets Per Second:** (PPS) Number of packets of data per second that can be processed.
- **Channel Efficiency**: The achieved throughput in relation to the channel capacity.
- **Media Access Control**: Provides addressing and channel access control for the radio network.

Background

Let's consider a simple Orbit MCR-900 point-to-point network as shown in Figure 1.

Figure 1 – Orbit MCR-900 Point-to-Point network connected to IXIA XM2 test system.

The Orbit MCR-900s are connected via 100 Mbit/s Ethernet to an IXIA XM2 test system. The IXIA XM2 is configured to run the standard RFC-2544 (http://www.ietf.org/rfc/rfc2544.txt) Ethernet throughput is tested using the UDP Echo Protocol across the MCR-900 radio link. RFC-2544 defines various frame sizes to be used for benchmarking, specifically Ethernet frame sizes of 64, 128, 256, 512, 1024, 1280 and 1518 bytes.

The throughput test takes into consideration all overhead produced by the MCR-900 system, and can also be used to determine the maximum packets per second supported. The Orbit MCR-900 has been specifically designed to minimize unnecessary overhead. Furthermore, the Orbit MCR-900 MAC design minimizes overhead on application data, while at the same time providing highly efficient access control of the radio channel using a proprietary patent-pending protocol. The MAC protocol provides methods for high reliability and low latency frequency hopping media access. The MAC protocol also solves the classic "hidden node" problem found in many wireless networks, and guarantees that application data will never collide over the air. These design considerations yield an extremely efficient solution that provides the end application the highest achievable throughput.

Results

A key feature of the Orbit MCR-900 series radio is its support of a wide variety of data rate modems. This allows the end user to customize their network based on application requirements such as distance, latency, number of end points, and offered load. Presented below are throughput test results for each modem supported by Orbit MCR-900 for both downstream and upstream traffic against varying UDP packet sizes.

Test parameters

- 1xOrbit MCR-900 configured as an Access Point
- 1xOrbit MCR-900 configured as a Remote
- 50 millisecond dwell time setting
- Frequency hopping enabled
- Compression disabled
- All other settings default

Throughput

Maximum throughput is obtained when we consider results using the largest packet size of 1518 bytes.

Downstream Throughput (kbps)		Packet Size (bytes)						
Dwell Time = 50		64	128	256	512	1024	1280	1518
Modem	125	44	66	88	104	115	114	116
	250	79	122	163	203	225	224	227
	500	122	204	286	368	429	432	436
	1000	157	266	429	612	763	785	810
	1000W	160	266	435	613	759	785	810
	1250	173	306	490	709	900	952	974

Table 1 – MCR-900 Downstream throughput.

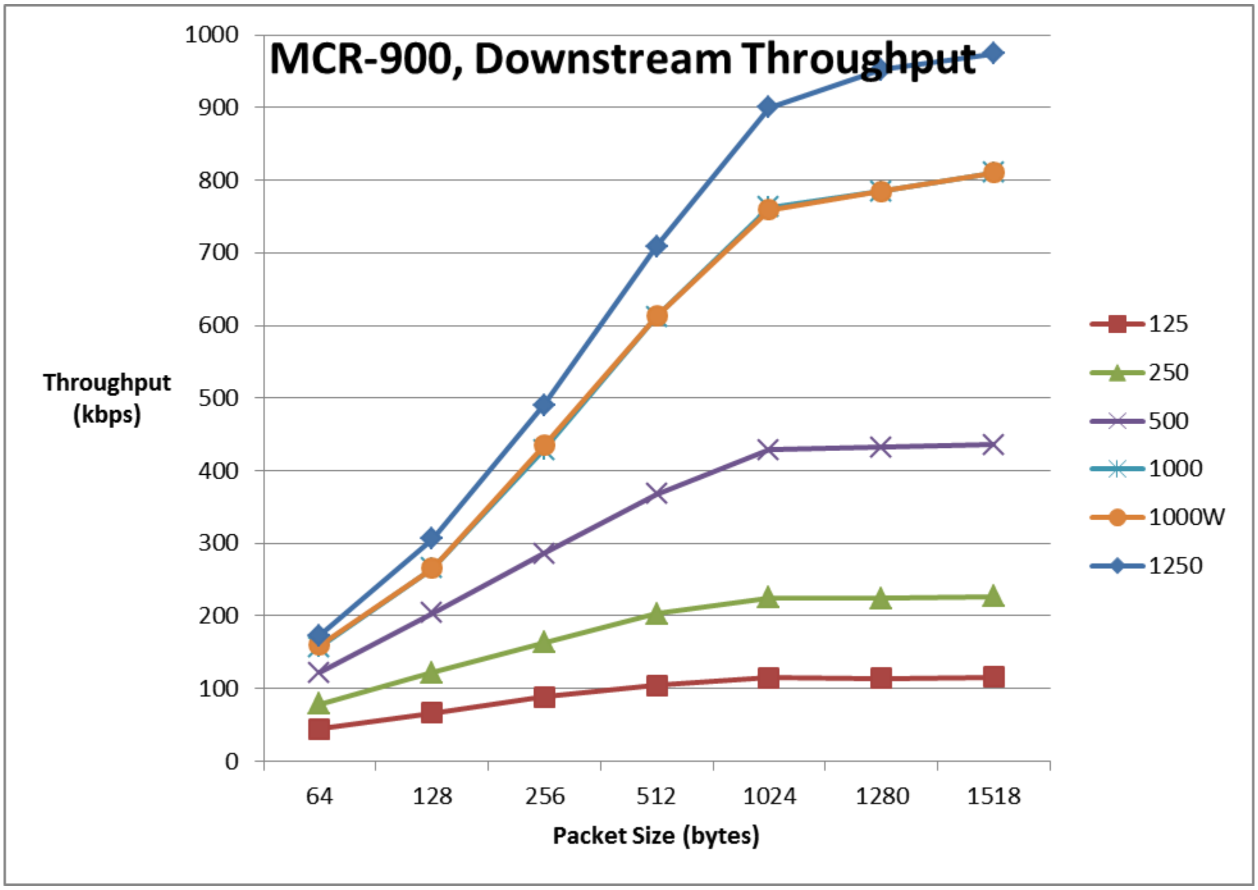

Figure 2 – MCR-900 Downstream throughput against various UDP packet sizes.

Upstream Throughput (kbps)		Packet Size (bytes)						
Dwell Time = 50		64	128	256	512	1024	1280	1518
Modem	125	41	61	81	99	110	114	116
	250	79	119	161	195	219	224	228
	500	143	218	300	368	415	409	418
	1000	194	326	489	648	660	719	734
	1000W	200	327	491	654	667	739	745
	1250	228	385	582	612	820	887	932

Table 2 – MCR-900 Upstream throughput.

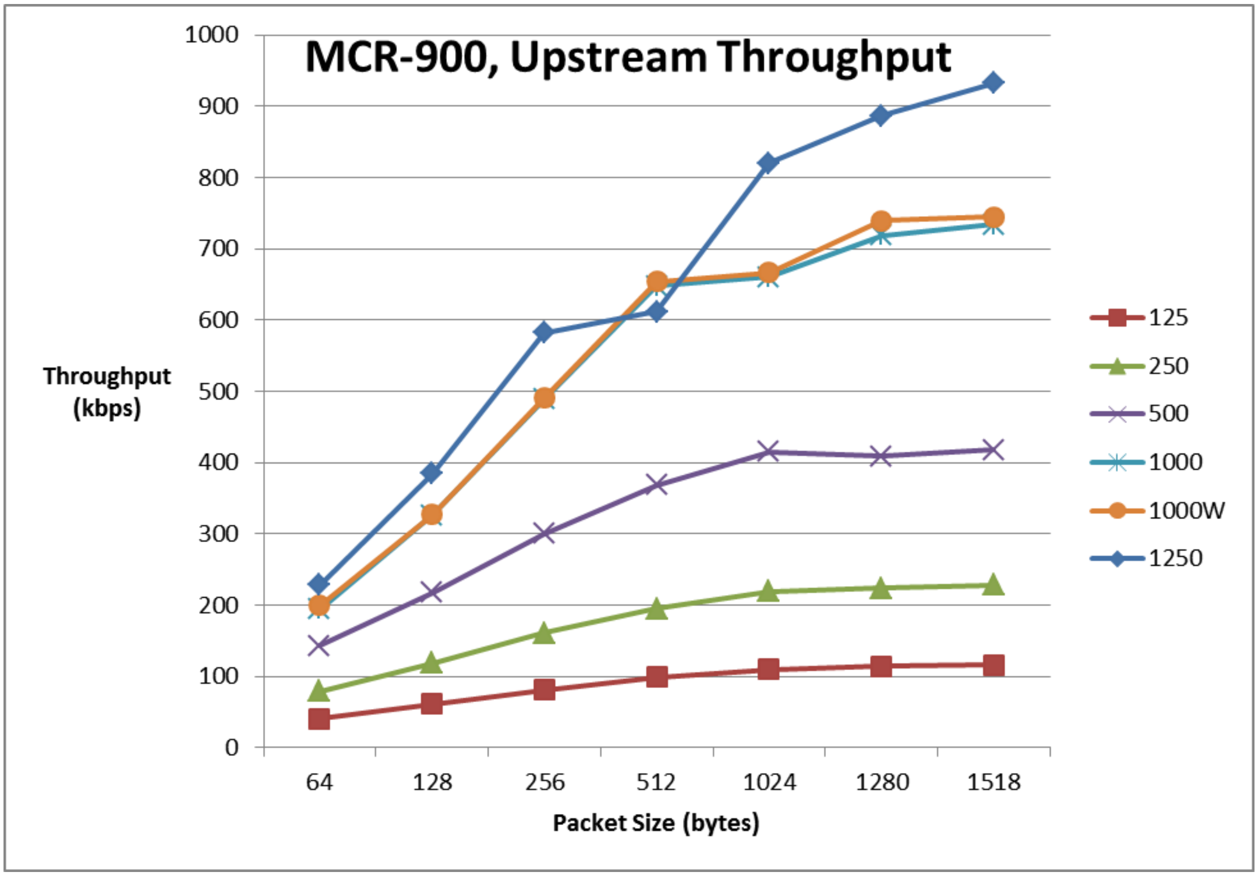

Figure 3 – MCR-900 Upstream throughput against various UDP packet sizes.

The Orbit MCR-900 series radio achieved exceptional throughput performance up to 974 kbps.

Channel Efficiency

Maximum channel efficiency is obtained when we consider results using the largest packet size of 1518 bytes.

Downstream Efficiency		Packet Size (bytes)						
Dwell Time = 50		64	128	256	512	1024	1280	1518
Modem	125	35%	53%	70%	83%	92%	91%	93%
	250	32%	49%	65%	81%	90%	90%	91%
	500	24%	41%	57%	74%	86%	86%	87%
	1000	16%	27%	43%	61%	76%	79%	81%
	1000W	16%	27%	44%	61%	76%	79%	81%
	1250	14%	24%	39%	57%	72%	76%	78%

Table 3 – MCR-900 Downstream channel efficiency.

Upstream Efficiency		Packet Size (bytes)						
Dwell Time = 50		64	128	256	512	1024	1280	1518
Modem	125	33%	49%	65%	79%	88%	91%	93%
	250	32%	48%	64%	78%	88%	90%	91%
	500	29%	44%	60%	74%	83%	82%	84%
	1000	19%	33%	49%	65%	66%	72%	73%
	1000W	20%	33%	49%	65%	67%	74%	75%
	1250	18%	31%	47%	49%	66%	71%	75%

Table 4 – MCR-900 Upstream channel efficiency.

The Orbit MCR-900 series radio achieved exceptional channel efficiency performance up to 93%.

Packets Per Second

Maximum packets per second are obtained when we consider results using the smallest packet size of 64 bytes.

Downstream pps		Packet Size (bytes)						
Dwell Time = 50		64	128	256	512	1024	1280	1518
Modem	125	86 pps	64 pps	43 pps	25 pps	14 pps	11 pps	10 pps
	250	154 pps	119 pps	80 pps	50 pps	27 pps	22 pps	19 pps
	500	238 pps	199 pps	140 pps	90 pps	52 pps	42 pps	36 pps
	1000	307 pps	260 pps	209 pps	149 pps	93 pps	77 pps	67 pps
	1000W	313 pps	260 pps	212 pps	150 pps	93 pps	77 pps	67 pps
	1250	338 pps	299 pps	239 pps	173 pps	110 pps	93 pps	80 pps

Table 5 – MCR-900 Downstream packets per second.

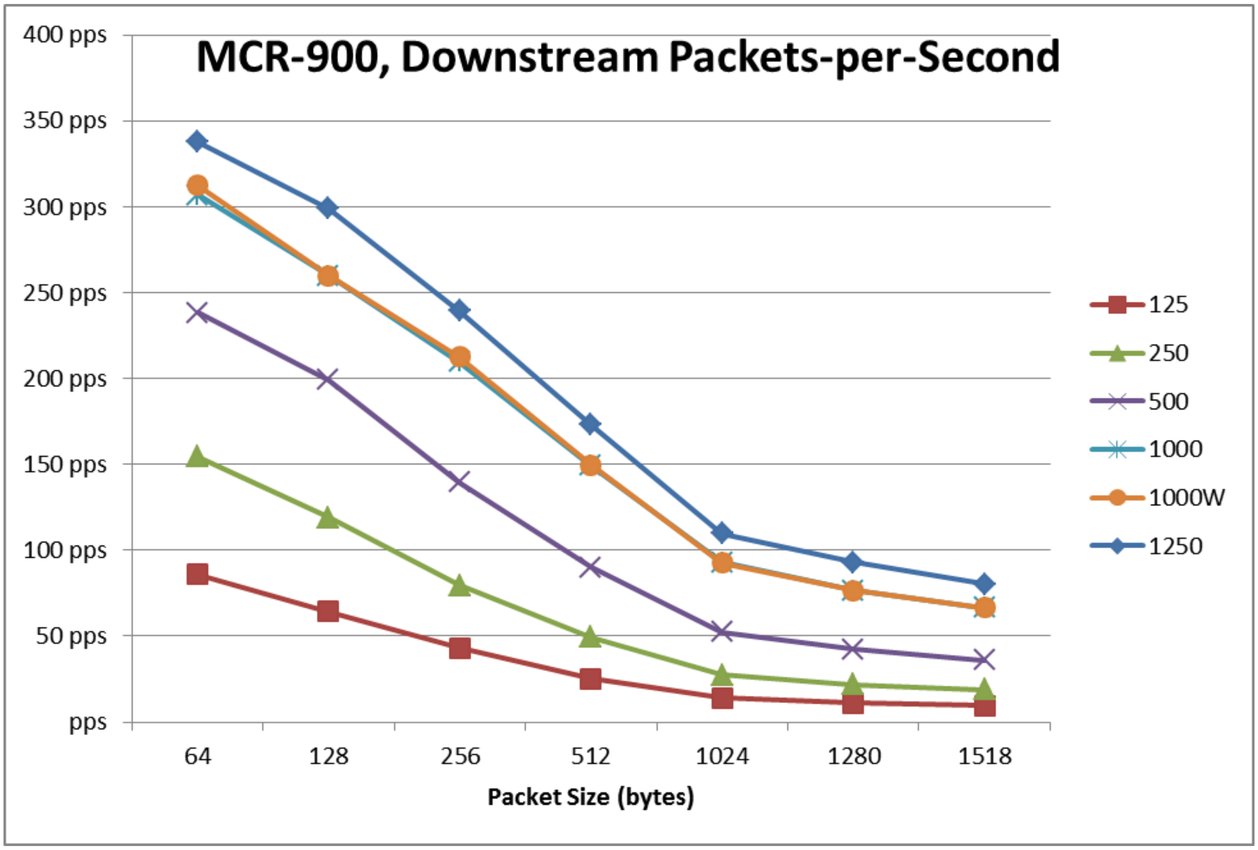

Figure 4 – MCR-900 Downstream packets per second.

Upstream pps		Packet Size (bytes)						
Dwell Time = 50		64	128	256	512	1024	1280	1518
Modem	125	80 pps	60 pps	40 pps	24 pps	13 pps	11 pps	10 pps
	250	154 pps	116 pps	79 pps	48 pps	27 pps	22 pps	19 pps
	500	279 pps	213 pps	146 pps	90 pps	51 pps	40 pps	34 pps
	1000	379 pps	318 pps	239 pps	158 pps	81 pps	70 pps	60 pps
	1000W	391 pps	319 pps	240 pps	160 pps	81 pps	72 pps	61 pps
	1250	445 pps	376 pps	284 pps	149 pps	100 pps	87 pps	77 pps

Table 6 – MCR-900 Upstream packets per second.

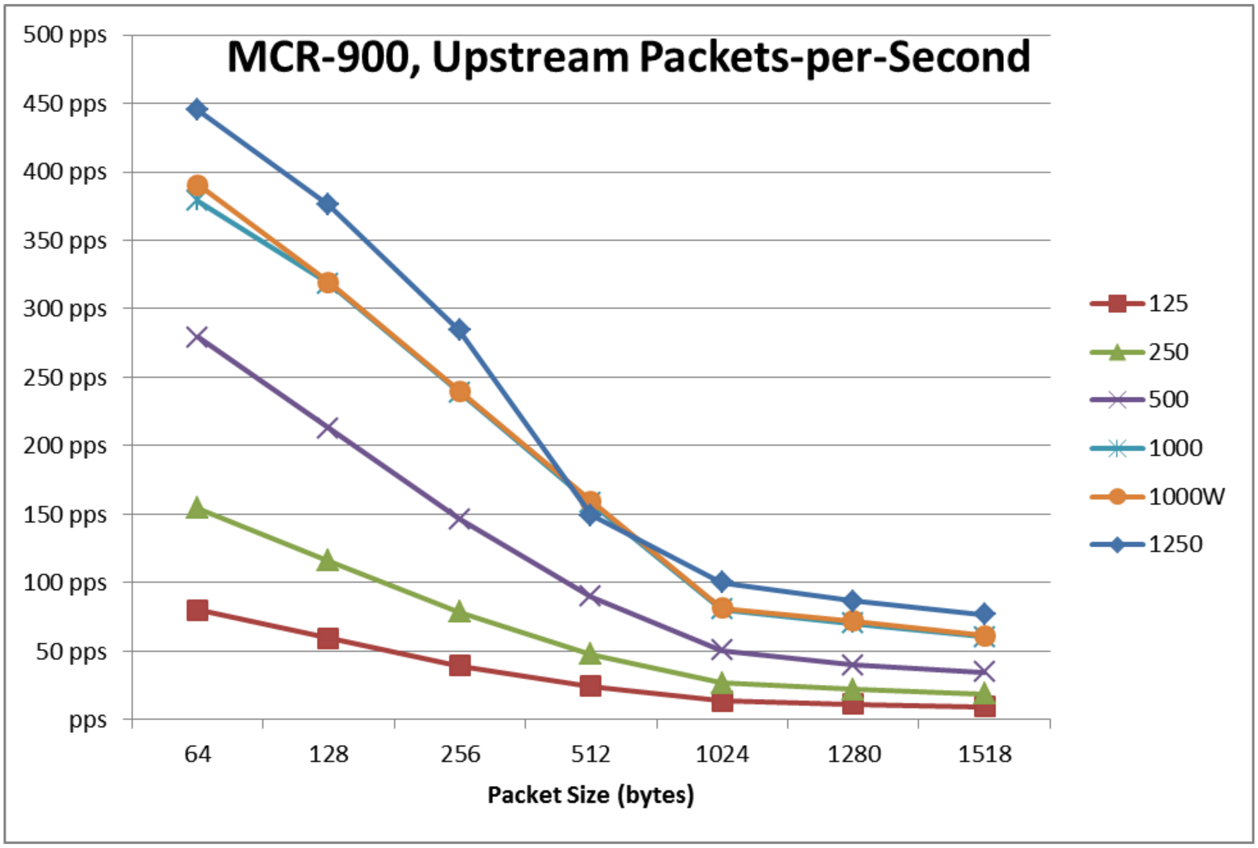

Figure 5 – MCR-900 Upstream packets per second.

The Orbit MCR-900 series radio achieved exceptional packet per second performance up to 445 pps.

Comparison to iNET-II

The same test was run against iNET-II using the default dwell time of 65.5 milliseconds. iNET-II only supports two data rates 512 kbps and 1024 kbps; for a fair comparison, we compared against the closest Orbit MCR-900 data rates of 500 kbps and 1000 kbps.

Throughput

Downstream Throughput (kbps)		Packet Size (bytes)						
Dwell Time = 65.5/50		64	128	256	512	1024	1280	1518
Modem	MCR-900 500kbps	122	204	286	368	429	432	436
	MCR-900 1000kbps	157	266	429	612	763	785	810
	iNET-II 512kbps	119	99	351	337	161	309	309
	iNET-II 1024kbps	173	106	313	283	283	392	222

Table 7 – MCR-900 and iNET-II Downstream throughput comparison.

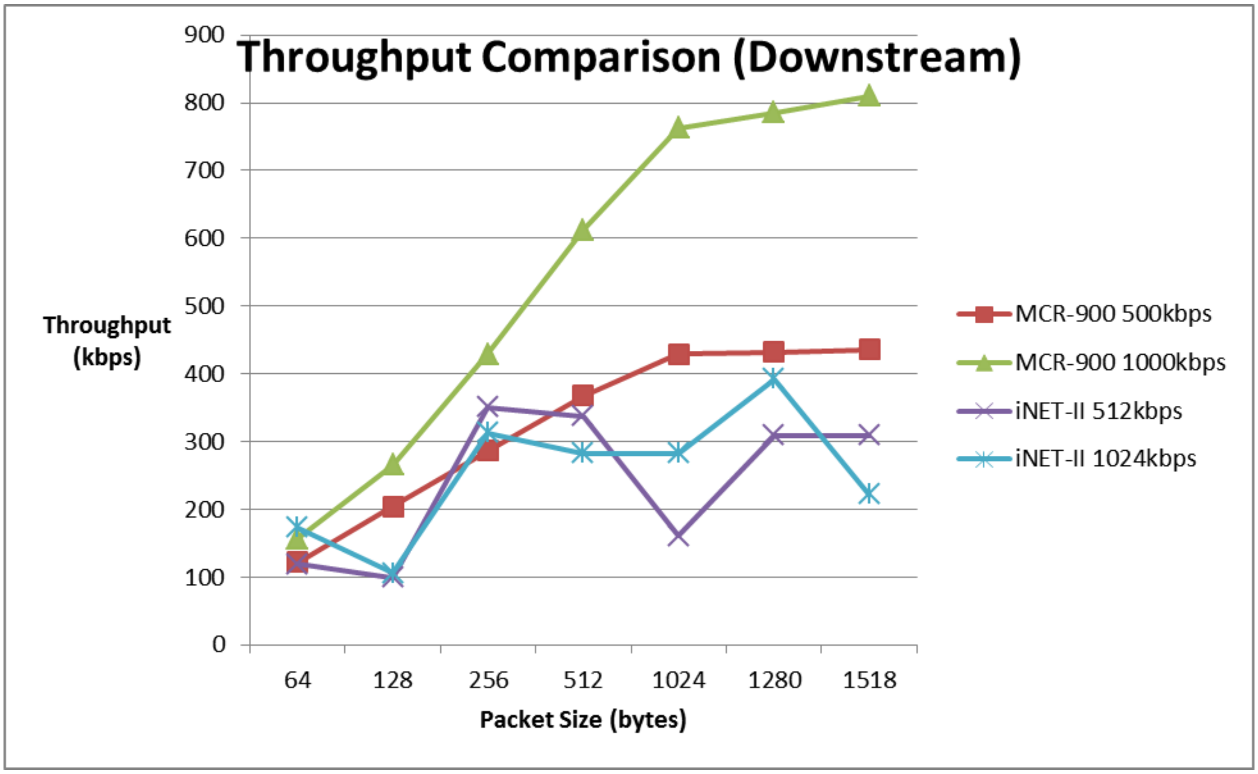

Figure 6 – MCR-900 and iNET-II Downstream throughput comparison.

Upstream Throughput (kbps)		Packet Size (bytes)						
Dwell Time = 65.5/50		**64**	**128**	**256**	**512**	**1024**	**1280**	**1518**
Modem	**MCR-900 500kbps**	143	218	300	368	415	409	418
	MCR-900 1000kbps	194	326	489	648	660	719	734
	iNET-II 512kbps	87	125	165	177	188	182	200
	iNET-II 1024kbps	103	153	196	216	255	254	262

Table 8 – MCR-900 and iNET-II Upstream throughput comparison.

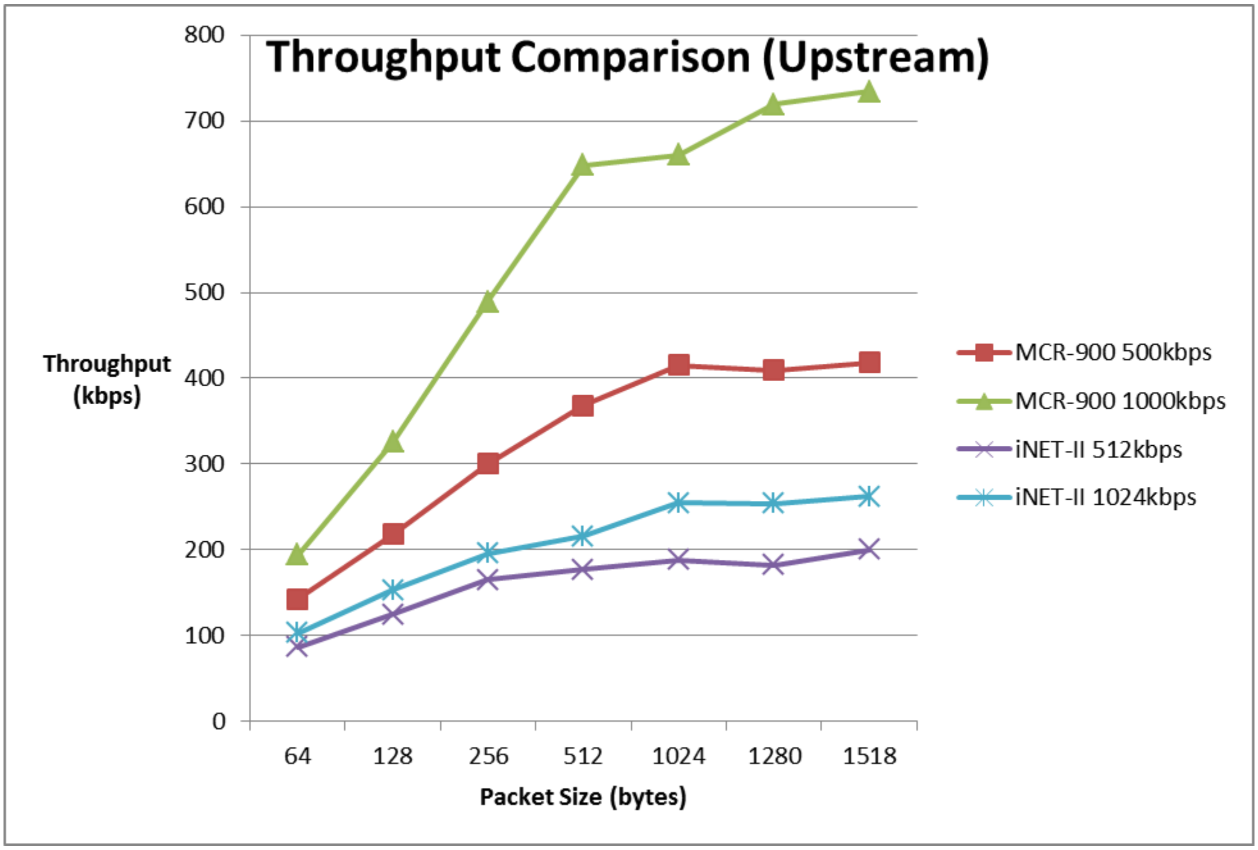

Figure 7 – MCR-900 and iNET-II Upstream throughput comparison.

In this aggressive test Orbit MCR-900 performance was considerably more favorable than the iNET-II. The improvements of the Orbit MCR-900 radio and MAC over iNET-II are clearly apparent.

Packets Per Second

Downstream pps		Packet Size (bytes)						
Dwell Time = 65.5/50		64	128	256	512	1024	1280	1518
Modem	MCR-900 500kbps	238 pps	199 pps	140 pps	90 pps	52 pps	42 pps	36 pps
	MCR-900 1000kbps	307 pps	260 pps	209 pps	149 pps	93 pps	77 pps	67 pps
	iNET-II 512kbps	232 pps	97 pps	171 pps	82 pps	20 pps	30 pps	25 pps
	iNET-II 1024kbps	338 pps	104 pps	153 pps	69 pps	35 pps	38 pps	18 pps

Table 8 – MCR-900 and iNET-II Downstream packets per second comparison.

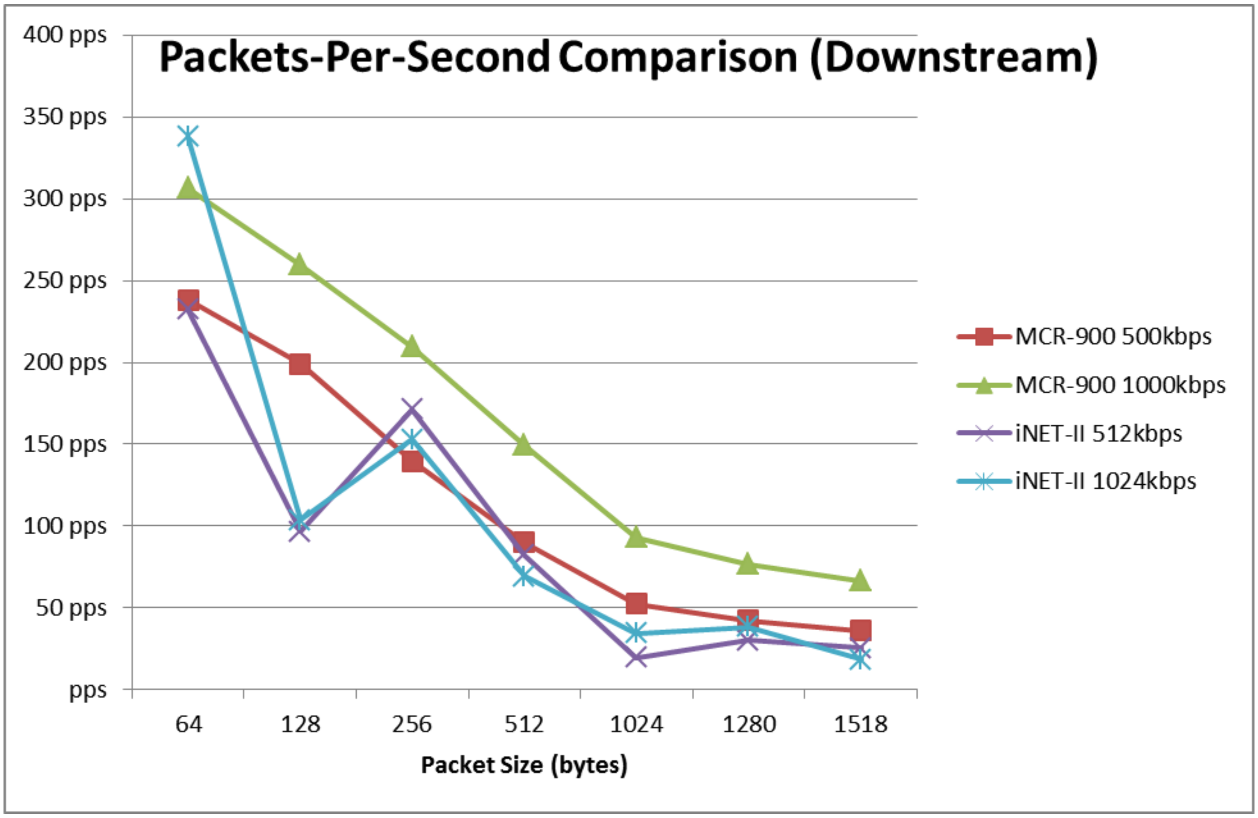

Figure 8 – MCR-900 and iNET-II Downstream packets per second comparison.

Upstream pps		Packet Size (bytes)						
Dwell Time = 65.5/50		64	128	256	512	1024	1280	1518
Modem	MCR-900 500kbps	279 pps	213 pps	146 pps	90 pps	51 pps	40 pps	34 pps
	MCR-900 1000kbps	379 pps	318 pps	239 pps	158 pps	81 pps	70 pps	60 pps
	iNET-II 512kbps	170 pps	122 pps	81 pps	43 pps	23 pps	18 pps	16 pps
	iNET-II 1024kbps	201 pps	149 pps	96 pps	53 pps	31 pps	25 pps	22 pps

Table 9 – MCR-900 and iNET-II Upstream packets per second comparison.

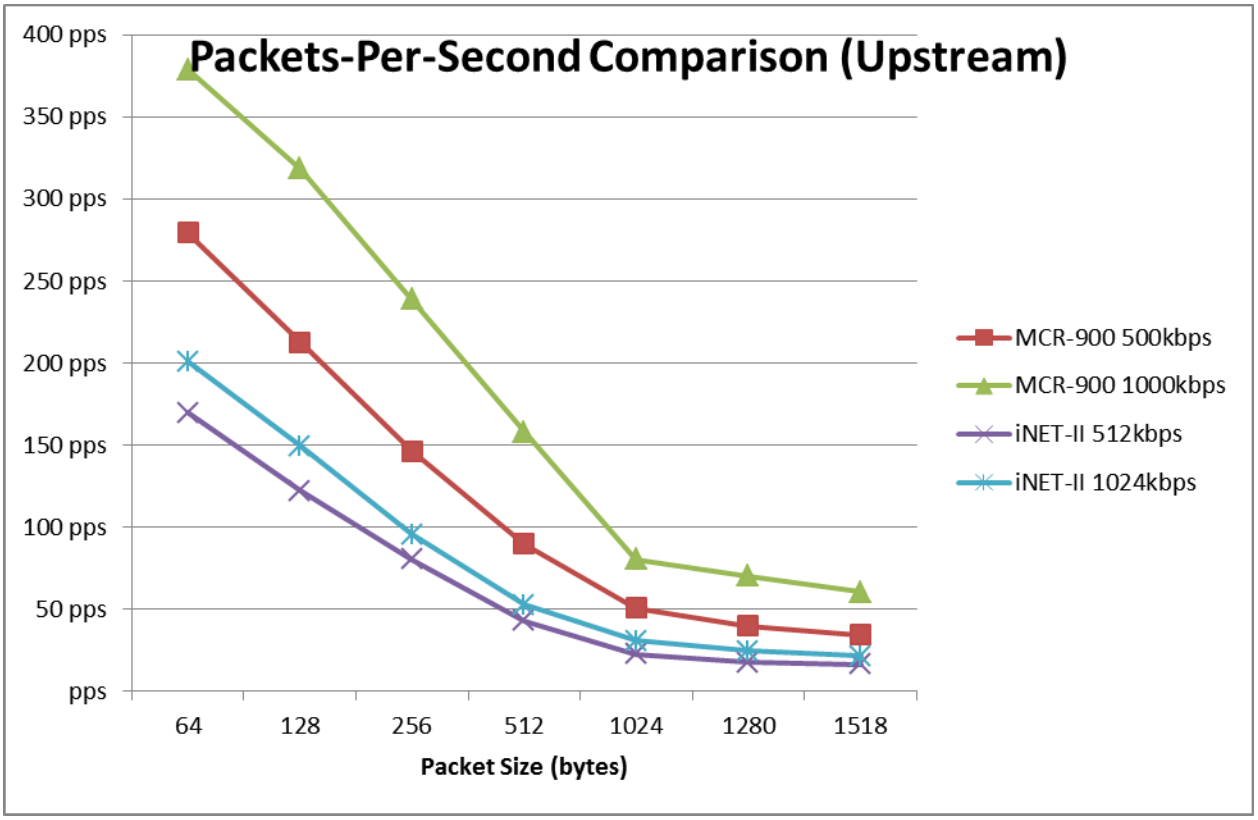

Figure 9 – MCR-900 and iNET-II Upstream packets per second comparison.

The Orbit MCR-900 radio dependably outperformed iNET-II in packets per second performance.

Summary

MDS Orbit MCR-900 provides exceptional performance with up to 93% channel efficiency, a maximum application throughput of 974 kbps, and up to 445 pps. The radio demonstrates substantial improvements over iNET-II in comparative test. The MDS Orbit MCR-900 series radio provides an efficient, high throughput, 900 MHz unlicensed radio solution.

End of application bulletin.