SC-FDE System Capacity and Modulation Efficiency

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Anader Benyamin-Seeyar
Harris Corporation Inc.
mailto:[abenyami@harris.com]

Brian Eidson
Conexant Systems Inc
mailto: brian.eidson@conexant.com

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IEEE 802.16abc-01/47

Purpose:

This contribution is presented to the Task Group in Session #16 to update the Single Carrier PHY throughput and channel efficiency clause of the IEEE802.16ab-01/r2 document.

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Anader Benyamin-Seeyar
Harris Corporation Inc.
3 Hotel de Ville
Dollard-des-Ormeaux, Quebec, Canada, H9B 3G4

Voice: (514) 845-8850
Fax: (514) 871-4859
mailto: abenyami@harris.com

Brian Eidson
Conexant Systems Inc
9868 Scranton Rd
San Diego 92121, USA

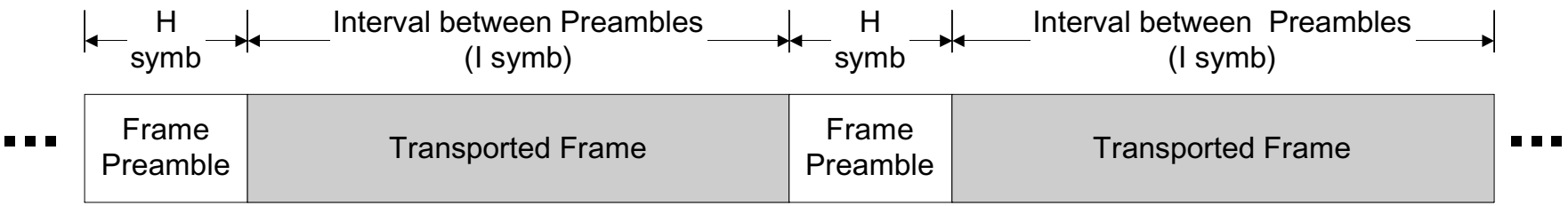
Voice: (858) 713-4720
Fax: (858) 713-3555
mailto: brian.eidson@conexant.com

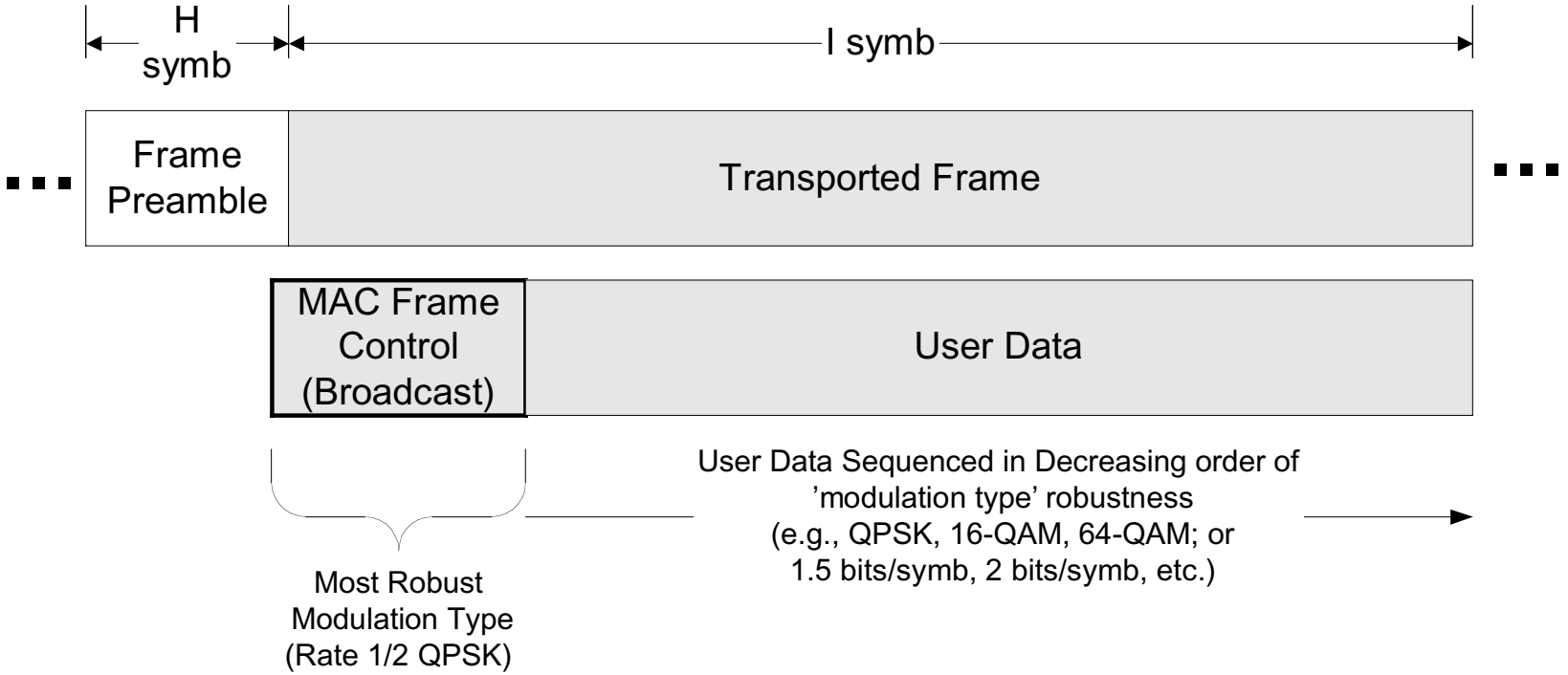
Contribution

- Incorporate provided text as revision of Section 8.3.4.15 of document 80216ab-01_01r2.

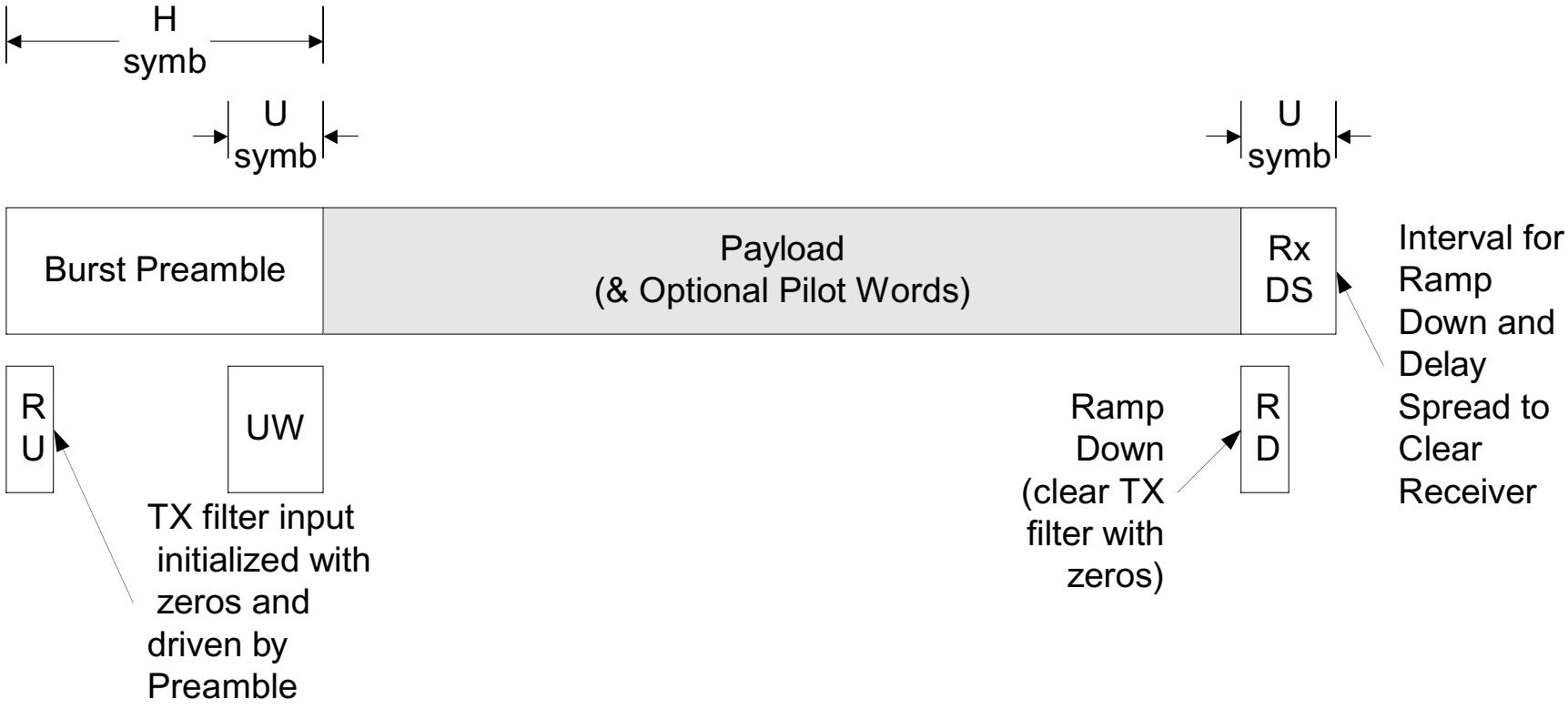
- This contribution completely simplifies and merges two subsections into one with more accurate results.

Continuous transmission Format:

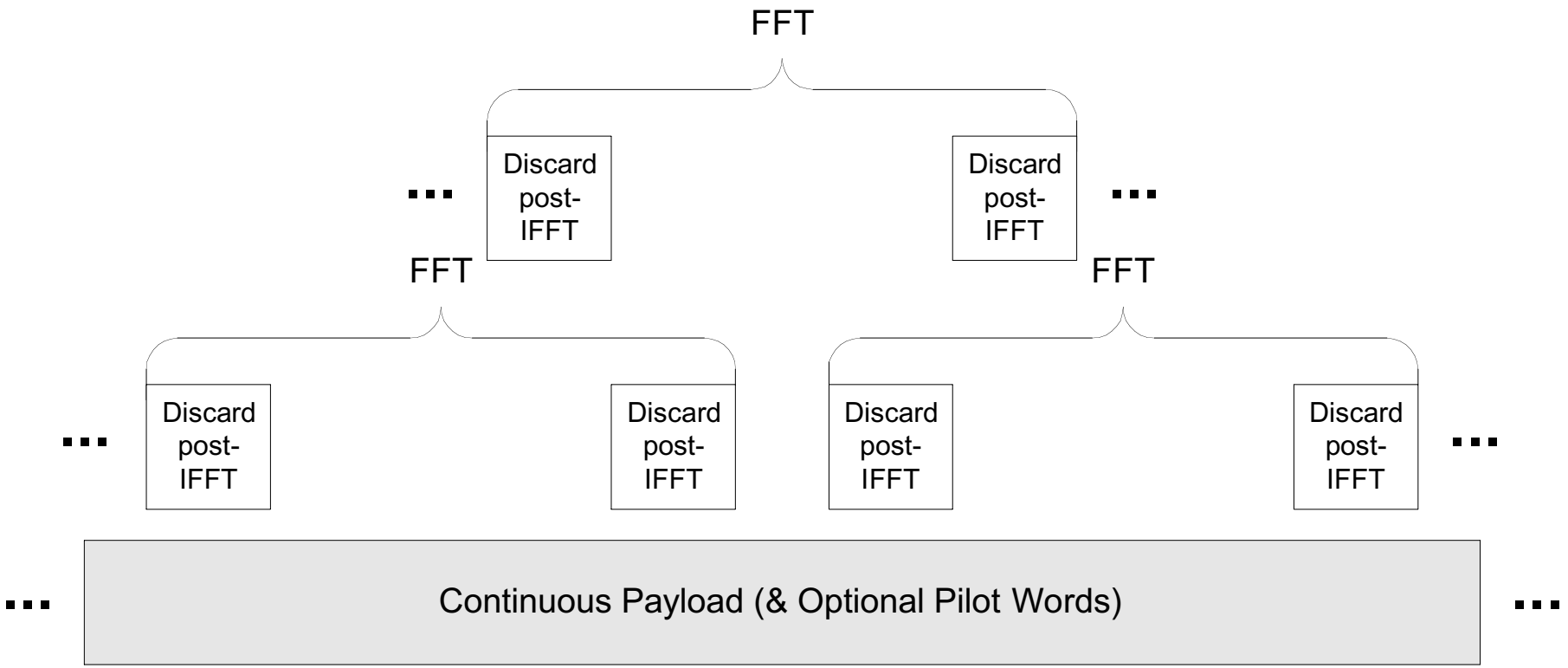




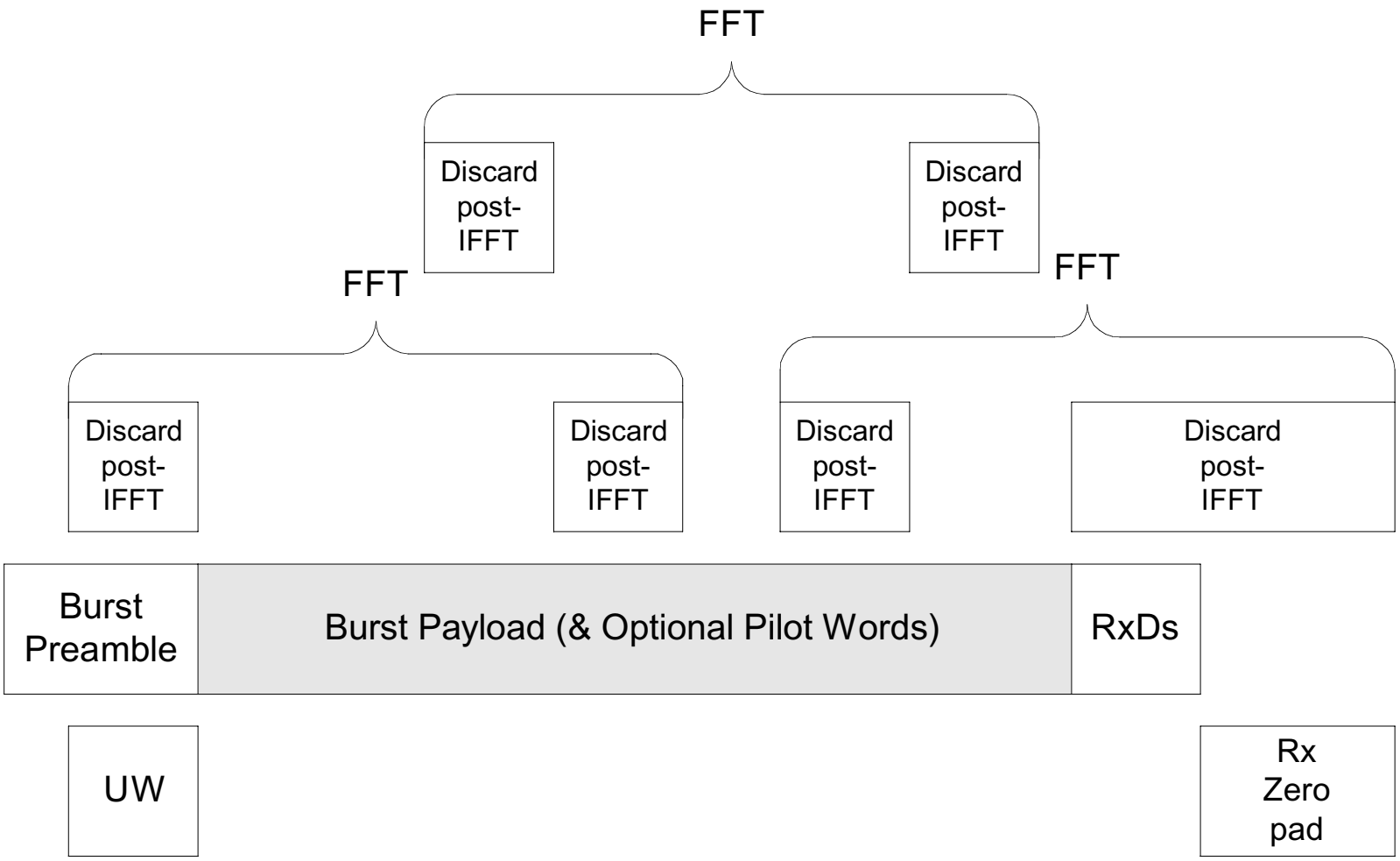
Burst transmissions Frame Format



Overlap Save Scheme of Arbitrary Continuous Payload



Overlap Save Scheme of Arbitrary Bursty Payload



Parameters and Values Defining Operating Modes for SC Systems

Selection Level	Parameter	Symbol	Set of Values
System-Dependent Parameters	Channel BandWidth (MHz)	W	1.75, 3.5, 7, 14, 1.5, 3, 6, 12
	Design Maximum Delay Spread (μsec)	d	4, 10,20
	Spectral Guard Factor	γ	0.18, 0.25
	Symbol Rate (MSymb/sec)	R	$R = (1+\gamma)W$
Link-Dependent Parameters	Number of QAM Constellation States	M	4, 16, 64
	Convolutional (Inner) Code Rate	r_I	1/2, 2/3, 3/4, 7/8
	Reed-Solomon (Outer) Code Rate	r_O	239 / 255 = 0.937
Traffic-Dependent Parameter	Burst Data Payload Size for uplink (in Bytes)	P	239, 717, 1195, 1673
Traffic-Dependent Parameter	Continuous Data Payload Size for downlink (in Bytes)	P	1673, 2151, 2629, 3585

System throughput for the burst transmission modes

U = R • d, rounded up to the nearest power of 2.

$$T_{burst} = \frac{8PR\log_2(M)}{\left(\frac{8P}{r_I r_O} + (A+U)\log_2(M)\right)}$$

System throughput for the continuous transmission modes

$$T_{cont} = \frac{8PR\log_2(M)}{\left(\frac{8P}{r_I r_O} + A\log_2(M)\right)}$$

P is the burst data size and A is used as the average frame preamble size (in symbols).

The choice of A=2U for the uplink and the choice of A=4U for the downlink.

SC Channel Efficiency

$$E_{burst} = T_{burst} / W = \frac{T_{burst}}{(1+\gamma)R} = \frac{8P\log_2(M)}{(1+\gamma)\left(\frac{8P}{r_I r_O} + (A+U)\log_2(M)\right)}$$

$$E_{cont} = T_{cont} / W = \frac{T_{cont}}{(1+\gamma)R} = \frac{8P\log_2(M)}{(1+\gamma)\left(\frac{8P}{r_I r_O} + A\log_2(M)\right)}$$

Throughput for various Models in 1.75 MHz Channels (Uplink Burst)

System Throughput for Overlap Save Technique (for Single Carrier Burst Mode U/L with W = 1.75 MHz bandwidth)								
System-Dependent Parameters		**Link-Dependent Parameters**		**System Throughput (in Mbits/sec)**				**System Efficiency**
Symbol [Sample] Rate (MS/sec)	Design Max Delay Spread (U in Symbols)	Number of QAM States	Convolu-tional Code Rate	**Packet Size (P in Bytes)**				**(in MBits/sec/Hz)**
				239	**717**	**1195**	**1673**	**(P= 1673)**
			1/2	1.37	1.38	1.39	1.39	0.79
		4	2/3	1.82	1.84	1.85	1.85	1.06
			3/4	2.05	2.07	2.08	2.08	1.19
	8		7/8	2.38	2.42	2.42	2.43	1.39
			1/2	2.72	2.76	2.77	2.77	1.58
		16	3/4	4.03	4.12	4.14	4.15	2.37
			2/3	5.31	5.47	5.51	5.52	3.16
		64	5/6	6.56	6.82	6.87	6.89	3.94
			1/2	1.36	1.38	1.38	1.39	0.79
		4	2/3	1.80	1.83	1.84	1.85	1.05
			3/4	2.01	2.06	2.07	2.07	1.19
1.5	16		7/8	2.34	2.40	2.41	2.42	1.38
			1/2	2.66	2.74	2.75	2.76	1.58
		16	3/4	3.90	4.07	4.11	4.13	2.36
			2/3	5.08	5.39	5.46	5.49	3.13
		64	5/6	6.22	6.69	6.79	6.84	3.91
			1/2	1.33	1.37	1.38	1.38	0.79
		4	2/3	1.74	1.82	1.83	1.84	1.05
			3/4	1.95	2.04	2.06	2.06	1.18
	32		7/8	2.25	2.37	2.39	2.40	1.37
			1/2	2.54	2.70	2.73	2.74	1.57
		16	3/4	3.65	3.98	4.06	4.09	2.34
			2/3	4.68	5.23	5.36	5.41	3.09
		64	5/6	5.63	6.44	6.64	6.72	3.84

Throughput for various Models in 6 MHz Channels (Downlink Continuous)

System Throughput for Overlap Save Technique (Single Carrier Continuous Mode D/L with W = 6 MHz bandwidth)								
System-Dependent Parameters		**Link-Dependent Parameters**		**System Throughput (in Mbits/sec)**				**System Efficiency**
Symbol [Sample] Rate (MS/sec)	Design Max Delay Spread (U in Symbols)	Number of QAM States	Convolu-tional Code Rate	**Packet Size (P in Bytes)**				**(in MBits/sec/Hz)**
				1673	**2151**	**2629**	**3585**	**(P= 3585)**
			1/2	4.69	4.95	5.00	5.02	0.84
		4	2/3	6.22	6.58	6.66	6.69	1.12
			3/4	6.98	7.40	7.49	7.53	1.25
	8		7/8	8.12	8.62	8.73	8.78	1.46
			1/2	9.24	9.84	9.97	10.03	1.67
		16	3/4	13.65	14.68	14.90	15.00	2.50
			2/3	17.94	19.47	19.81	19.96	3.33
		64	5/6	22.10	24.21	24.68	24.89	4.15
			1/2	4.62	4.92	4.98	5.01	0.84
		4	2/3	6.10	6.54	6.63	6.67	1.11
			3/4	6.83	7.34	7.45	7.50	1.25
5.1	16		7/8	7.91	8.54	8.68	8.74	1.46
			1/2	8.97	9.74	9.90	9.98	1.66
		16	3/4	13.07	14.45	14.76	14.90	2.48
			2/3	16.94	19.06	19.55	19.77	3.30
		64	5/6	20.60	23.58	24.29	24.60	4.10
			1/2	4.48	4.87	4.95	4.99	0.83
		4	2/3	5.86	6.44	6.57	6.63	1.11
			3/4	6.53	7.22	7.38	7.45	1.24
	32		7/8	7.51	8.38	8.58	8.67	1.45
			1/2	8.47	9.53	9.78	9.89	1.65
		16	3/4	12.03	14.00	14.48	14.69	2.45
			2/3	15.24	18.30	19.06	19.41	3.24
		64	5/6	18.14	22.42	23.53	24.04	4.01