

Referências Bibliográficas

- 1 IEEE 802.11 Working Group, IEEE Std 802.11. **Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications of IEEE 802.11**. Março 1999.
- 2 IEEE 802.11 Working Group, IEEE Std 802.11b. **Wireless LAN Medium Access Control (MAC) and Physical Layer (PHY) Specifications: Higher-Speed Physical Layer Extension in the 2.4 GHz Band**.
- 3 IEEE 802.11 Working Group:
<http://grouper.ieee.org/groups/802/11/index.html>.
- 4 Resende, Luis E.A.. **Wireless LAN e o Padrão IEEE 802.11**. Departamento de Engenharia Elétrica / CETUC / PUC-Rio. Dezembro 2002.
- 5 Prange, Cristian R.; Rochol, Juergen. **Redes Locais sem Fio e o Padrão IEEE 802.11: Uma Análise Crítica**. Instituto de Informática da Universidade Federal do Rio Grande do Sul.
- 6 Abras, Gustavo E.; Sanches, Jayme C. G.. **Wireless LAN**. Centro de Ciências Exatas e de Tecnologia da Pontifícia Universidade Católica do Paraná. Fevereiro 2002.
- 7 J. Geier. **Wireless LAN - Implementing High Performance in IEEE 802.11 Networks**. SANS. 2001.
- 8 Weatherspoon, Sultan. **Overview of IEEE 802.11b Security**. Network Communications Group – Intel Corporation. Março 2001.
- 9 Borisov, Nikita; Goldberg, Ian; Wagner, David. **Intercepting Mobile Communications: The Insecurity of 802.11**. Apresentado na 7th Annual International Conference on Mobile Computing and Networking. Julho 2001.
- 10 Fluhrer, Scott; Martin, Itsik; Shamir, Adi. **Weakness in the Key Scheduling Algorithm of RC4**. Apresentado na 8th Annual Workshop on Selected Areas in Cryptography. Agosto 2001.

- 11 Arbaugh, William A; Shankar, Narendar; Wan, Y. C. Justin. **Your 802.11 Wireless Network Has No Clothes**. Department of Computer Science, University of Maryland. Março 2001.
- 12 Stubblefield, Adam; Joannidis, John; Rubin, Aviel D.. **Using the Fluhrer, Mantin and Shamir Attack to Break WEP**. Rice University e AT&T Labs Research. Agosto 2001.
- 13 Rivest, R.. **RSA Security Response to Weaknesses in Key Scheduling Algorithm of RC4**. RSA Security's. Dezembro 2001.
<http://www.rsasecurity.com/rsalabs/technotes/>
- 14 Walker, Jessé. **Unsafe at any key size: an analysis of the WEP encapsulation**. IEEE Document. Outubro 2000.
- 15 Veríssimo, Fernando. **Segurança em Redes Sem Fio**. Universidade Federal do Rio de Janeiro. Janeiro 2002.
- 16 J. Geier. **Wireless LAN - Implementing High Performance in IEEE 802.11 Networks**. SANS. 2001.
- 17 Xylomenos, G., Polyzos, G.C.. **TCP and UDP performance over a wireless LAN**. INFOCOM 1999. Apresentado na 8th Annual Joint Conference of the IEEE Computer and Communications Societies. 1999.
- 18 Wong, Jenne. **Performance Investigation of Secure 802.11 Wireless LANS: Raising the Security Bar to Which Level?** Department of Computer Science and Software Engineering, University of Canterbury. New Zealand. 2003.
- 19 Junior, Paulo D. M.; Nunes, Bruno A. A.; Campos, Carlos A. V.; De Moraes, Luís F. M.. **Avaliando a Sobrecarga Introduzida nas Redes 802.11 pelos Mecanismos de Segurança WEP e VPN/IPSec**. RAVEL/COPPE/UFRJ. 2003.
- 20 Baghaei, Nilufar. **IEEE 802.11 Wireless LAN Security Performance Using Multiple Clients**. Department of Computer Science and Software Engineering, University of Canterbury. New Zealand. 2003.
- 21 Baghaei, Nilufar; Hunt, Ray. **Security performance of loaded IEEE 802.11b wireless networks**. Department of Computer Science and Software Engineering, University of Canterbury. New Zealand. Julho 2004.
- 22 Mishra, Arunesh; Arbaugh, Willian. **An Initial Security Analysis of The IEEE 802.1x Standard**. Department of Computer Science, University of Maryland.

- 23 Berger-Sabbatel, Gilles; Duda, Andrzej; Heusse, Martin; Rousseau, Franck. **Performance Anomaly of 802.11b**. LSR-IMAG Laboratory. Grenoble, France.
- 24 RSA Security. **Improving Wireless LAN Authentication – A Description of the Authentication in 802.1x Standard**. RSA Security Inc.
- 25 Aboba, B., Calhoun, P. (2003). **RADIUS (Remote Authentication Dial In User Service) Support For Extensible Authentication Protocol (EAP)**. IETF Request for Comments 3579.
- 26 Congdon, P., Aboba, B., Smith, A., Zorn, G., Roese, J. (2003). **IEEE 802.1X Remote Authentication Dial In User Service (RADIUS) Usage Guidelines**. IETF Request for Comments 3580.
- 27 RFC 2284. **PPP Extensible Authentication Protocol (EAP)**. Março 1998.
- 28 RFC 2716. **PPP EAP-TLS Authentication Protocol**. Outubro 1999.
- 29 RFC 2759. **Microsoft PPP CHAP Extensions, Version 2 (MS-CHAPv2)**. Janeiro 2000.
- 30 RFC 1321. **MD5 Message-Digest Algorithm**. Abril 1992.
- 31 RFC 2246. **TLS Protocol**. Janeiro 1999.
- 32 RFC 1661. **The Point-to-Point Protocol (PPP)**. Julho 1994.
- 33 RFC 1994. **PPP Challenge Handshake Authentication Protocol (CHAP)**. Agosto 1996.
- 34 RFC 2865. **Remote Authentication Dial In User Service (RADIUS)**. Junho 2000.
- 35 Funk, Paul and Simon Blake-Wilson. **EAP Tunneled TLS Authentication Protocol (EAP-TTL)**. Internet Engineering Task Force. 2004. <http://www.funk.com/nidx/draft-ietf-pppext-eap-ttls-05.txt>
- 36 Hakan, Andersson; Josefsson, Simon; Zorn, Glen; Simon, Dan; Ashwin, Palekar. **Protected EAP Protocol (PEAP)**. Internet Engineering Task Force. 2004. IETF-draft-josefsson-pppext-eaptls-eap-05.txt.
- 37 Microsoft. **Decisão sobre uma Estratégia de Rede sem Fio Protegida**. Maio 2004.
- 38 Microsoft. **Planejando uma Implementação de Segurança de LAN sem Fio**. Junho 2004.

- 39 Microsoft. **Planejando uma Infra-estrutura RADIUS para Segurança de Rede Local sem Fio.** Maio 2004.
- 40 Microsoft. **Planejando Segurança de LAN sem Fio usando 802.1x.** Maio 2004.
- 41 Air Defense. **Wireless LAN Policies for Security & Management.** White Paper. 2003. www.airdefense.net
- 42 Convery, Sean; Miller, Darrin; Sundaralingam, Sri. **Cisco SAFE: Wireless LAN Security in Depth.** Cisco Systems. White Paper. 2003.
- 43 Cisco Systems. **Extensible Authentication Protocol Transport Layer Security.** Deployment Guide for Wireless LAN Networks. White Paper.
- 44 Interlink Networks. **EAP Methods for Wireless Authentication.** White Paper. Abril 2003. www.interlinknetworks.com
- 45 Meetinghouse Data Communications. **Selecting an EAP Method for your Wireless LAN.** White Paper. Setembro 2004. www.mtghouse.com
- 46 LaRosa, Jon A.. **WPA: A Key Step Forward in Enterpriser - class Wireless LAN (WLAN) Security.** Meetinghouse Data Communications. White Paper. MAio 2003. www.mtghouse.com
- 47 Silva, Gilson M.; Souza, João N.. **Uma análise dos mecanismos de segurança de redes locais sem fio e uma proposta de melhoria.** Universidade Federal de Uberlândia (UFU).
- 48 Ethereal, <http://www.ethereal.com/>. 2004.
- 49 The FreeRADIUS Project (2003). **FreeRADIUS Server Project.**
- 50 Soares, L.F.G.; Lemos, G.; Colcher, S. **Redes de Computadores: das LANs, MANs e WANs às redes ATM.** Rio de Janeiro: Campus. 1995.

Apêndice A

Tabelas com as Medidas Realizadas

1. Rede com 01 Cliente Configurado em 11Mbps

1.1 Tráfego FTP

		<i>Throughput</i> (Bytes/s)	<i>Throughput</i> (Mbps)	$T_{Resposta}$ (seg)	Número Pacotes Tx	Tamanho Médio dos Pacotes	Qte Bytes de Tráfego
Sistema Sem Segurança	1	673.023,357	5,3842	10,089	7.071	960,304	6.790.313
	2	678.713,544	5,4297	10,005	7.073	960,047	6.790.415
	3	676.378,401	5,4110	10,039	7.073	960,047	6.790.415
	4	675.158,333	5,4013	10,058	7.073	960,047	6.790.415
	5	671.716,620	5,3737	10,109	7.073	960,047	6.790.313
	6	678.174,153	5,4254	10,013	7.071	960,304	6.790.415
	7	678.997,856	5,4320	10,001	7.073	960,047	6.790.313
	8	673.315,739	5,3865	10,085	7.071	960,304	6.790.313
	9	675.455,036	5,4036	10,053	7.073	960,047	6.790.313
	10	673.737,607	5,3899	10,079	7.071	960,304	6.790.313
	11	670.763,215	5,3661	10,123	7.071	960,304	6.790.313
	12	675.828,886	5,4066	10,047	7.071	960,304	6.790.313
	13	677.632,464	5,4211	10,021	7.071	960,304	6.790.313
	14	678.878,960	5,4310	10,002	7.071	960,304	6.790.313
	15	677.773,357	5,4222	10,019	7.071	960,304	6.790.313
		M	675.703,169	5,4056	10,050	7.072	960,201
	σ	2.699,036	0,0216	0,040	1	0,130	47
Controle Endereço MAC	1	673.245,870	5,3860	10,086	7.071	960,304	6.790.314
	2	674.376,059	5,3950	10,069	7.071	960,304	6.790.312
	3	679.239,589	5,4339	9,997	7.071	960,304	6.790.312
	4	675.048,477	5,4004	10,059	7.071	960,304	6.790.312
	5	675.759,787	5,4061	10,048	7.071	960,304	6.790.312
	6	676.465,768	5,4117	10,038	7.071	960,304	6.790.312
	7	677.881,035	5,4230	10,017	7.071	960,304	6.790.312
	8	678.334,688	5,4267	10,010	7.071	960,304	6.790.312
	9	677.304,280	5,4184	10,025	7.071	960,304	6.790.312
	10	677.977,057	5,4238	10,016	7.073	960,049	6.790.427
	11	674.612,375	5,3969	10,066	7.073	960,049	6.790.427
	12	678.169,450	5,4254	10,013	7.071	960,304	6.790.312
	13	679.259,981	5,4341	9,997	7.073	960,047	6.790.414

	14	675.195,613	5,4016	10,057	7.071	960,304	6.790.312
	15	675.708,675	5,4057	10,049	7.071	960,304	6.790.312
	M	676.571,914	5,4126	10,036	7.071	960,253	6.790.334
	σ	1.881,896	0,0151	0,028	1	0,106	46
		Throughput (Bytes/s)	Throughput (Mbps)	T_{Resposta} (seg)	Número Pacotes Tx	Tamanho Médio dos Pacotes	Qte Bytes de Tráfego
WEP 64 Bits	1	678.756,961	5,4301	10,004	7.072	960,176	6.790.366
	2	658.335,092	5,2667	10,010	7.071	960,304	6.790.312
	3	675.384,789	5,4031	10,054	7.071	960,304	6.790.312
	4	679.341,293	5,4347	9,996	7.072	960,176	6.790.366
	5	676.462,265	5,4117	10,038	7.071	960,304	6.790.312
	6	677.118,930	5,4170	10,028	7.072	960,176	6.790.366
	7	675.208,369	5,4017	10,057	7.073	960,048	6.790.420
	8	675.936,157	5,4075	10,046	7.072	960,176	6.790.366
	9	672.472,452	5,3798	10,098	7.072	960,176	6.790.366
	10	680.364,579	5,4429	9,980	7.071	960,304	6.790.312
	11	678.285,086	5,4263	10,011	7.074	959,919	6.790.468
	12	679.805,010	5,4384	9,989	7.071	960,304	6.790.312
	13	672.028,029	5,3762	10,105	7.075	959,791	6.790.522
	14	678.639,113	5,4291	10,006	7.071	960,304	6.790.313
	15	674.265,996	5,3941	10,071	7.071	960,304	6.790.313
		M	675.260,511	5,4021	10,035	7.072	960,185
	σ	5.512,039	0,0441	0,039	1	0,163	67
WEP 128 Bits	1	672.883,664	5,3831	10,091	7.071	960,304	6.790.312
	2	677.670,066	5,4214	10,020	7.073	960,047	6.790.414
	3	673.204,256	5,3856	10,087	7.073	960,047	6.790.414
	4	677.390,819	5,4191	10,024	7.071	960,304	6.790.312
	5	676.941,549	5,4155	10,031	7.071	960,304	6.790.312
	6	676.820,977	5,4146	10,033	7.071	960,304	6.790.312
	7	678.248,635	5,4260	10,012	7.071	960,304	6.790.312
	8	673.973,025	5,3918	10,075	7.071	960,304	6.790.312
	9	676.151,076	5,4092	10,043	7.071	960,304	6.790.312
	10	675.091,024	5,4007	10,059	7.073	960,048	6.790.420
	11	678.468,875	5,4278	10,008	7.071	960,304	6.790.312
	12	676.654,698	5,4132	10,035	7.073	960,048	6.790.420
	13	674.330,713	5,3946	10,070	7.071	960,304	6.790.312
	14	674.556,532	5,3965	10,066	7.071	960,304	6.790.312
	15	676.629,156	5,4130	10,036	7.072	960,175	6.790.360
		M	676.152,243	5,4092	10,043	7.072	960,222
	σ	1.654,358	0,0132	0,025	1	0,119	49

		Medição do Cliente			Medição no Coletor		
		Throughput (Bytes/s)	Throughput (Mbps)	T _{Resposta} (seg)	Throughput (Bytes/s)	Throughput (Mbps)	T _{Resposta} (seg)
EAP-TLS	1	670.495,724	5,3640	10,127	672.017,916	5,376	10,126
	2	668.456,943	5,3480	10,158	669.949,978	5,360	10,157
	3	672.601,745	5,3810	10,096	674.157,158	5,393	10,094
	4	674.155,101	5,3930	10,072	675.667,033	5,405	10,071
	5	676.376,047	5,4110	10,039	677.895,058	5,423	10,038
	6	676.976,613	5,4160	10,030	678.484,809	5,428	10,029
	7	676.022,396	5,4080	10,045	677.529,347	5,420	10,043
	8	675.117,176	5,4010	10,058	676.599,380	5,413	10,057
	9	676.726,917	5,4140	10,034	678.219,117	5,426	10,033
	10	677.471,215	5,4200	10,023	678.973,884	5,432	10,022
	11	674.849,323	5,3990	10,062	676.327,601	5,411	10,061
	12	676.859,729	5,4150	10,032	678.301,190	5,426	10,032
	13	677.785,974	5,4220	10,019	679.320,786	5,435	10,017
	14	674.879,771	5,3990	10,062	676.400,524	5,411	10,060
	15	674.010,734	5,3920	10,074	675.511,304	5,404	10,073
		M	674.852,361	5,3989	10,062	676.357,006	5,411
	σ	2.637,956	0,0211	0,039	2.633,801	0,021	0,039
PEAP	1	671.406,698	5,3710	10,114	672.931,502	5,383	10,112
	2	674.120,797	5,3930	10,073	675.622,595	5,405	10,071
	3	673.990,305	5,3920	10,075	675.485,280	5,404	10,074
	4	672.628,021	5,3810	10,095	674.112,044	5,393	10,094
	5	671.475,396	5,3720	10,113	672.967,931	5,384	10,111
	6	674.235,333	5,3940	10,071	675.715,708	5,406	10,070
	7	667.499,033	5,3400	10,173	669.408,776	5,355	10,172
	8	675.819,200	5,4070	10,048	677.327,357	5,419	10,046
	9	673.788,293	5,3900	10,078	675.276,881	5,402	10,077
	10	673.010,745	5,3840	10,089	674.521,067	5,396	10,088
	11	669.475,478	5,3560	10,143	670.956,860	5,368	10,141
	12	675.251,982	5,4020	10,056	676.744,079	5,414	10,055
	13	666.339,531	5,3310	10,191	667.930,699	5,343	10,189
	14	673.754,382	5,3900	10,078	675.247,515	5,402	10,077
	15	673.606,429	5,3890	10,081	675.104,376	5,401	10,080
		M	672.426,775	5,3795	10,099	673.956,845	5,392
	σ	2.833,088	0,0226	0,043	2.763,821	0,022	0,043

		Medição do Cliente			Medição no Coletor		
		Throughput (Bytes/s)	Throughput (Mbps)	T _{Resposta} (seg)	Throughput (Bytes/s)	Throughput (Mbps)	T _{Resposta} (seg)
EAP-TTLS	1	676.663,147	5,4130	10,035	678.189,069	5,426	10,033
	2	677.671,209	5,4210	10,020	697.153,240	5,433	10,019
	3	675.250,109	5,4020	10,056	676.743,098	5,414	10,055
	4	675.839,182	5,4070	10,047	677.319,930	5,419	10,046
	5	676.591,296	5,4130	10,036	678.116,671	5,425	10,034
	6	675.339,694	5,4030	10,055	676.821,801	5,415	10,054
	7	674.788,757	5,3980	10,063	676.296,294	5,410	10,061
	8	673.151,330	5,3850	10,087	674.644,255	5,397	10,086
	9	676.166,458	5,4090	10,042	677.680,009	5,421	10,041
	10	674.677,277	5,3970	10,065	676.220,112	5,410	10,063
	11	676.571,896	5,4130	10,036	678.157,132	5,425	10,034
	12	672.347,283	5,3790	10,099	673.870,914	5,391	10,098
	13	676.805,829	5,4140	10,033	678.325,646	5,427	10,032
	14	675.283,010	5,4020	10,056	676.780,200	5,414	10,054
	15	679.218,630	5,4340	9,997	680.736,842	5,446	9,996
		M	675.757,674	5,4060	10,048	678.470,348	5,418
	σ	1.740,889	0,0140	0,026	5.619,441	0,014	0,026
LEAP	1	669.812,838	5,3590	10,138	671.314,281	5,371	10,136
	2	675.597,404	5,4050	10,051	677.087,862	5,417	10,050
	3	674.788,194	5,3980	10,063	676.286,270	5,410	10,062
	4	673.823,089	5,3910	10,077	675.333,347	5,403	10,076
	5	670.335,861	5,3630	10,130	671.820,266	5,375	10,128
	6	674.068,606	5,3930	10,074	675.569,632	5,405	10,073
	7	672.279,137	5,3780	10,101	673.827,499	5,391	10,098
	8	673.143,213	5,3850	10,087	674.630,042	5,397	10,086
	9	671.417,993	5,3710	10,113	672.910,053	5,383	10,112
	10	672.605,907	5,3810	10,096	674.187,736	5,394	10,093
	11	670.713,405	5,3660	10,124	672.200,604	5,378	10,123
	12	672.916,896	5,3830	10,091	674.433,287	5,395	10,089
	13	670.373,827	5,3630	10,129	671.875,372	5,375	10,128
	14	671.038,885	5,3680	10,119	672.531,636	5,380	10,118
	15	674.884,137	5,3990	10,061	676.378,580	5,411	10,060
		M	672.519,959	5,3802	10,097	674.025,764	5,392
	σ	1.857,205	0,0148	0,028	1.858,593	0,015	0,028

1.2

Tráfego HTTP

		<i>Throughput</i> (Bytes/s)	<i>Throughput</i> (Mbps)	T _{Resposta} (seg)	Número Pacotes Tx	Tamanho Médio dos Pacotes	Qte Bytes de Tráfego
Sistema Sem Segurança	1	9.018,357	0,0721	23,111	1.158	179,985	208.423
	2	9.157,007	0,0733	23,116	1.214	174,360	211.673
	3	9.106,031	0,0728	23,330	1.224	173,566	212.445
	4	9.009,340	0,0721	23,140	1.159	179,877	208.477
	5	8.800,092	0,0704	23,833	1.177	178,193	209.733
	6	9.138,323	0,0731	23,197	1.219	173,895	211.978
	7	9.035,976	0,0723	23,066	1.158	179,985	208.423
	8	8.903,850	0,0712	23,253	1.134	182,575	207.040
	9	9.166,012	0,0733	23,165	1.225	173,331	212.331
	10	9.183,191	0,0735	23,172	1.233	172,581	212.792
	11	9.031,291	0,0723	23,084	1.159	179,877	208.477
	12	8.943,398	0,0715	23,123	1.130	183,004	206.795
	13	8.992,990	0,0719	23,022	1.134	182,575	207.040
	14	8.913,177	0,0713	23,384	1.158	179,985	208.423
	15	8.951,924	0,0716	23,270	1.156	180,203	208.315
		M	9.023,397	0,0722	23,218	1.176	178,266
	σ	111,144	0,0009	0,197	37	3,689	2.152
Controle Endereço MAC	1	8.821,866	0,0706	23,521	1.142	181,700	207.501
	2	9.287,275	0,0743	23,169	1.274	168,901	215.180
	3	8.676,203	0,0694	23,106	1.061	191,121	202.779
	4	9.121,090	0,0730	23,092	1.196	176,104	210.620
	5	8.803,555	0,0704	23,166	1.081	188,659	203.940
	6	8.959,070	0,0717	23,116	1.135	182,462	207.094
	7	9.070,060	0,0726	23,206	1.186	177,471	210.481
	8	8.856,961	0,0709	23,125	1.096	186,874	204.814
	9	8.974,750	0,0718	23,115	1.141	181,812	207.447
	10	8.967,424	0,0717	23,043	1.127	183,348	206.633
	11	9.139,473	0,0731	23,021	1.192	176,513	210.404
	12	9.354,330	0,0748	23,195	1.305	166,261	216.970
	13	8.977,037	0,0718	23,042	1.131	182,890	206.849
	14	9.202,335	0,0736	23,074	1.225	173,331	212.331
	15	8.989,980	0,0719	23,051	1.130	183,385	207.225
		M	9.013,427	0,0721	23,136	1.161	180,055
	σ	186,119	0,0015	0,121	68	6,966	3.979

		<i>Throughput</i> (Bytes/s)	<i>Throughput</i> (Mbps)	T_{Resposta} (seg)	Número Pacotes Tx	Tamanho Médio dos Pacotes	Qte Bytes de Tráfego
WEP 64 Bits	1	9.099,659	0,0728	23,185	1.202	175,518	210.973
	2	8.971,263	0,0718	23,108	1.139	1.825,005	207.304
	3	8.965,644	0,0717	23,190	1.146	181,426	207.914
	4	8.901,395	0,0712	23,152	1.118	184,337	206.089
	5	9.013,452	0,0721	23,130	1.159	179,877	208.477
	6	8.942,382	0,0715	23,149	1.134	182,549	207.011
	7	8.811,447	0,0705	23,127	1.078	189,039	203.784
	8	9.116,307	0,0729	23,059	1.189	176,798	210.213
	9	8.948,357	0,0716	23,109	1.130	182,999	206.789
	10	9.344,660	0,0748	23,156	1.291	167,613	216.389
	11	9.079,285	0,0726	23,105	1.181	177,630	209.781
	12	8.943,679	0,0715	23,095	1.124	183,769	206.556
	13	8.894,579	0,0712	23,106	1.108	185,487	205.520
	14	8.824,096	0,0706	23,072	1.075	189,389	203.593
	15	9.249,093	0,0740	23,150	1.256	170,483	214.127
	M	9.000,403	0,0720	23,122	1.152	298,314	208.111
σ	151,740	0,0012	0,036	61	439,456	3.596	
WEP 128 Bits	1	8929,170	0,0714	23,114	1.123	183,783	206.388
	2	8606,091	0,0688	23,832	1.100	186,454	205.099
	3	8878,875	0,0710	23,101	1.101	186,297	205.113
	4	8882,295	0,0711	23,321	1.136	182,349	207.148
	5	9128,876	0,0730	23,194	1.215	174,266	211.733
	6	9044,834	0,0724	23,127	1.171	178,636	209.183
	7	9043,886	0,0724	23,226	1.186	177,109	210.051
	8	8945,362	0,0716	23,163	1.137	182,236	207.202
	9	9225,140	0,0738	23,199	1.254	170,664	214.013
	10	8769,440	0,0702	23,133	1.062	191,019	202.862
	11	9141,269	0,0731	23,189	1.219	173,895	211.978
	12	8943,772	0,0716	23,081	1.123	183,822	206.432
	13	8822,549	0,0706	23,221	1.097	186,753	204.868
	14	9112,700	0,0729	23,039	1.184	177,317	209.943
	15	8967,678	0,0717	23,162	1.146	181,249	207.711
	M	8.965,198	0,0717	23,213	1.152	180,862	208.095
σ	166,978	0,0013	0,191	55	5,813	3.187	

		Medição do Cliente			Medição no Coletor		
		Throughput (Bytes/s)	Throughput (Mbps)	T _{Resposta} (seg)	Throughput (Bytes/s)	Throughput (Mbps)	T _{Resposta} (seg)
EAP-TLS	1	8279,237	0,0660	26,009	8392,068	0,0660	26,010
	2	8880,790	0,0710	23,078	8995,849	0,0710	23,079
	3	8938,035	0,0720	23,079	9055,904	0,0720	23,080
	4	9040,157	0,0720	23,214	9156,076	0,0720	23,216
	5	8943,691	0,0720	23,143	9058,862	0,0720	23,145
	6	8893,805	0,0710	23,141	9003,998	0,0710	23,143
	7	8811,081	0,0700	23,199	8918,978	0,0700	23,200
	8	8893,216	0,0710	23,110	9006,877	0,0710	23,112
	9	9036,162	0,0720	24,432	9159,515	0,0720	24,433
	10	8915,521	0,0710	23,149	9033,558	0,0710	23,151
	11	9180,117	0,0730	23,274	9311,129	0,0730	23,276
	12	8820,126	0,0710	23,203	8925,167	0,0710	23,205
	13	9174,782	0,0730	23,267	9296,932	0,0730	23,269
	14	7979,425	0,0640	26,062	8081,453	0,0640	26,063
	15	9130,864	0,0730	23,489	9253,041	0,0730	23,491
	M	8.861,134	0,0708	23,657	8.976,627	0,0708	23,658
σ	324,471	0,0025	1,022	329,922	0,0025	1,021	
PEAP	1	8831,513	0,0710	23,265	8946,702	0,0710	23,267
	2	9034,965	0,0720	23,288	9159,545	0,0720	23,290
	3	9016,500	0,0720	23,308	9137,744	0,0720	23,310
	4	8946,837	0,0720	23,161	9136,271	0,0720	23,162
	5	8848,090	0,0710	23,187	8962,925	0,0710	23,188
	6	9271,097	0,0740	23,265	9402,650	0,0740	23,267
	7	9040,734	0,0720	23,183	9158,071	0,0720	23,185
	8	9177,625	0,0730	23,248	9304,440	0,0730	23,250
	9	9033,607	0,0720	23,126	9248,565	0,0720	23,127
	10	9069,206	0,0730	23,418	9190,477	0,0730	23,420
	11	9232,035	0,0740	23,161	9358,030	0,0740	23,163
	12	9269,514	0,0740	23,231	9391,444	0,0740	23,233
	13	8873,401	0,0710	23,247	8981,430	0,0710	23,249
	14	9033,257	0,0720	23,310	9155,364	0,0720	23,312
	15	8983,259	0,0720	23,195	9104,674	0,0720	23,197
	M	9.044,109	0,0723	23,240	9.175,889	0,0723	23,241
σ	142,206	0,0010	0,075	145,866	0,0010	0,075	

		Medição do Cliente			Medição no Coletor		
		Throughput (Bytes/s)	Throughput (Mbps)	T _{Resposta} (seg)	Throughput (Bytes/s)	Throughput (Mbps)	T _{Resposta} (seg)
EAP-TTLS	1	9057,555	0,0720	23,095	9180,918	0,0720	23,097
	2	9057,792	0,0720	23,082	9180,693	0,0720	23,084
	3	9011,406	0,0720	23,084	9132,738	0,0720	23,085
	4	8911,313	0,0710	23,080	9025,622	0,0710	23,082
	5	8913,651	0,0710	23,145	9022,431	0,0710	23,146
	6	8991,413	0,0720	23,322	9108,613	0,0720	23,324
	7	9070,832	0,0730	23,303	9188,581	0,0730	23,306
	8	9030,426	0,0720	23,215	9145,251	0,0720	23,217
	9	8866,741	0,0710	23,173	8976,126	0,0710	23,174
	10	8909,278	0,0710	23,166	9023,532	0,0710	23,167
	11	9055,941	0,0720	23,180	9171,257	0,0720	23,181
	12	8819,342	0,0710	23,066	8922,844	0,0710	23,068
	13	9175,153	0,0730	23,204	9298,734	0,0730	23,206
	14	9180,766	0,0730	23,311	9305,733	0,0730	23,313
	15	9179,006	0,0730	23,346	9370,223	0,0730	23,347
		M	9.015,374	0,0719	23,185	9.136,886	0,0719
	σ	113,932	0,0008	0,097	127,541	0,0008	0,097
LEAP	1	8762,750	0,0700	23,448	8870,840	0,0700	23,449
	2	8630,827	0,0690	23,501	8733,259	0,0690	23,503
	3	8745,698	0,0700	23,586	8854,780	0,0700	23,588
	4	8798,989	0,0700	23,548	8914,001	0,0700	23,550
	5	8764,736	0,0700	23,523	8879,687	0,0700	23,525
	6	8696,877	0,0700	23,613	8806,871	0,0700	23,614
	7	8820,758	0,0710	23,484	8929,426	0,0710	23,486
	8	8602,372	0,0690	23,677	8705,741	0,0690	23,678
	9	8899,734	0,0710	23,504	9012,385	0,0710	23,506
	10	8866,798	0,0710	23,417	8975,915	0,0710	23,419
	11	8577,753	0,0690	23,59	8676,018	0,0690	23,592
	12	8905,342	0,0710	23,654	9027,990	0,0710	23,656
	13	8761,619	0,0700	23,556	8874,997	0,0700	23,558
	14	7776,382	0,0620	26,351	7875,393	0,0620	26,353
	15	8691,675	0,0700	24,504	8805,708	0,0700	24,506
		M	8.686,821	0,0695	23,797	8.796,201	0,0695
	σ	270,988	0,0022	0,752	275,324	0,0022	0,752

1.3

Consolidação dos Valores Médios

	FTP		HTTP	
	<i>Throughput</i> (Mbps)	T_{Resposta} (seg)	<i>Throughput</i> (Mbps)	T_{Resposta} (seg)
	Média	Média	Média	Média
Sem Segurança	5,4056	10,050	0,0722	23,218
Controle MAC	5,4126	10,036	0,0721	23,136
WEP 64 bits	5,4021	10,035	0,0720	23,122
WEP 128 bits	5,4092	10,043	0,0717	23,123
EAP-TLS	5,3990	10,062	0,0708	23,657
PEAP	5,3795	10,099	0,0723	23,240
EAP-TTLS	5,4060	10,048	0,0719	23,185
LEAP	5,3802	10,097	0,0695	23,797

2

Tempo de Autenticação (Rede com 01 Cliente em 11Mbps)

		Medição no Cliente			Medição no Coletor		
		T _{Início}	T _{Fim}	T _{Aut (s)}	T _{Início}	T _{Fim}	T _{Aut (s)}
EAP-TLS	1	104,625	104,745	0,120	104,636	104,745	0,109
	2	164,751	164,875	0,124	164,766	164,879	0,113
	3	224,878	225,002	0,124	224,897	225,011	0,114
	4	285,004	285,128	0,124	285,028	285,140	0,112
	5	405,295	405,422	0,127	405,327	405,442	0,115
	6	465,421	465,546	0,125	465,459	465,572	0,113
	7	525,548	525,672	0,125	525,589	525,702	0,114
	8	585,674	585,796	0,122	585,719	585,830	0,111
	9	645,800	645,942	0,142	645,850	645,980	0,130
	10	705,946	706,070	0,124	706,000	706,113	0,113
	11	766,072	766,196	0,124	766,131	766,243	0,112
	12	1.006,673	1.006,796	0,122	1.006,748	1.006,859	0,111
	13	1.066,800	1.066,941	0,141	1.066,879	1.067,009	0,131
	14	1.126,945	1.127,067	0,121	1.127,028	1.127,139	0,111
	15	1.187,072	1.187,193	0,122	1.187,159	1.187,270	0,112
		M	617,767	617,893	0,126	617,814	617,929
	σ		0,007			0,006	
PEAP	1	544,781	544,874	0,093	552,827	552,909	0,083
	2	604,869	604,963	0,094	612,919	613,002	0,083
	3	664,957	665,050	0,093	673,010	673,094	0,083
	4	725,045	725,139	0,094	733,103	733,187	0,084
	5	785,132	785,224	0,091	793,195	793,276	0,081
	6	845,220	845,312	0,092	853,287	853,368	0,081
	7	905,308	905,401	0,093	913,379	913,462	0,083
	8	965,396	965,489	0,093	973,471	973,554	0,083
	9	1.025,484	1.025,578	0,094	1.033,563	1.033,647	0,084
	10	1.085,572	1.085,666	0,094	1.093,656	1.093,739	0,083
	11	1.145,659	1.145,752	0,093	1.153,748	1.153,830	0,083
	12	1.205,747	1.205,842	0,094	1.213,840	1.213,924	0,084
	13	1.265,835	1.265,929	0,094	1.273,933	1.274,015	0,083
	14	1.325,923	1.326,015	0,092	1.334,023	1.334,105	0,082
	15	1.386,011	1.386,105	0,094	1.394,116	1.394,200	0,084
		M	965,396	965,489	0,093	973,471	973,554
	σ		0,001			0,001	

EAP-TTLS	1	189,688	189,902	0,214	196,729	196,931	0,203
	2	249,892	250,128	0,237	256,936	257,161	0,225
	3	310,133	310,333	0,200	317,181	317,371	0,190
	4	370,336	370,574	0,237	377,389	377,616	0,227
	5	430,578	430,849	0,271	437,635	437,896	0,261
	6	490,839	491,056	0,216	497,900	498,105	0,205
	7	611,573	611,736	0,163	618,642	618,795	0,152
	8	671,737	671,976	0,239	678,811	679,040	0,229
	9	792,413	792,720	0,307	799,495	799,792	0,296
	10	852,713	853,023	0,310	859,799	860,099	0,300
	11	913,012	913,333	0,321	920,103	920,413	0,310
	12	973,331	973,670	0,339	980,426	980,754	0,329
	13	1.033,669	1.033,897	0,228	1.040,768	1.040,986	0,218
	14	1.093,891	1.094,126	0,235	1.100,997	1.101,219	0,222
	15	1.154,114	1.154,425	0,311	1.161,222	1.161,522	0,300
	M	675,861	676,116	0,255	682,935	683,180	0,244
	σ			0,052			0,052
PEAP	1	LEAP não permite capturar os pacotes de autenticação no cliente			47,633	47,652	0,018
	2				107,668	107,686	0,018
	3				287,771	287,789	0,018
	4				407,840	407,858	0,018
	5				467,874	467,892	0,018
	6				527,909	527,927	0,018
	7				647,978	647,996	0,018
	8				708,012	708,030	0,018
	9				768,046	768,065	0,018
	10				828,081	828,099	0,018
	11				888,115	888,133	0,018
	12				1.008,184	1.008,202	0,018
	13				1.068,218	1.068,236	0,018
	14				1.128,252	1.128,271	0,018
	15				1.188,287	1.188,305	0,018
	M				671,991	672,009	0,018
σ			0,000				

2.1

Consolidação dos Valores Médios

	Tempo de Autenticação (seg)	
	CLIENTE	COLETOR
EAP-TLS	0,126	0,115
PEAP	0,093	0,083
EAP-TTLS	0,255	0,244
LEAP	--	0,018

3

Rede com 01 Cliente Interligado Diretamente ao HUB (10Mbps) e Switch (100Mbps)

		Tráfego FTP		Tráfego HTTP	
		Throughput (Mbps)	Throughput (Mbps)	T _{Resposta} (seg)	T _{Resposta} (seg)
HUB (10Mbps)	1	9,566	5,714	0,072	23,188
	2	9,454	5,782	0,070	23,515
	3	9,564	5,712	0,071	23,265
	4	9,543	5,728	0,070	24,187
	5	9,573	5,710	0,070	23,407
	6	9,564	5,715	0,070	23,208
	7	9,563	5,716	0,072	23,190
	8	9,575	5,709	0,066	23,385
	9	9,530	5,736	0,070	23,331
	10	9,567	5,714	0,072	23,309
	11	9,568	5,713	0,071	23,179
	12	9,562	5,716	0,072	23,163
	13	9,527	5,738	0,071	23,246
	14	9,556	5,720	0,072	23,106
	15	9,571	5,711	0,073	23,084
	M	9,552	5,722	0,071	23,318
	σ	0,031	0,019	0,002	0,268
S	1	75,627	0,723	0,070	23,272

	2	74,813	0,731	0,073	23,099
	3	75,386	0,725	0,070	23,306
	4	76,267	0,717	0,073	23,131
	5	76,662	0,713	0,069	23,487
	6	75,360	0,725	0,066	24,788
	7	75,823	0,730	0,073	23,071
	8	75,423	0,725	0,072	23,095
	9	76,212	0,717	0,072	23,090
	10	75,349	0,725	0,071	23,275
	11	76,064	0,719	0,071	23,257
	12	75,919	0,720	0,072	23,163
	13	75,086	0,728	0,074	22,982
	14	76,124	0,718	0,070	23,539
	15	74,975	0,729	0,072	23,153
	M	75,673	0,723	0,071	23,314
	σ	0,533	0,005	0,002	0,436

4

Rede com 02 Clientes Configurados em 11Mbps

		Tráfego FTP	
		Throughput (Mbps)	T _{Resposta} (seg)
Sistema Sem Segurança	1	3,315	16,386
	2	3,102	17,512
	3	3,034	17,931
	4	3,016	18,010
	5	3,050	17,815
	6	3,006	18,069
	7	3,008	18,067
	8	3,320	16,362
	9	3,210	16,922
	10	3,307	16,427
	11	3,148	17,255
	12	3,154	17,225
	13	3,078	17,659
	14	3,119	17,414

	15	3,090	17,597
	M	3,130	17,377
	σ	0,111	0,607
WEP 128 Bits	1	3,151	17,242
	2	3,073	17,692
	3	3,043	17,853
	4	3,059	17,757
	5	3,092	17,570
	6	3,229	16,823
	7	3,140	17,299
	8	3,423	15,732
	9	3,323	16,352
	10	3,088	17,593
	11	3,048	17,819
	12	3,061	17,749
	13	3,071	17,692
	14	3,212	16,911
	15	3,078	17,656
	M	3,139	17,316
	σ	0,112	0,616

5

Rede com 02 Clientes Configurados em 1Mbps e 11Mbps

		Tráfego FTP	
		Throughput (Mbps)	T _{Resposta} (seg)
Sistema Sem Segurança	1	0,722	75,400
	2	0,727	74,810
	3	0,719	75,584
	4	0,719	75,692
	5	0,716	76,105
	6	0,733	74,194
	7	0,731	74,313
	8	0,724	75,114
	9	0,720	75,487
	10	0,691	78,739

	11	0,729	74,567
	12	0,717	75,962
	13	0,733	74,167
	14	0,751	72,515
	15	0,729	74,601
	M	0,724	75,150
	σ	0,013	1,347
WEP 128 Bits	1	0,750	72,422
	2	0,719	75,760
	3	0,717	75,978
	4	0,718	75,932
	5	0,718	76,133
	6	0,712	76,462
	7	0,726	74,910
	8	0,739	73,545
	9	0,692	78,611
	10	0,708	77,006
	11	0,711	76,450
	12	0,716	75,883
	13	0,707	76,886
	14	0,709	76,758
	15	0,710	76,767
	M	0,717	75,967
	σ	0,014	1,471

6

Rede com 03 Clientes Configurados em 11Mbps

		Tráfego FTP	
		Throughput (Mbps)	T _{Resposta} (seg)
Sistema Sem Segurança	1	2,038	26,655
	2	2,070	26,243
	3	2,033	26,723
	4	2,043	26,593
	5	2,041	26,617
	6	2,057	26,420
	7	2,080	26,113
	8	2,044	26,571
	9	2,035	26,697

	10	2,056	26,420
	11	2,039	26,645
	12	2,037	26,708
	13	2,088	26,022
	14	2,062	26,339
	15	2,060	26,371
	M	2,052	26,476
	σ	0,017	0,223

7

Rede com 04 Clientes Configurados em 11Mbps

		Tráfego FTP	
		Throughput (Mbps)	T _{Resposta} (seg)
Sistema Sem Segurança	1	2,038	26,655
	2	2,070	26,243
	3	2,033	26,723
	4	2,043	26,593
	5	2,041	26,617
	6	2,057	26,420
	7	2,080	26,113
	8	2,044	26,571
	9	2,035	26,697
	10	2,056	26,420
	11	2,039	26,645
	12	2,037	26,708
	13	2,088	26,022
	14	2,062	26,339
	15	2,060	26,371
		M	2,052
	σ	0,055	1,416

8

Consolidação

	Tráfego FTP	
	<i>Throughput</i> (Mbps)	T_{Resposta} (seg)
1 Cliente	5,4156	10,05
2 Clientes	3,13	17,377
3 Clientes	2,052	26,476
4 Clientes	1,532	35,523