Candela Technologies Jed Reynolds 02/18/15



Example of Using the LANforge Enforce Fairness Plug-in

Starting a series of UDP Layer 3 connections between virtual stations leads to unbalanced sending rates. The Enforce Fairness plug-in can be used to determine what reduction of bandwidth allows equal transmit rates among a group of virtual stations. There is a chapter in the LANforge User Manual describing the Enforce Fairness plug-in. Specifically, the Enforce Fairness plug-in will drop the beginning transmit rate according to this formula: $R_{final} = (0.9)^{10} R_{begin}$. The final transmit rate will be about **34%** of the beginning transmit rate. There are ten drop iterations performed by the plug-in, each dropping the bandwidth by 10% of the previous rate.

To effectively use this plug-in, you first want to compute a logical maximum of bandwidth per station. In the following example, we will be pointing twenty virtual stations at one 802.11abgn Access Point. The **logical maximum per station** is (300Mbps / 20) = 15Mbps per station.

Balanced Example:

Starting TxBps/Station	Ending TxBps/Station
20Mbps	(0.34)20 = 6.8Mbps

In this example, the traffic will balance out because the transmit rate will fall well below the logical maximum transmit rate per station.

Unbalanced Example:

Starting TxBps/Station	Ending TxBps/Station
200Mbps	(0.34)200 = 68Mbps

In this example, the traffic will not have a chance to balance because the final transmit rate is still above the logical maximum transmit rate.

Detailed Examples

The remainder of this document is a series of steps that can be used as a cookbook for using the Enforce Fairness plug-in. It was conducted on two LANforge CT523 servers, one hosting a 802.11abgn virtual AP and the station machine with two 802.11ac radios running ten stations per radio.

1. We start with twenty stations, ten each on two radios. Stations 100-109 are on wiphy0 and stations 200-209 are on wiphy1.

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1.1.03				0.0.0.0		0	wiphy1			154,966,	074	1,237,359)	0	0	14,643,097	9,6	
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1.1.02		1		0.0.0.0		0	wiphy0			125,803,	130	1,008,954	l I	0	226	83,649,184	54	2
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1.1.08		1		0.0.0.0		0	vap0	w	iphy0	12,146,	415	108,399)	0	23	82,667,170	54	2
1.2.077	7			10.43.3.240		0	sta209	w	iphy1	1,755,	057	29,690)	0	0	116,87	71	
1.2.076	i 🗌]		10.43.3.230		0	sta208	w	iphy1	1,755,	852	29,842	2	0	0	110,71	4	
1.2.075	i 🗌]		10.43.3.231		0	sta207	w	iphy1	1,851,	188	32,034	ļ.	0	0	120,06	<u> 6</u>	
1.2.074]		10.43.3.242		0	sta206	w	iphy1	1,808,	240	30,774	ļ 👘	0	0	110,96	67	
1.2.073	3			10.43.3.241		0	sta205	w	iphy1	1,839,	513	31,076	6	0	0	112,42	26	
1.2.072	2			10.43.3.244		0	sta204	w	iphy1	1,810,	686	31,054	l I	0	0	116,50)8	
1.2.071				10.43.3.234		0	sta203	w	iphy1	1,753,	187	29,157	7	0	0	111,98	35	
1.2.070				10.43.3.239		0	sta202	w	iphy1	1,732,	831	28,996	6	0	0	116,94	13	
1.2.069				10.43.3.246		0	sta201	w	iphy1	1,864,	049	31,773	3	0	0	109,32	20	
1.2.067	/			10.43.3.243		0	sta200	w	iphy1	1,822,	842	30,942	2	0	0	125,28	39	
1.2.012	2			10.43.3.221		0	stal09	w	iphy0	4,182,71	1,	2,792,008	3	0	0	322,41	.3	
1.2.011				10.43.3.222		0	sta108	W	iphy0	4,327,04	2,	2,887,536	i	0	0	242,36	j2	
1.2.010				10.43.3.235		0	stal07	W	iphy0	4,188,16	9,	2,793,325	5	0	0	306,03	33	
1.2.009				10.43.4.0		0	stal06	W	iphy0	4,418,00	1,	2,947,477	/	0	0	336,24	12	
1.2.008	3			10.43.3.226		0	sta105	W	iphy0	4,255,43	6,	2,839,561		0	0	287,72	23	
1.2.007	/			10.43.3.217		0	stal04	W	iphy0	4,483,80	5,	2,990,274	1	0	0	262,32	24	
1.2.006	i 🗖			10.43.3.229		0	sta103	W	iphy0	4,367,33	9,	2,914,315	5	0	0	269,97	/8	
1.2.005	i 🗌			10.43.3.212		0	stal02	W	iphy0	4,480,60	7,	2,988,430)	0	0	305,83	32	
1.2.004				10.43.3.220		0	stal01	W	iphy0	4,591,14	7,	3,063,657	/	0	0	420,83	30	
1.2.002	2			10.43.3.255		0	sta100	W	iphy0	7,497,74	3,	4,982,258	3	0	0	431,06	<u>;8</u>	
1.1.01				10.43.8.1		0	eth1			224,748,5	56	148,056		0	0	4,387,93	34	
1.2.001				10.43.8.2		0	eth1			4,386,	392	7,488	3	0	0	224,748,60	14	4
1.1.00				192.168.100	0.43	0	eth0			46,038,60	01	38,480,	1,	222	12,063	52,717,432	40	9
1.2.000) [192.168.100	0.38	0	eth0			1,086,36	9,	4,604,945	5	140	279,667	43,176,896	30	9-
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- 2. In the **Layer-3** tab, create a UDP connection between *sta100* and *eth1*.
 - 1. Select wiphy0
 - 2. Set the TX rate to **20Mbps** for *eth1* and **0** for *sta100*.
 - 3. Set the Endpoint A and Endpoint B send and receive buffers to 2MB.
 - 4. Click Apply.

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+ - All		5			Display	Sync	Batch-Create	е	Apply	ОК	Cance	el –
CX Name: CX Type:	Cross-Connect s100-e1-1000 LANforge / UDP	_		•	Report Timer:	Cross-Connect default (5 s)						
Resource:	Endpoint A 2 (medtest)	-	Endpoint B 2 (medtest)	-	Pld Pattern Min IP Port:	incre AUTO	asing	•	increasing AUTO	3	v	
Port: Min Tx Rate:	2 (stal00) Zero (0 bps)	•	l (ethl) 20Mbps	•	Max IP Port: Min Duration:	Same Forev	ver	•	Same Forever		 ▼ ▼ 	
Max Tx Rate: Min PDU Size:	Same UDP Pld (1,472 B)	•	Same UDP Pld (1,472 B)	•	Max Duration: Min Reconn:	Same O	(0 ms)	•	Same O (Om	s)	▼▼	
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IP Addr:	Endpoint A AUTO	•	Endpoint B AUTO	•	Send Bad FCS: Src MAC:	zero	(0%)	-	zero (0%)		-	
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Dest MAC:	<custom></custom>	-	<custom></custom>	-	Socket Priority:	0	Payload		0	Payload		ļ

3. Use the **Batch Create** tool to make nine more of these on this radio.

🛓 Laye	r-3 Batch Cr	eator: s100-e1-1000		Ŷ _ D X					
s100-el-1001, s100-e	1-1002 s10	0-el-1009							
Endp-A Resources: 2	22								
Endp-B Resources: 2, 2 2									
Endp-A Ports: stal01, stal02 stal09									
Endp-B Ports: ei	Endp-B Ports: ethl, ethl ethl								
Endp-A IPs: A	Endp-A IPs: AUTO, AUTO AUTO								
Endp-B IPs: A	Endp-B IPs: AUTO, AUTO AUTO								
Quantity:	9	Number of Digits:	4	Zero Pad					
Starting Name Suffix:	1000	Name Increment:	1						
Resource Increment A:	0	Resource Increment B:	0						
Port Increment A:	1	Port Increment B:	0						
IP Addr Increment A:	0	IP Addr Increment B:	0						
IP-Port Increment A:	1	IP-Port Increment B:	1						
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pt Timer: default (5 s) 🔻 Go Test Manager all 👻 Select All Start Stop Quiesce Clear										
/iew 0 - 200	iew 0-200 ▼Go Display Cr <u>e</u> ate Modify Delete									
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Name	Туре	State	Pkt Rx A	Pkt Rx B	Bps Rx A	Bps Rx B	Rx Drop %	A Rx Dro		
s100-el-1000	LF/UDP	Stopped	0	0	0	C) (0		
s100-e1-1001	LF/UDP	Stopped	0	0	0	C) (0		
s100-e1-1002	LF/UDP	Stopped	0	0	0	C) (D		
s100-el-1003	LF/UDP	Stopped	0	0	0	C) (D		
s100-el-1004	LF/UDP	Stopped	0	0	0	C) (0		
s100-el-1005	LF/UDP	Stopped	0	0	0	C) (0		
s100-el-1006	LF/UDP	Stopped	0	0	0	C) (0		
s100-el-1007	LF/UDP	Stopped	0	0	0	C) (0		
s100-el-1008	LF/UDP	Stopped	0	0	0	C) (0		
s100-e1-1009	LF/UDP	Stopped	0	0	0	C) (0		
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Logged in to: ledtest:4002 a	s: Admin	1								

4. You now have ten connections for wiphy0.

- 5. In the Layer-3 tab, create a UDP connection between sta200 and eth1.
 - 1. Select wiphy1
 - 2. Make the connection with TX rate and buffer the same as the previous connections.
 - 3. Click Apply.

+ All Display Sync Batch-Create Apply OK Cancel CK Name: 5200-81-3010 Cross-Connect Scross-Connect Gross-Connect Mar Diversing V AllTO V Same V Mar Na Reconn: Same V Mar Reconn: Same V Mar Reconn: Same V Mar Reconn: Normal (0) V Vormal (0) V Vorma	<u>\$</u>		9	200-e1-1010 - Crea	ite/M	odify Cross Con	nect		Û	- 0	1
Cross-Connect S200-81-1010 Cross-Connect default (5 s) Cross-Connect default (5 s) Cross-Connect S200-81-1010 Endpoint B Resource: 2 (medtest) 2 Port: S2(sia200) 1 (eth1) Min PLP ort: Same Same Min PLP ort: Same Same Min PLD Size: Same Same Best Effort (0) Best Effort Max (1,024 B) If inite Thin ite Thin ite Same Cross-Connect Same Same Same Pts To Send: Infinite Thin ite Thin ite Cross-Connect Sing Buff Size: Endpoint A Endpoint A Endpoint B Test Manager Gefault_tim Thin ite Quiesce: 3 (3 sec) V IP Addr: AUTO AUTO AUTO Proxy Partice Loss Proxy Dese Proxy IP Addr: Dest Mac Dest Mac Proxy Port: O Dest Mac Dest Mac Dest Mac O O Proxy Port: O O O <	+ - All					Display	Sync Batch-Create		Apply OK	Cance	I
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Cross-Connect Endpoint A Endpoint A Endpoint B Test Manager default_tm v Xn Buff Size: ZMB (2 MB) v ZMB (2 MB) v Quiesce: 3 (3 sec) v Rcv Buff Size: ZMB (2 MB) v ZMB (2 MB) v IP Addr: Endpoint A Endpoint A Endpoint O v Send Bad FCS: Zero (0%) v zero (%) v IP Addr: Endpoint A Endpoint O v Send Bad FCS: Zero (0%) v Juse-Proxy v IP Addr: Doest Mac Dest Mac Dest Mac Posty Port: 0.0.0.0 0.0.0.0 0.0.0.0 IP Replay File Dest Mac Posty Port: 0 0 0 0 0 IP Replay File Loop Posty Port: 0 <	Pkts To Sena:	Intitle	•	TILLTITLE			Script Thresholds		Script Thresholds		
Test Manager default_tm m m m 2/8 <	8	Cross-Connect				4	Endpoint A	_	Endpoint B		
Quiesce: 3 (3 sec) Rcv Buff Size: 248 (2 MB) ZMB	Test Manager	default_tm			-	Snd Buff Size:	2MB (2 MB)	-	2MB (2 MB)	-	
Endpoint A Endpoint B Send Bad FCS: Zera (0%) ¥ Zero (0%) ¥ IP Addr. AUTO AUTO Src MAC: Src MAC: Use-Proxy Use-Proxy Use-Proxy IP Addr. Dest Mac Dest Mac Proxy Port: 0.0.0.0 0.0.0.0 0.0.0.0	Quiesce:	3 (3 sec)			-	Rcv Buff Size:	2MB (2 MB)	•	2MB (2 MB)	-	
P Addr: AUTO AUTO Src MAC: Use-Proxy Use-Proxy Replay File Replay File Loop Dest Mac Dest Mac Proxy Addr: 0.0.0.0 0.0.0.0 Filename: Dest Mac Proxy Port: 0 0 0 0 Dest MAC: Socket Priority: 0 0 0		Endpoint A		Endpoint B		Send Bad FCS:	zero (0%)	-	zero (0%)	-	
Replay File Replay File Use-Proxy Use-Proxy Loop Loop Proxy Addr. 0.0.0 0.0.00 Proxy Port: October Proxy Port: October October Elename:	IP Addr:	AUTO	-	AUTO	-	Src MAC:					
Filename: Filename: Filename: O Dest MAC: <custom> Socket Priority: O O</custom>		Replay File Loop Dest Mac		Replay File Loop Dest Mac		Proxy Addr:	Use-Proxy 0.0.0.0		Use-Proxy 0.0.0.0		
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	Dest MAC:	<custom></custom>	-	<custom></custom>	-	Socker Phoney:	<u> </u>) <u> </u>		

6. Use the **Batch Create** tool to make nine more on radio *wiphy1*.

<u>چ</u>	Lay	er-3 Batch Cr	eator: s200-e1-1010		Ŷ _ O X					
	s200-el-1011, s200	-el-1012 s20	0-el-1019							
	Endp-A Resources:	2, 2 2								
	Endp-B Resources:	2, 2 2								
	Endp-A Ports:									
	Endp-B Ports:									
	Endp-A IPs:	AUTO, AUTO /	AUTO, AUTO AUTO							
	Endp-B IPs:	AUTO, AUTO /	AUTO, AUTO AUTO							
	Quantity:	9	Number of Digits:	4	Zero Pad					
	Starting Name Suffix:	1010	Name Increment:	1						
	Resource Increment	A: 0	Resource Increment B:	0						
	Port Increment A:	1	Port Increment B:	0						
	IP Addr Increment A:	0	IP Addr Increment B:	0						
	IP-Port Increment A:	1	IP-Port Increment B:	1						
		Арр	ly Close		1 6					

7. In the **Layer-3** tab you will see twenty connections. Highlight them all, right click and select the *Enforce Fairness* option. (Or go to the Plugins Menu and select the plugin there.)

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Control Reporting Tear-Of	ff <u>I</u> nfo <u>P</u> lugins	S								
				Stop /	All Resta	rt Manager		Refresh	HELP	
Collision-Domains File-IO	Cayer-4 G	eneric Test	t Mgr Test Group	Resource Mgr	Event Log Alerts	Port Mgr	Messages			
Status Layer-3	Status Layer-3 L3 Endps VoIP/RTP VoIP/RTP Endps Armageddon WanLinks Attenuators									
Rpt Timer: default (5 s) 🔻 Go Test Manager all 💌 Select All Start Stop Quiesce Clear										
View 0 -	200		▼ Go		Display Crea	ate Mod	ifv Del	ete		
				L						
	1		Cross Connect	s for Selected Test N	lanager					
Name	Туре	State Pkt	t Rx A Pkt Rx B	Bps Rx A	Bps Rx B	Rx Drop % A	Rx Drop % B	Drop Pkts A	Drop Pkts E	
-100 -1 1000	1.5 (1)0.0									
s100-e1-1000	LF/UDP Sto	opped	0 0	0	0	0	0	0		
s100-e1-1001	LE/UDP Sto	pped	Start Selected		0	0	0	0		
s100-e1-1002	LE/UDP Sto	opped	Stop Selected		0	0	0	0		
s100-e1-1004	LF/UDP Sto	opped	Clear Selected		0	0	0	0	- i	
s100-e1-1005	LF/UDP Sto	pped	Modify Selected		0	0	0	0	(
s100-e1-1006	LF/UDP Sto	pped	Display Colocted		0	0	0	0	(
s100-e1-1007	LF/UDP Sto	opped	Display Selected		0	0	0	0	(
s100-el-1008	LF/UDP Sto	opped	✤ Dynamic Report	D	0	0	0	0	(
s100-el-1009	LF/UDP Sto	opped	Table Report		0	0	0	0	(
s200-el-1010	LF/UDP Sto	opped	Count Selected		0	0	0	0	(
s200-el-1011	LF/UDP Sto	opped	Calculations		0	0	0	0	(
s200-el-1012	LF/UDP Sto	opped	Add Design Table	Columna -	0	0	0	0	(
s200-el-1013	LF/UDP Sto	opped	Add/Remove Table	Columns	0	0	0	0	(
s200-el-1014	LF/UDP Sto	opped	Add/ <u>R</u> emove Table	Report Columns	0	0	0	0	(
s200-el-1015	LF/UDP Sto	opped	Save Table Layout		0	0	0	0	(
s200-el-1016	LF/UDP Sto	opped	Reset Table Layout		0	0	0	0	(
s200-e1-1017	LF/UDP Sto	opped	Auto-Resize Column	15	0	0	0	0	(
s200-el-1018	LF/UDP Sto	pped	- Contracting of Containing		0	0	0	0	(
s200-el-1019	LF/UDP Sto	pped	Enforce Fairness		0	0	0	0	(
•			Ш	A .					•	
Logged in to: ledtest:4002	as: Admin									

8. In the Enforce Fairness plugin, set the Reporting Interval to 3s. Click *Start*. (Notice the button will change to *Stop*).

<u>ی</u>	Enforce Fairr	ness		Ŷ.		×
Duration:		30000				-
Per-Second Reporting Inte	erval:	3-second Run	ining Avei	rage		•
	Cross-Conne	ect Selection				
CXS IN Use s100-e1-1000 s100-e1-1001 s100-e1-1002 s100-e1-1004 s100-e1-1005 s100-e1-1005 s100-e1-1006 s100-e1-1007 s100-e1-1008 s100-e1-1009	< A Remove (dd CXss CXs>>		-ree CXs		
			Start		Close	

- 9. Let the plugin run for 5 minutes. The *Stop* button will change back to *Start* when done. The *Enforce Fairness Reporting* window will have pie charts giving you time slice views of transmission percentage per station.
 - 1. See clear transmission inequity at the start:





2. See resulting equity in the final iteration:



3. The bottom of the report charts the overall transmission rates for each iteration: