

llss, a Hardware Address Based MTD for Ad-Hoc Wireless Networking

In other words: you can't hit me, I'm moving too fast

Wireless security is difficult

- Wireless is broadcast by definition
 - Packets are easily sniffable
- Many networking protocols are even easier to attack over wireless
- Systems are often security-second (or no security...)
- ARP
 - Insecure
 - Abusable

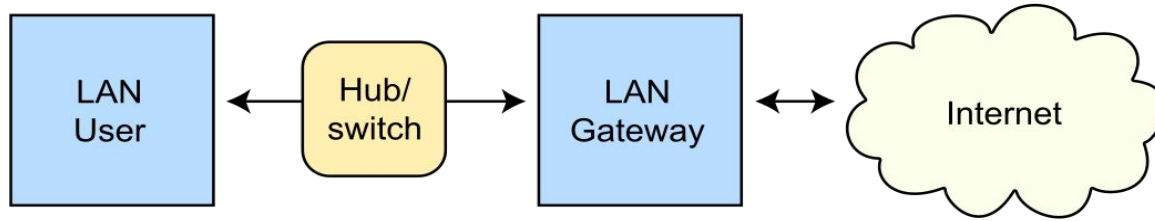


Problem statement

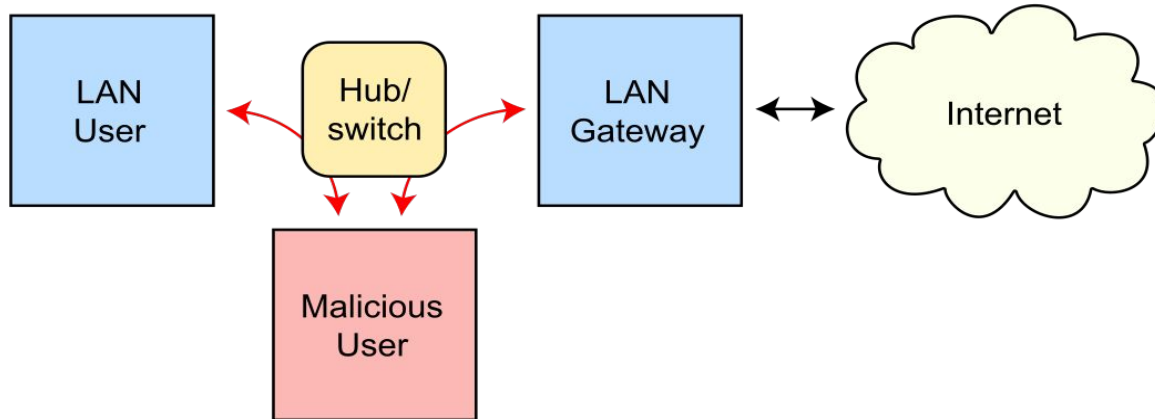
- ARP is inherently insecure
 - First Come First Serve
 - Requests are broadcast
 - In a wireless setting, this is **BAD**
- ARP cache poisoning
 - Very bad
 - Helps establish a MITM (Man In The Middle) for adversaries
- MITM
 - A malicious host places itself in between two legitimate hosts
 - The ultimate goal of a network attack



Routing under normal operation



Routing subject to ARP cache poisoning



llss, basic description

- llss is a hardware address based MTD
 - Hardware Address = MAC address
- MTD
 - Moving Target Defense
 - Moves an attackers target, thus making it harder to attack.
- What does this mean?
 - **llss is a MAC address shuffling tool taken to the extreme.**
- UDP Transport mechanism



MAC Address Shuffling?

- Hardware address shuffling is an under researched field
 - Apple and Microsoft currently have pseudo implementations
 - At session layer, or when connecting to a network initially
- llss
 - Shuffling takes place at the packet layer
 - Every. Single. Packet. is sent to a new MAC address



The Setup

1. Raspberry Pi 4-8GB (Sender)
2. Raspberry Pi 4-4GB (Receiver)
3. Raspberry Pi 3 (Adversary)
4. 8 Port Ethernet Switch (control)
5. 3 Port HDMI Switch (if failure)
6. 2 Port HDMI Switch (to/from PC)
7. 4in2out USB switch (Pi control)
8. Keyboard to control Pi's
9. Mouse to Control Pi's
10. My super cool keyboard I got as a birthday gift from my girlfriend
11. Logitech G502 Mouse (The best mouse no contest).
12. Cup
13. Hand Sanitizer (stay safe)
14. lofi (stay sane)

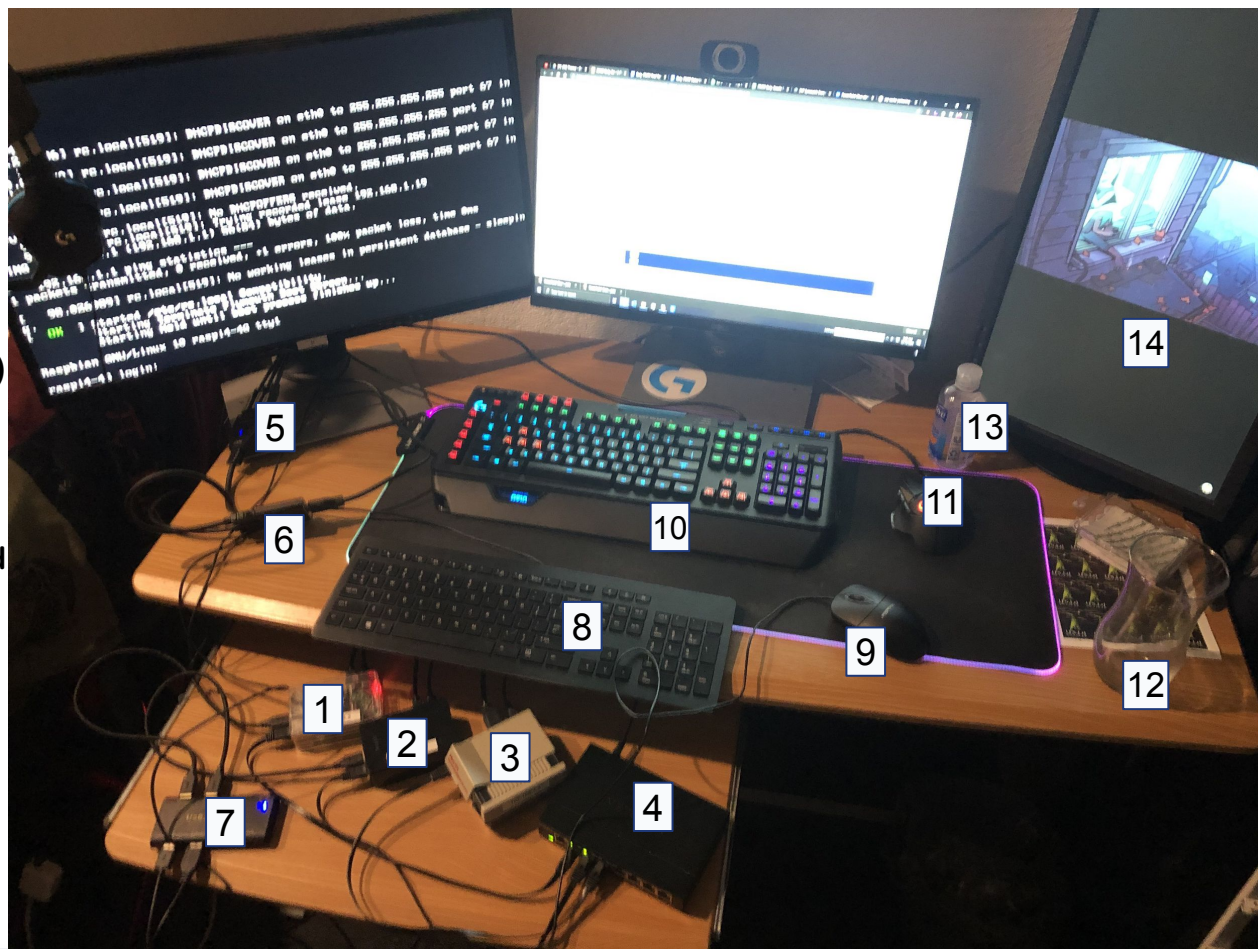
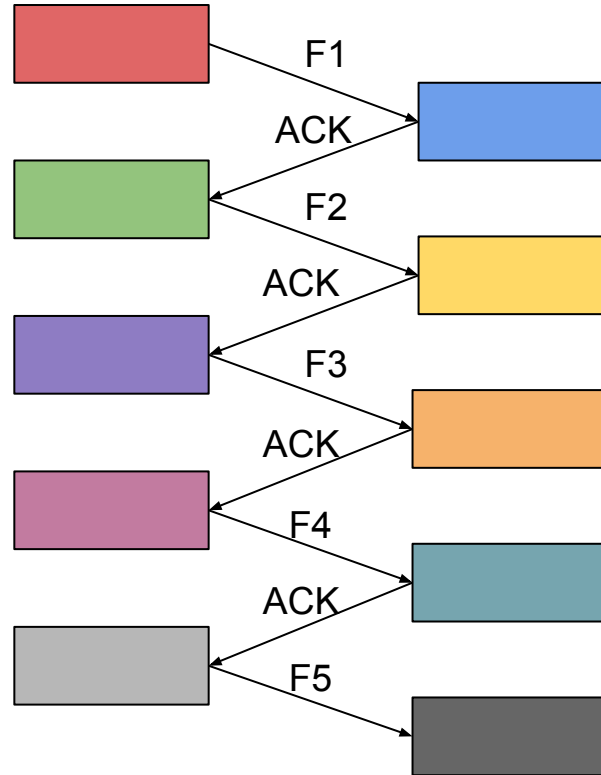


Figure 4 - Frame > Advance > Ack > Advance



llss features

- MAC address shuffling every packet!
- AES-256 Bit Encryption
- File Transfer
- Considerable user agency (lots of options)
- A fully functioning Wizard!
- ~1500 Lines of code
 - Line count doesn't really matter, it's just a fun statistic.



Demonstration

id	name	gender	age	height	weight	blood pressure	cholesterol	glucose
1	JOHN DOE	M	35	175	70	120/80	200	100
2	JANE SMITH	F	28	160	55	110/70	180	90
3	BOB JONES	M	42	180	85	130/90	220	110
4	ALICE BROWN	F	31	165	60	115/75	190	95
5	CHARLIE GREEN	M	25	170	65	125/80	210	105
6	DIANA WHITE	F	38	155	50	105/65	170	85
7	EDWARD BLACK	M	45	185	90	135/95	230	115
8	FLORENCE GRAY	F	29	162	58	112/72	185	92
9	GEORGE HARRIS	M	33	172	68	122/82	205	102
10	HENRIETTA KING	F	36	158	52	108/68	175	88
11	IRVING LEE	M	41	178	75	128/85	215	108
12	JESSICA MORGAN	F	27	163	56	113/73	188	93
13	KENNETH PERKINS	M	39	174	72	124/84	208	104
14	LUCAS ROBERTS	M	26	168	62	120/78	202	106
15	MARIA STEVENSON	F	34	159	53	109/69	178	89
16	NATHAN TAYLOR	M	43	182	88	132/92	225	112
17	OLIVIA WALLACE	F	30	161	57	111/71	182	91
18	PETER YOUNG	M	37	171	69	121/81	207	103
19	QUINN ZIMMERMAN	F	29	164	59	114/74	192	94
20	RICHARD ADAMS	M	44	184	92	134/96	235	118
21	SARAH BAKER	F	28	160	55	110/70	180	90
22	THOMAS CLARK	M	32	173	71	123/83	209	105
23	URSULA EVANS	F	35	157	51	107/67	172	87
24	VICTOR FOSTER	M	40	176	73	126/86	212	107
25	WENDY GIBSON	F	31	166	61	116/76	195	96
26	Xavier Hall	M	27	169	63	119/79	201	101
27	Yvonne King	F	33	156	50	106/66	170	86
28	Zoe Lee	F	26	167	64	120/80	203	103
29	Adam Miller	M	36	170	67	122/82	206	106
30	Bella Moore	F	29	162	58	112/72	185	92
31	Charlie Nelson	M	42	180	85	130/90	220	110
32	Diana Ortiz	F	31	165	60	115/75	190	95
33	Edward Parker	M	25	170	65	125/80	210	105
34	Fiona Quinn	F	38	155	50	105/65	170	85
35	George Reed	M	45	185	90	135/95	230	115
36	Helen Scott	F	29	162	58	112/72	185	92
37	Ivan Taylor	M	33	172	68	122/82	205	102
38	Jessica Vance	F	27	163	56	113/73	188	93
39	Kenneth Ward	M	39	174	72	124/84	208	104
40	Laura White	F	26	168	62	120/78	202	106
41	Max Wilson	M	43	182	88	132/92	225	112
42	Nancy Young	F	30	161	57	111/71	182	91
43	Oscar Ziegler	M	37	171	69	121/81	207	103
44	Pamela Adams	F	29	164	59	114/74	192	94
45	Quinn Baker	F	28	160	55	110/70	180	90
46	Rachel Clark	F	32	173	71	123/83	209	105
47	Samuel Evans	M	35	175	74	125/85	211	107
48	Tina Foster	F	31	166	61	116/76	195	96
49	Umar Gibson	M	27	169	63	119/79	201	101
50	Vivian Hall	F	33	156	50	106/66	170	86
51	Walter King	M	40	176	73	126/86	212	107
52	Xenia Lee	F	31	166	61	116/76	195	96
53	Yakov Miller	M	27	169	63	119/79	201	101
54	Zoe Moore	F	33	156	50	106/66	170	86
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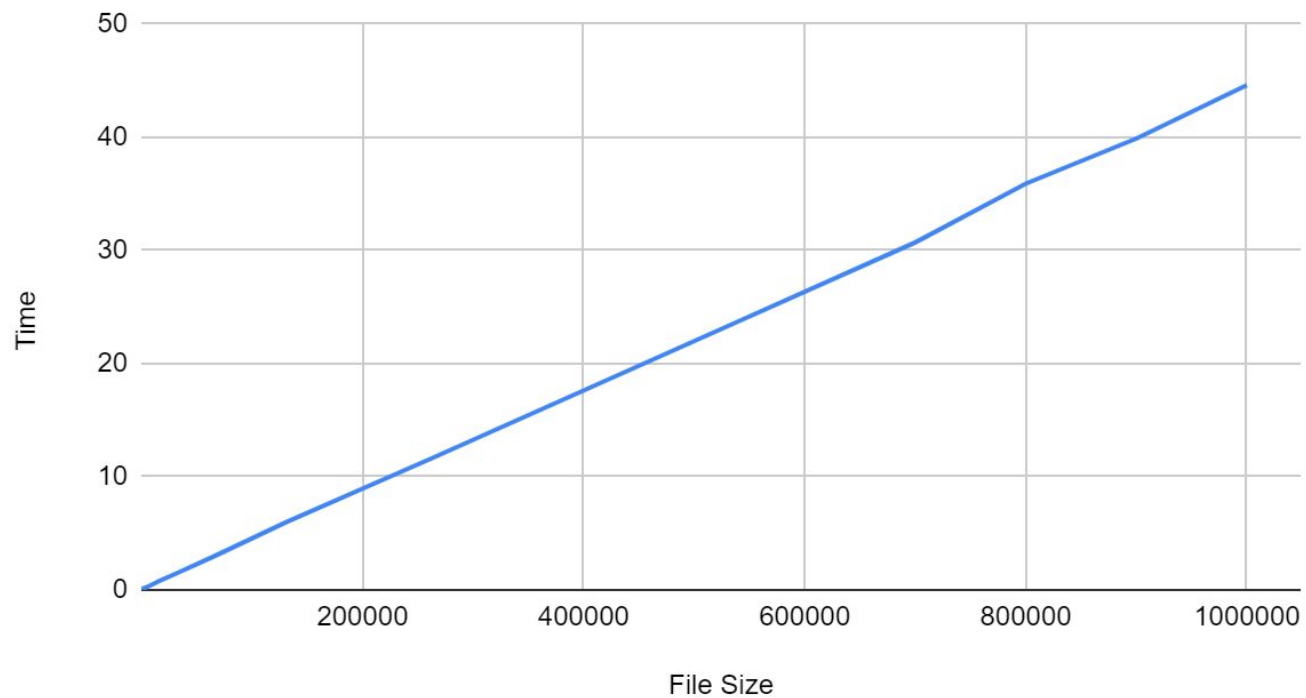


Results

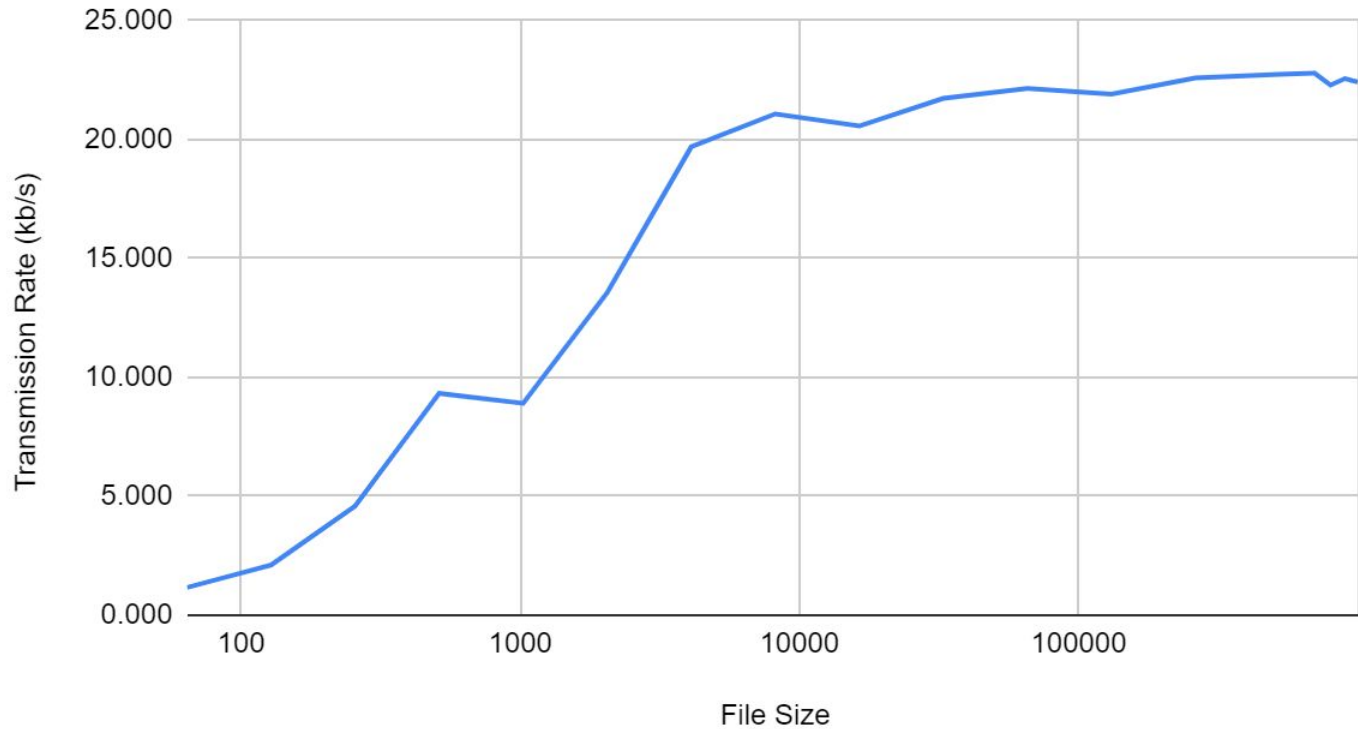
- Success?
 - Yes! Packets could be sent and decrypted!
- Files could be successfully transmitted up to 1MB
- At 1MB, strange socket issues arose
 - Closing and opening rapidly?
- Sniffable
 - Not as easily!
- MITM-Able
 - Very difficult!
 - No ARP Messages!
- Metrics
 - Maximum single-packet bandwidth = 27.37kb/s
 - Maximum no-limits bandwidth = 84.24kb/s
 - Slow, but good enough for text files.



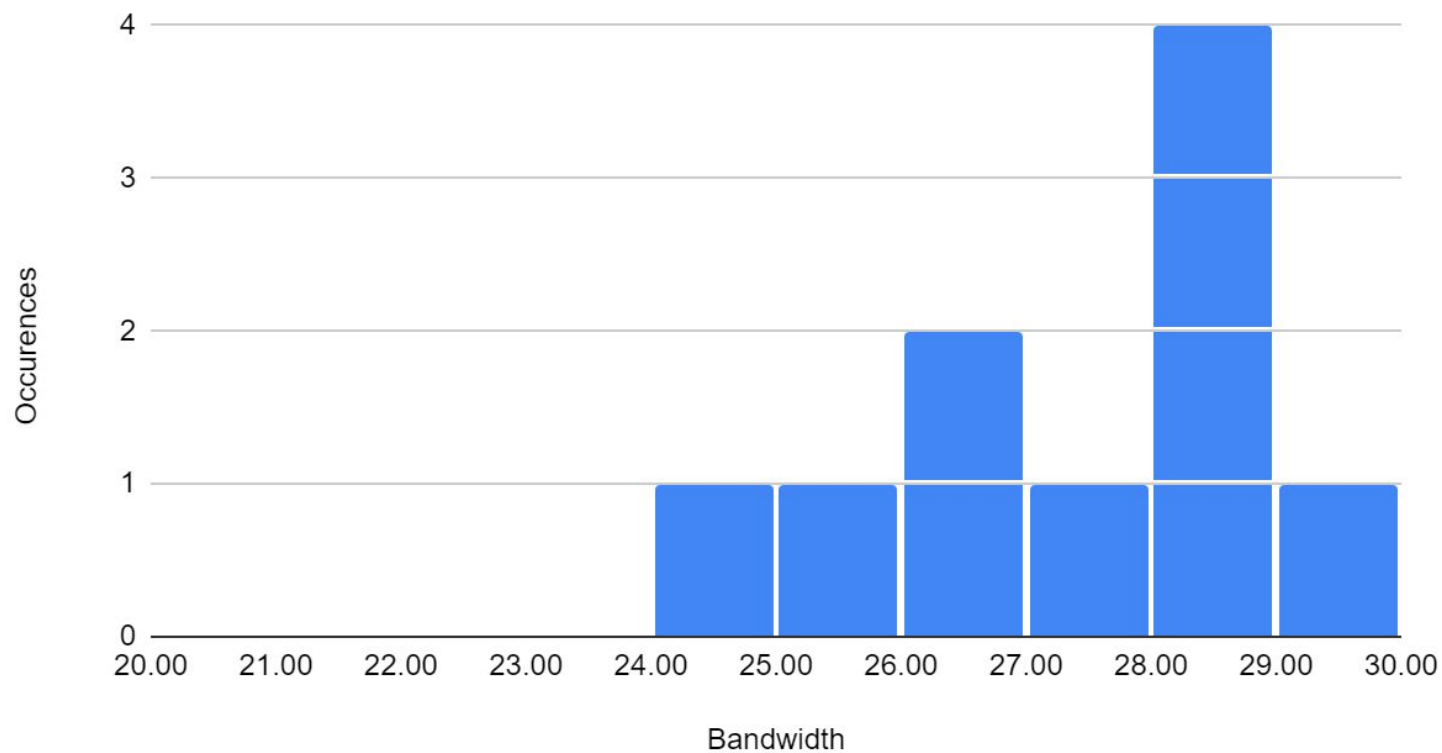
Time vs. File Size



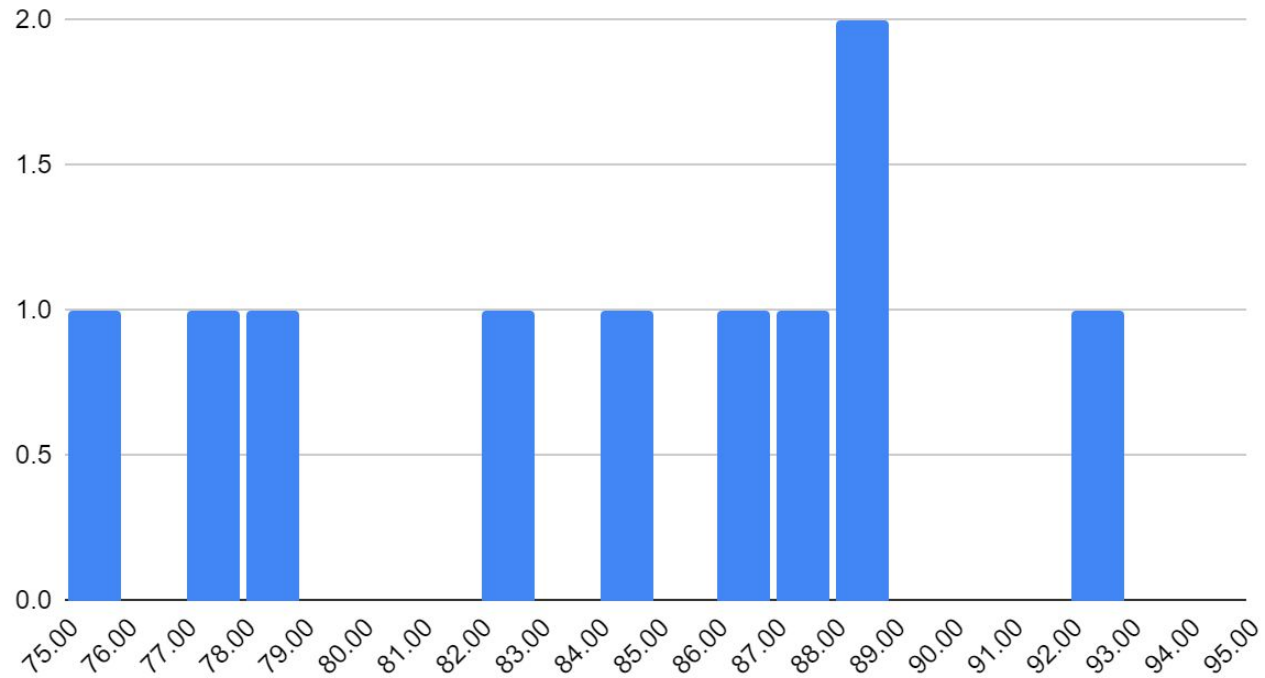
Transmission Rate (kb/s) vs. File Size



Bandwidth (KBps) Occurences



Maximized Bandwidth (IPv4 Fragmentation)



Learning Opportunities

- Do not be a victim of hubris
- Other people know how to help you
- Workflow optimisation is an absolute godsend
- Networking becomes more difficult as you interface with lower layers
- Never roll your own crypto
- Never write your own crypto methods



Conclusion

- MAC address based Moving Target Defense is possible, and practical for small amounts of data.
- Further optimizations could increase the practicality of llss
 - Reliability
 - Timing optimization
 - Kernel optimization



Further information

Please visit

[llss.page](#)

