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802.11ac

Real life test by Martin Krug

Why and How

- When new technology arrives in to the market mostly We are curious how it will work and there are few questions
- Will it work in high interference environment
- Will it be worth the to replace (effort / cost)
- Deployment cost and antenna upgrade or ...
- We usually first try to search on Internet for a experience info from others

The best solution to answer all questions, is to test it.

The

MYTHBUSTERS

WAY

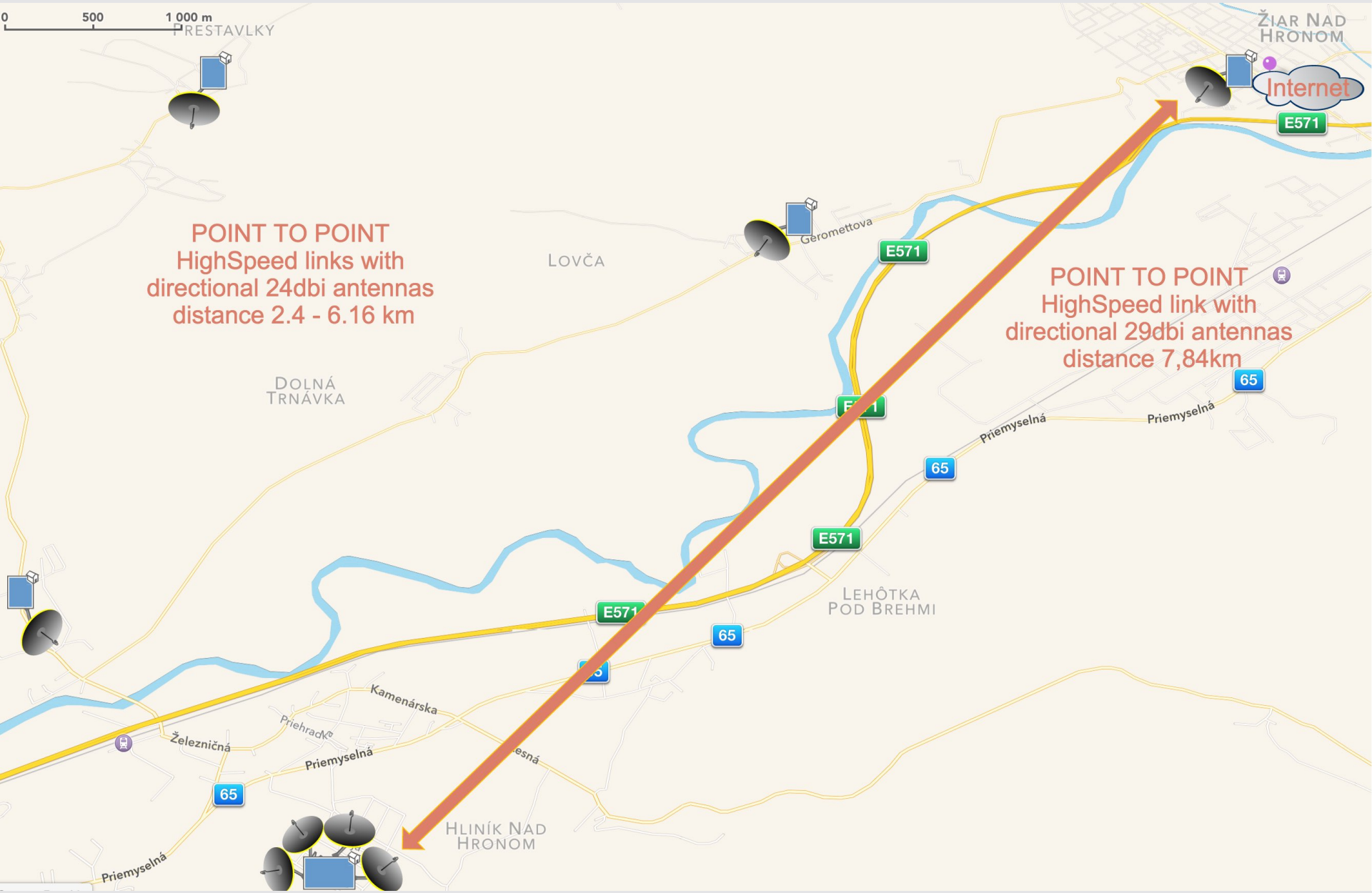
TEST HW
IN REAL
TO GAIN

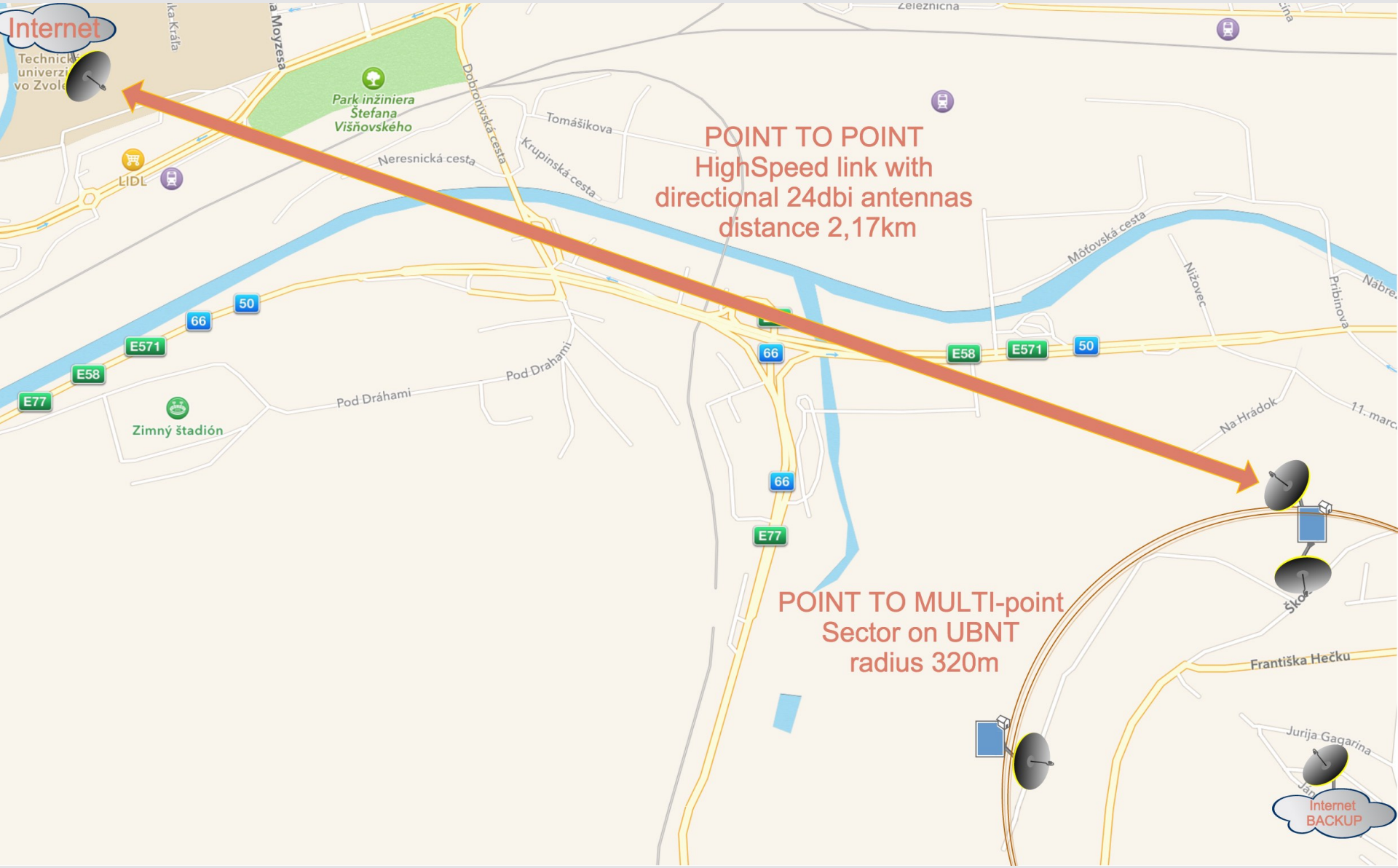
Testing environment

- To make test really comprehensive I do have 3 different scenarios :
  - PTP - LONG Distance - 8km
  - PTP - Medium Distance -2,5km
  - PTMP – Short distance - 300m

- I will test it first on older technology and then exchange for a 802.11ac

- The previous setup was not really old
- All direct links build on the
  - MikroTik RB911G-5HPnD
  - Point to Multipoint on the UBNT M5


MikroTik.cool
0
500
1 000 m
PRESTAVLKY
ŽIAR NAD HRONOM
Internet
E571
POINT TO POINT
HighSpeed links with
directional 24dbi antennas
distance 2.4 - 6.16 km
LOVČA
Geromettova
POINT TO POINT
HighSpeed link with
directional 29dbi antennas
distance 7,84km
DOLNÁ TRNÁVKA
65
Priemyselná
LEHÔTKA POD BREHMI
Kamenárska
Priehrad
Železničná
HLINÍK NAD HRONOM


Internet
POINT TO POINT
HighSpeed link with
directional 24dbi antennas
distance 2,17km
POINT TO MULTI-point
Sector on UBNT
radius 320m
Internet
BACKUP
Park inžiniera
Štefana
Višňovského
Zimný štadión
LIDL
Neresnická cesta
Dobronivská cesta
Tomášikova
Krupinská cesta
Pod Dráhami
Pod Drahami
Môťovská cesta
Nižovec
Pribinova
Na Hrádok
Františka Hečku
Jurija Gagarina
E77
E58
E571
66
50

- Testing procedure is based on comparing previous and new 802.11ac technology
- First I did frequency scan –Spectral Scan to identify concurrent sites and links – marked red on map.
- And on spectral scan you can see that it is a quite problem to find a free space for a 80MHz full 802.11ac implementation

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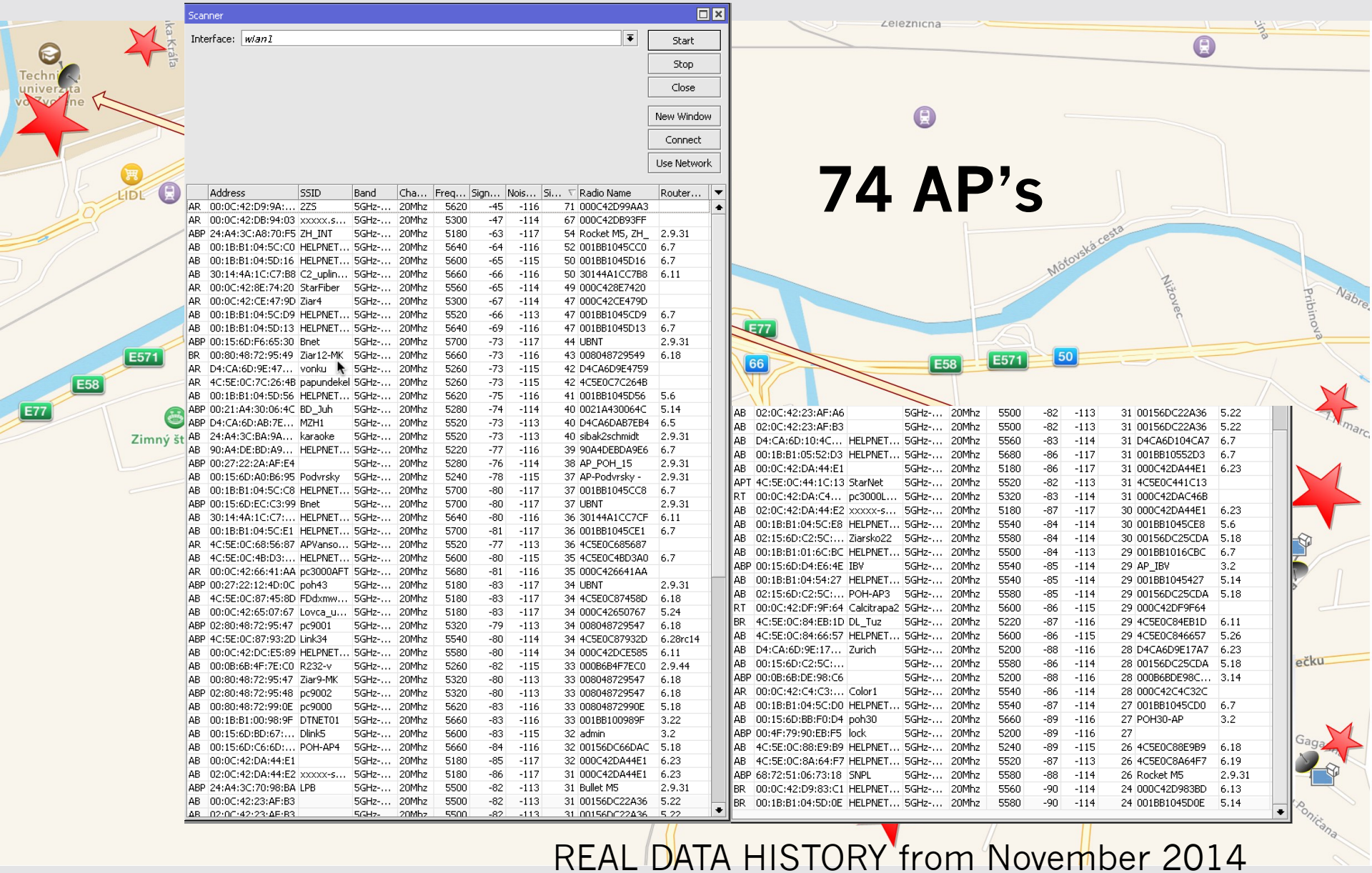
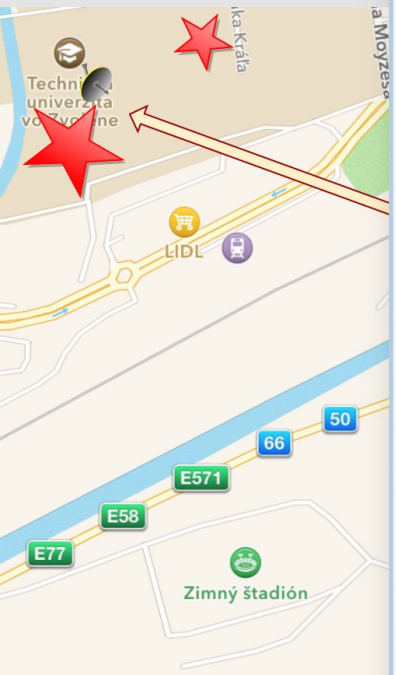
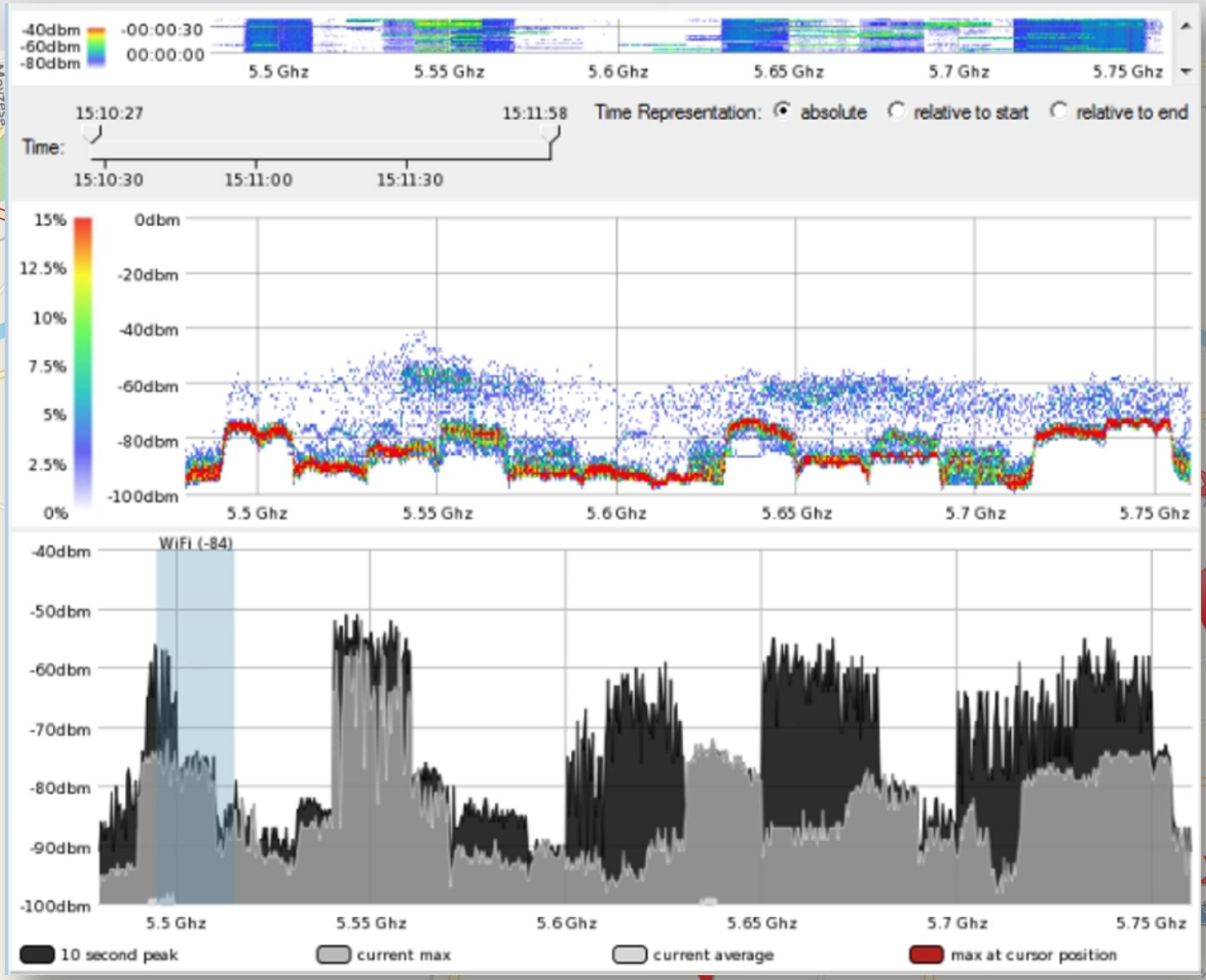


	Address	SSID	Band	Cha...	Freq...	Sign...	Nois...	Si...	Radio Name	Router...
AR	00:0C:42:D9:9A:...	2ZS	5GHz-...	20Mhz	5620	-45	-116	71	000C42D99AA3	
AR	00:0C:42:DB:94:03	xxxxx.s...	5GHz-...	20Mhz	5300	-47	-114	67	000C42DB93FF	
ABP	24:A4:3C:A8:70:F5	ZH_INT	5GHz-...	20Mhz	5180	-63	-117	54	Rocket M5, ZH_	2.9.31
AB	00:1B:B1:04:5C:C0	HELPNET...	5GHz-...	20Mhz	5640	-64	-116	52	001BB1045CC0	6.7
AB	00:1B:B1:04:5D:16	HELPNET...	5GHz-...	20Mhz	5600	-65	-115	50	001BB1045D16	6.7
AB	30:14:4A:1C:C7:B8	C2_uplin...	5GHz-...	20Mhz	5660	-66	-116	50	30144A1CC7B8	6.11
AR	00:0C:42:8E:74:20	StarFiber	5GHz-...	20Mhz	5560	-65	-114	49	000C428E7420	
AR	00:0C:42:CE:47:9D	Ziar4	5GHz-...	20Mhz	5300	-67	-114	47	000C42CE479D	
AB	00:1B:B1:04:5C:D9	HELPNET...	5GHz-...	20Mhz	5520	-66	-113	47	001BB1045CD9	6.7
AB	00:1B:B1:04:5D:13	HELPNET...	5GHz-...	20Mhz	5640	-69	-116	47	001BB1045D13	6.7
ABP	00:15:6D:F6:65:30	Bnet	5GHz-...	20Mhz	5700	-73	-117	44	UBNT	2.9.31
BR	00:80:48:72:95:49	Ziar12-MK	5GHz-...	20Mhz	5660	-73	-116	43	008048729549	6.18
AR	D4:CA:6D:9E:47:...	vonku	5GHz-...	20Mhz	5260	-73	-115	42	D4CA6D9E4759	
AR	4C:5E:0C:7C:26:4B	papundekel	5GHz-...	20Mhz	5260	-73	-115	42	4C5E0C7C264B	
AB	00:1B:B1:04:5D:56	HELPNET...	5GHz-...	20Mhz	5620	-75	-116	41	001BB1045D56	5.6
ABP	00:21:A4:30:06:4C	BD_Juh	5GHz-...	20Mhz	5280	-74	-114	40	0021A430064C	5.14
ABP	D4:CA:6D:AB:7E:...	MZH1	5GHz-...	20Mhz	5520	-73	-113	40	D4CA6DAB7EB4	6.5
AB	24:A4:3C:BA:9A:...	karaoke	5GHz-...	20Mhz	5520	-73	-113	40	sibak2schmidt	2.9.31
AB	90:A4:DE:BD:A9:...	HELPNET...	5GHz-...	20Mhz	5220	-77	-116	39	90A4DEBDA9E6	6.7
ABP	00:27:22:2A:AF:E4		5GHz-...	20Mhz	5280	-76	-114	38	AP_POH_15	2.9.31
AB	00:15:6D:A0:B6:95	Podvrsky	5GHz-...	20Mhz	5240	-78	-115	37	AP-Podvrsky -	2.9.31
AB	00:1B:B1:04:5C:C8	HELPNET...	5GHz-...	20Mhz	5700	-80	-117	37	001BB1045CC8	6.7
ABP	00:15:6D:EC:C3:99	Bnet	5GHz-...	20Mhz	5700	-80	-117	37	UBNT	2.9.31
AB	30:14:4A:1C:C7:...	HELPNET...	5GHz-...	20Mhz	5640	-80	-116	36	30144A1CC7CF	6.11
AB	00:1B:B1:04:5C:E1	HELPNET...	5GHz-...	20Mhz	5700	-81	-117	36	001BB1045CE1	6.7
AR	4C:5E:0C:68:56:87	APVanso...	5GHz-...	20Mhz	5520	-77	-113	36	4C5E0C685687	
AB	4C:5E:0C:4B:D3:...	HELPNET...	5GHz-...	20Mhz	5600	-80	-115	35	4C5E0C4BD3A0	6.7
AR	00:0C:42:66:41:AA	pc3000AFT	5GHz-...	20Mhz	5680	-81	-116	35	000C426641AA	
ABP	00:27:22:12:4D:0C	poh43	5GHz-...	20Mhz	5180	-83	-117	34	UBNT	2.9.31
AB	4C:5E:0C:87:45:8D	FDdxmw...	5GHz-...	20Mhz	5180	-83	-117	34	4C5E0C87458D	6.18
AB	00:0C:42:65:07:67	Lovca_u...	5GHz-...	20Mhz	5180	-83	-117	34	000C42650767	5.24
ABP	02:80:48:72:95:47	pc9001	5GHz-...	20Mhz	5320	-79	-113	34	008048729547	6.18
ABP	4C:5E:0C:87:93:2D	Link34	5GHz-...	20Mhz	5540	-80	-114	34	4C5E0C87932D	6.28rc14
AB	00:0C:42:DC:E5:89	HELPNET...	5GHz-...	20Mhz	5580	-80	-114	34	000C42DCE585	6.11
AB	00:0B:6B:4F:7E:C0	R232-v	5GHz-...	20Mhz	5260	-82	-115	33	000B6B4F7EC0	2.9.44
AB	00:80:48:72:95:47	Ziar9-MK	5GHz-...	20Mhz	5320	-80	-113	33	008048729547	6.18
ABP	02:80:48:72:95:48	pc9002	5GHz-...	20Mhz	5320	-80	-113	33	008048729547	6.18
AB	00:80:48:72:99:0E	pc9000	5GHz-...	20Mhz	5620	-83	-116	33	00804872990E	5.18
AB	00:1B:B1:00:98:9F	DTNET01	5GHz-...	20Mhz	5660	-83	-116	33	001BB100989F	3.22
AB	00:15:6D:BD:67:...	Dlink5	5GHz-...	20Mhz	5600	-83	-115	32	admin	3.2
AB	00:15:6D:C6:6D:...	POH-AP4	5GHz-...	20Mhz	5660	-84	-116	32	00156DC66DAC	5.18
AB	00:0C:42:DA:44:E1		5GHz-...	20Mhz	5180	-85	-117	32	000C42DA44E1	6.23
AB	02:0C:42:DA:44:E2	xxxxx-s...	5GHz-...	20Mhz	5180	-86	-117	31	000C42DA44E1	6.23
ABP	24:A4:3C:70:98:BA	LPB	5GHz-...	20Mhz	5500	-82	-113	31	Bullet M5	2.9.31
AB	00:0C:42:23:AF:B3		5GHz-...	20Mhz	5500	-82	-113	31	00156DC22A36	5.22
AB	02:0C:42:23:AF:A6		5GHz-...	20Mhz	5500	-82	-113	31	00156DC22A36	5.22
AB	02:0C:42:23:AF:B3		5GHz-...	20Mhz	5500	-82	-113	31	00156DC22A36	5.22
AB	D4:CA:6D:10:4C:...	HELPNET...	5GHz-...	20Mhz	5560	-83	-114	31	D4CA6D104CA7	6.7
AB	00:1B:B1:05:52:D3	HELPNET...	5GHz-...	20Mhz	5680	-86	-117	31	001BB10552D3	6.7
AB	00:0C:42:DA:44:E1		5GHz-...	20Mhz	5180	-86	-117	31	000C42DA44E1	6.23
APT	4C:5E:0C:44:1C:13	StarNet	5GHz-...	20Mhz	5520	-82	-113	31	4C5E0C441C13	
RT	00:0C:42:DA:C4:...	pc3000L...	5GHz-...	20Mhz	5320	-83	-114	31	000C42DAC46B	
AB	02:0C:42:DA:44:E2	xxxxx-s...	5GHz-...	20Mhz	5180	-87	-117	30	000C42DA44E1	6.23
AB	00:1B:B1:04:5C:E8	HELPNET...	5GHz-...	20Mhz	5540	-84	-114	30	001BB1045CE8	5.6
AB	02:15:6D:C2:5C:...	Ziarsko22	5GHz-...	20Mhz	5580	-84	-114	30	00156DC25CDA	5.18
AB	00:1B:B1:01:6C:BC	HELPNET...	5GHz-...	20Mhz	5500	-84	-113	29	001BB1016CBC	6.7
ABP	00:15:6D:D4:E6:4E	IBV	5GHz-...	20Mhz	5540	-85	-114	29	AP_IBV	3.2
AB	00:1B:B1:04:54:27	HELPNET...	5GHz-...	20Mhz	5540	-85	-114	29	001BB1045427	5.14
AB	02:15:6D:C2:5C:...	POH-AP3	5GHz-...	20Mhz	5580	-85	-114	29	00156DC25CDA	5.18
RT	00:0C:42:DF:9F:64	Calcitrapa2	5GHz-...	20Mhz	5600	-86	-115	29	000C42DF9F64	
BR	4C:5E:0C:84:EB:1D	DL_Tuz	5GHz-...	20Mhz	5220	-87	-116	29	4C5E0C84EB1D	6.11
AB	4C:5E:0C:84:66:57	HELPNET...	5GHz-...	20Mhz	5600	-86	-115	29	4C5E0C846657	5.26
AB	D4:CA:6D:9E:17:...	Zurich	5GHz-...	20Mhz	5200	-88	-116	28	D4CA6D9E17A7	6.23
AB	00:15:6D:C2:5C:...		5GHz-...	20Mhz	5580	-86	-114	28	00156DC25CDA	5.18
ABP	00:0B:6B:DE:98:C6		5GHz-...	20Mhz	5200	-88	-116	28	000B6BDE98C...	3.14
AR	00:0C:42:C4:C3:...	Color1	5GHz-...	20Mhz	5540	-86	-114	28	000C42C4C32C	
AB	00:1B:B1:04:5C:D0	HELPNET...	5GHz-...	20Mhz	5540	-87	-114	27	001BB1045CD0	6.7
AB	00:15:6D:BB:F0:D4	poh30	5GHz-...	20Mhz	5660	-89	-116	27	POH30-AP	3.2
ABP	00:4F:79:90:EB:F5	lock	5GHz-...	20Mhz	5200	-89	-116	27		
AB	4C:5E:0C:88:E9:B9	HELPNET...	5GHz-...	20Mhz	5240	-89	-115	26	4C5E0C88E9B9	6.18
AB	4C:5E:0C:8A:64:F7	HELPNET...	5GHz-...	20Mhz	5520	-87	-113	26	4C5E0C8A64F7	6.19
ABP	68:72:51:06:73:18	5NPL	5GHz-...	20Mhz	5580	-88	-114	26	Rocket M5	2.9.31
BR	00:0C:42:D9:83:C1	HELPNET...	5GHz-...	20Mhz	5560	-90	-114	24	000C42D983BD	6.13
BR	00:1B:B1:04:5D:0E	HELPNET...	5GHz-...	20Mhz	5580	-90	-114	24	001BB1045D0E	5.14

REAL DATA HISTORY from November 2014





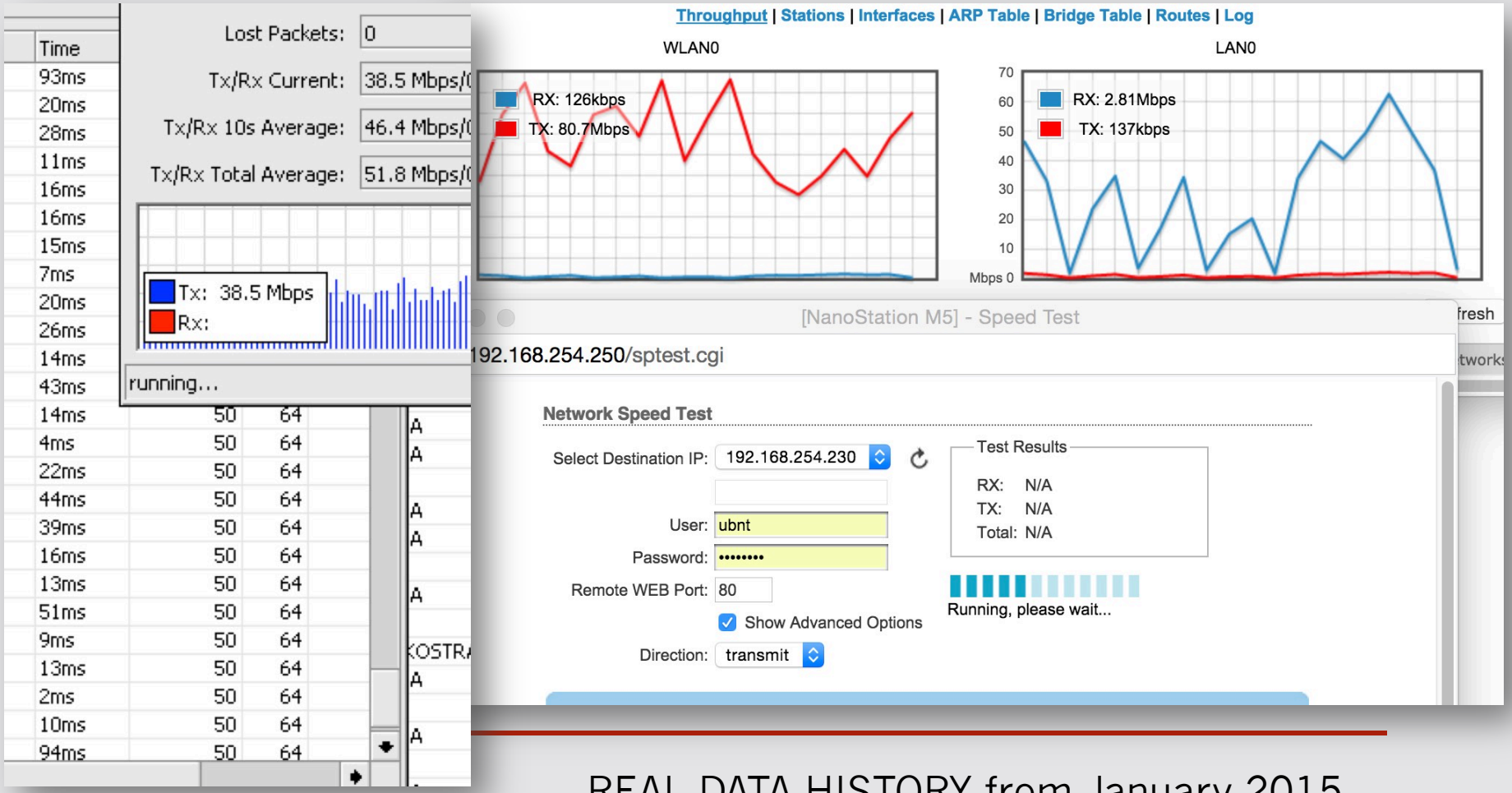
REAL DATA HISTORY from November 2014

- PtP - Trough the main link in November 2014 (802.11a with nv2) We transferred about 40-50Mbps of traffic (with approx. 50 subscribers)

- Latency:
  - With nv2 in HighLoad stable approx.. 14ms but in LowLoad is approx. the same.
  - Without nv2 better latency in MediumLoad from 1-8ms but in HighLoad up to 40ms.

REAL DATA HISTORY from November 2014

- PtMP – simultaneous speed test to booth stations reach 96Mbps – limit of the Ethernet Interface – approx. 50Mbps per client



REAL DATA HISTORY from January 2015

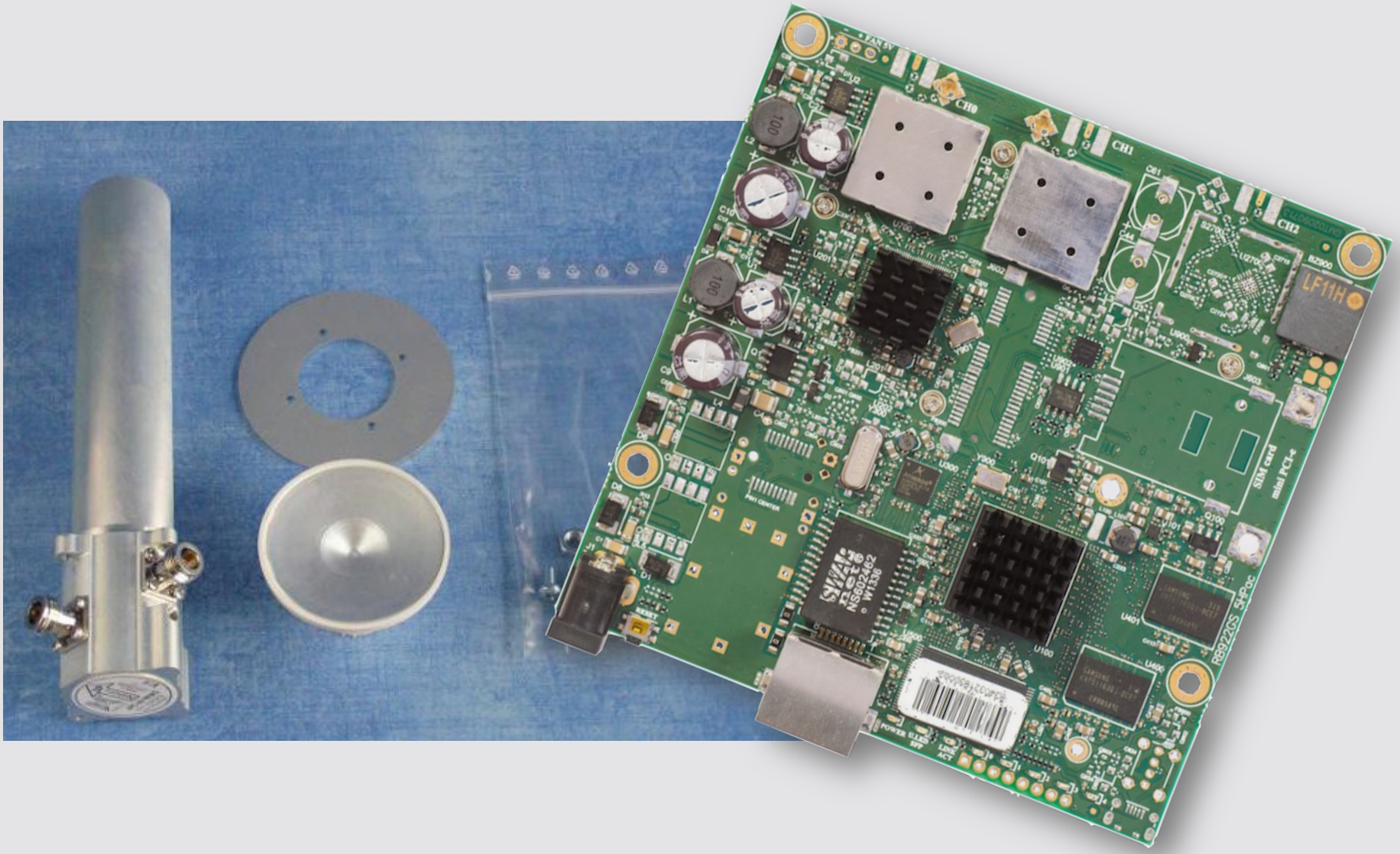
802.11ac

- In the PtP - I replaced only a RouterBoards for a RB911G-5HPacD - USE ONLY NEW PIGTAILs !

- and old Concurent devices for a RBSXTG-5HPacD
- PtMP for a Metal 5 on sector antena and SXTs

- On the old antennas I replaced only a emitter with the new MIMO version (there is kit available)

- This make the upgrade quite effective in the time of deployment and cost as well !


CH0
CH1
CH2
LF11H
SIM card
mini PCI-e
RB922GS-5HPacD

- Signal To noise and CCQ is Excelent !

Last Activity:	0.000 s
Tx/Rx Signal Strength:	-45/-46 dBm
Tx/Rx Signal Strength Ch0:	-49/-47 dBm
Tx/Rx Signal Strength Ch1:	-47/-52 dBm
Tx/Rx Signal Strength Ch2:	
Signal To Noise:	57 dB
Tx/Rx CCQ:	82/86 %
P Throughput:	

Signal Strengths

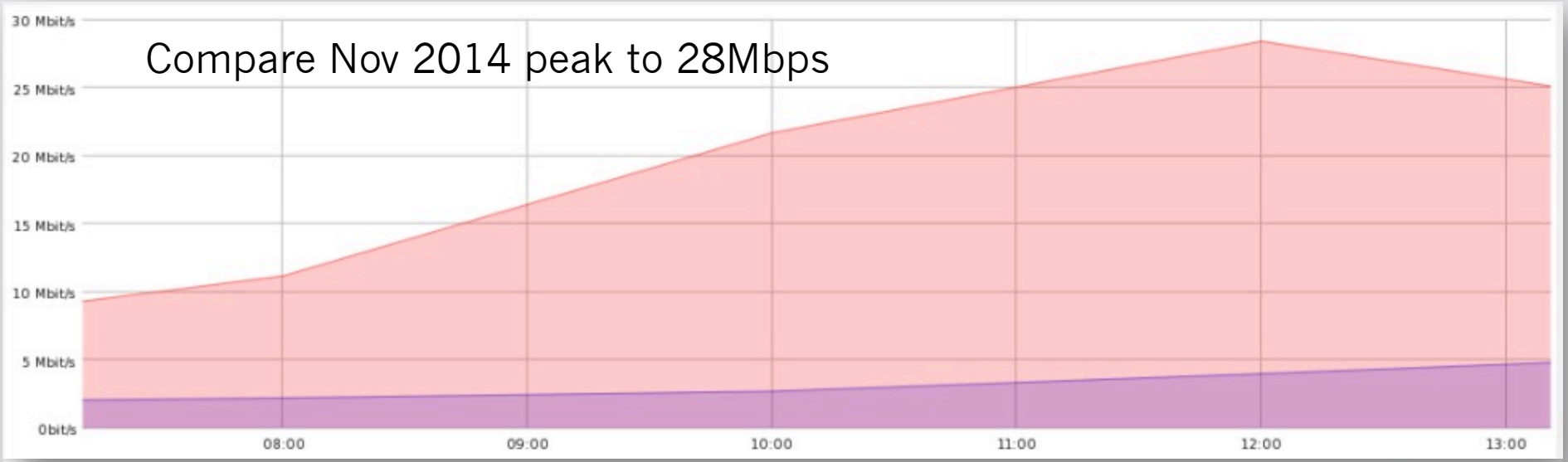
Rate	Strength	Last Measured
HT20-7	-50	00:00:00
HT20-6	-49	00:00:00
HT20-5	-49	00:00:00.13
HT20-4	-48	00:11:16.08
HT20-3	-49	06:37:31.50
HT20-2	-48	2d 03:37:33.58
HT20-1	-48	2d 03:37:33.15
HT20-0	-67	9d 11:08:03.11
54Mbps	-49	00:00:00
48Mbps	-74	2d 04:27:25.94
36Mbps	-73	2d 00:36:42.18
24Mbps	-67	3d 01:34:17.29

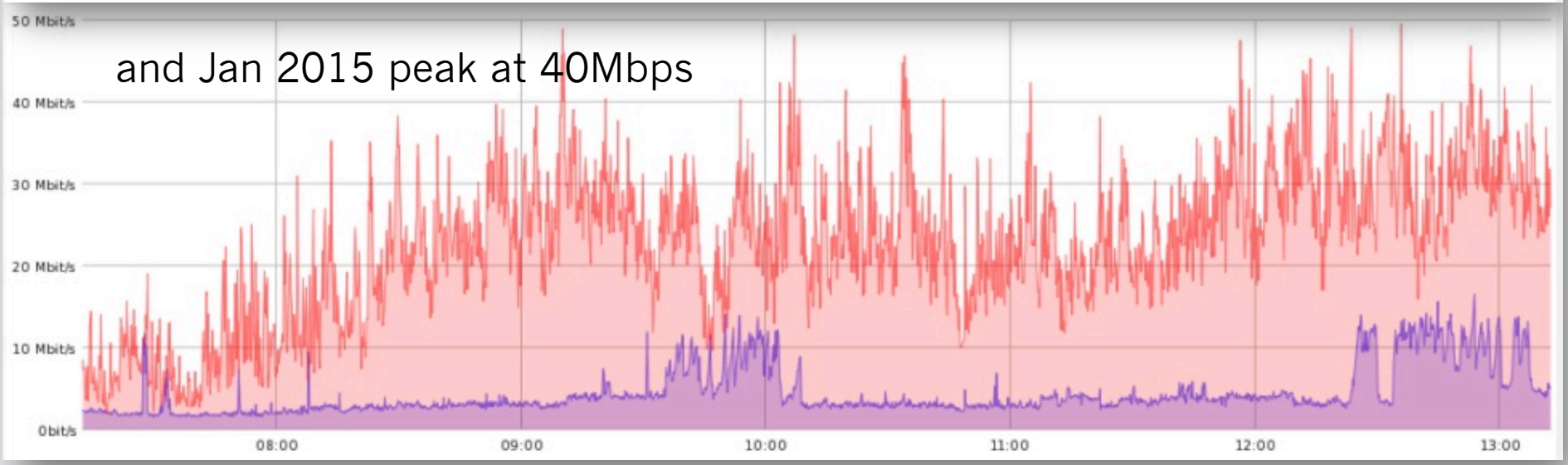
- Testing procedure is based on comparing previous and new 802.11ac technology

- Before measurements were made. I first optimized all parameters of links. And they were tested with real customer traffic so you can compare real life performance)

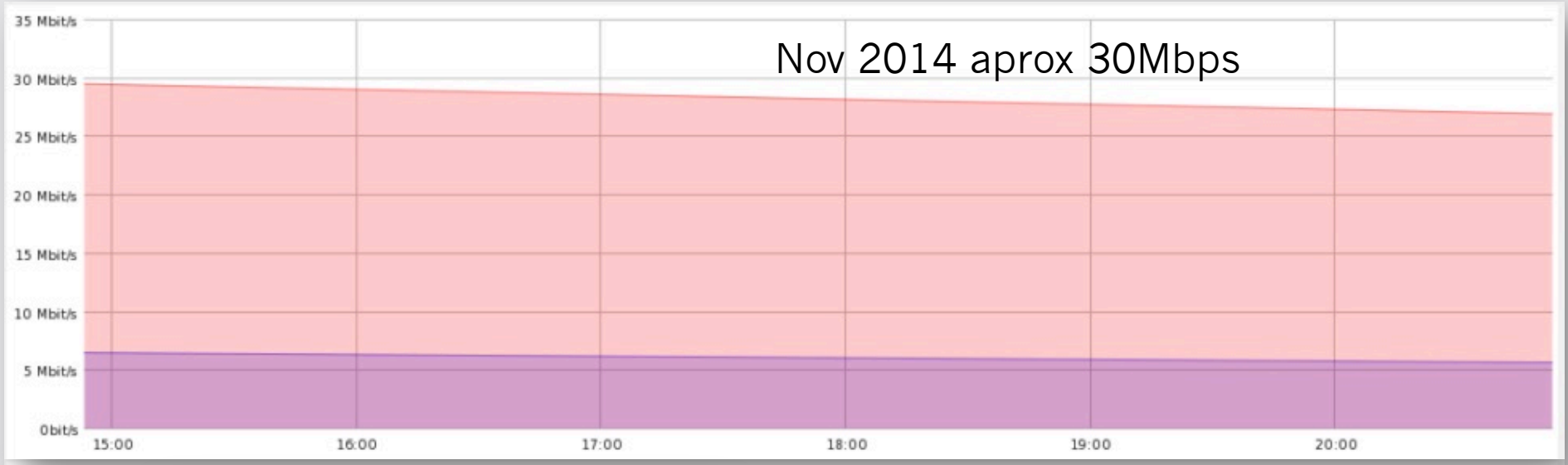
- I compared throughput and latency in LowTrafic from 6AM to 1PM
- I compared throughput and latency in HighTrafic from 2PM to 9PM
- 802.11a in Nov-Dec and 802.11ac in Jan-Feb

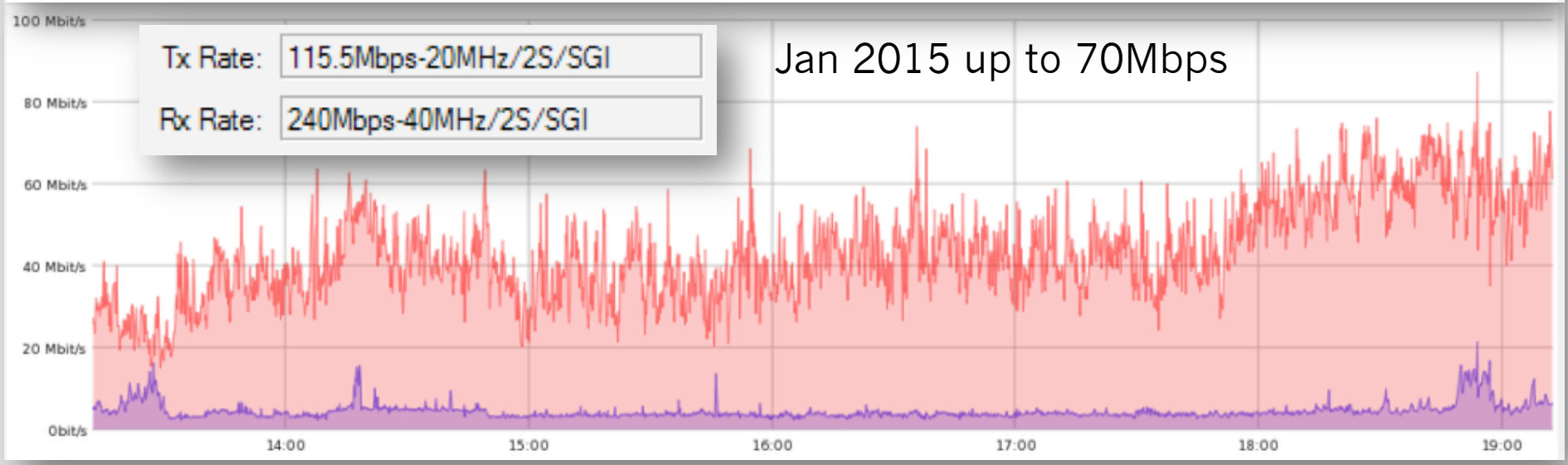
- PtP – Morning comparing – from 8:00 to 13:00



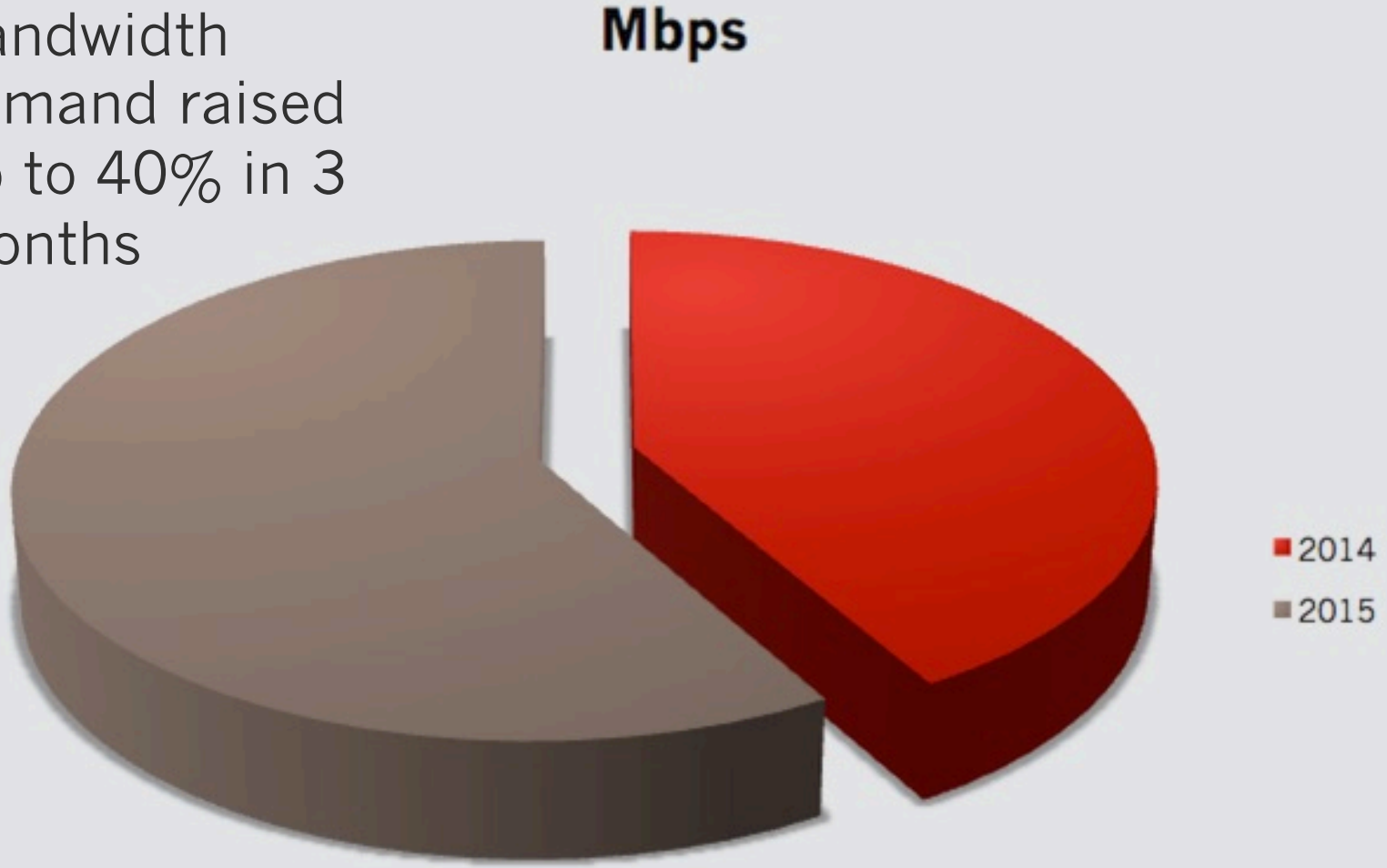


- PtP – after 1PM comparing in real network





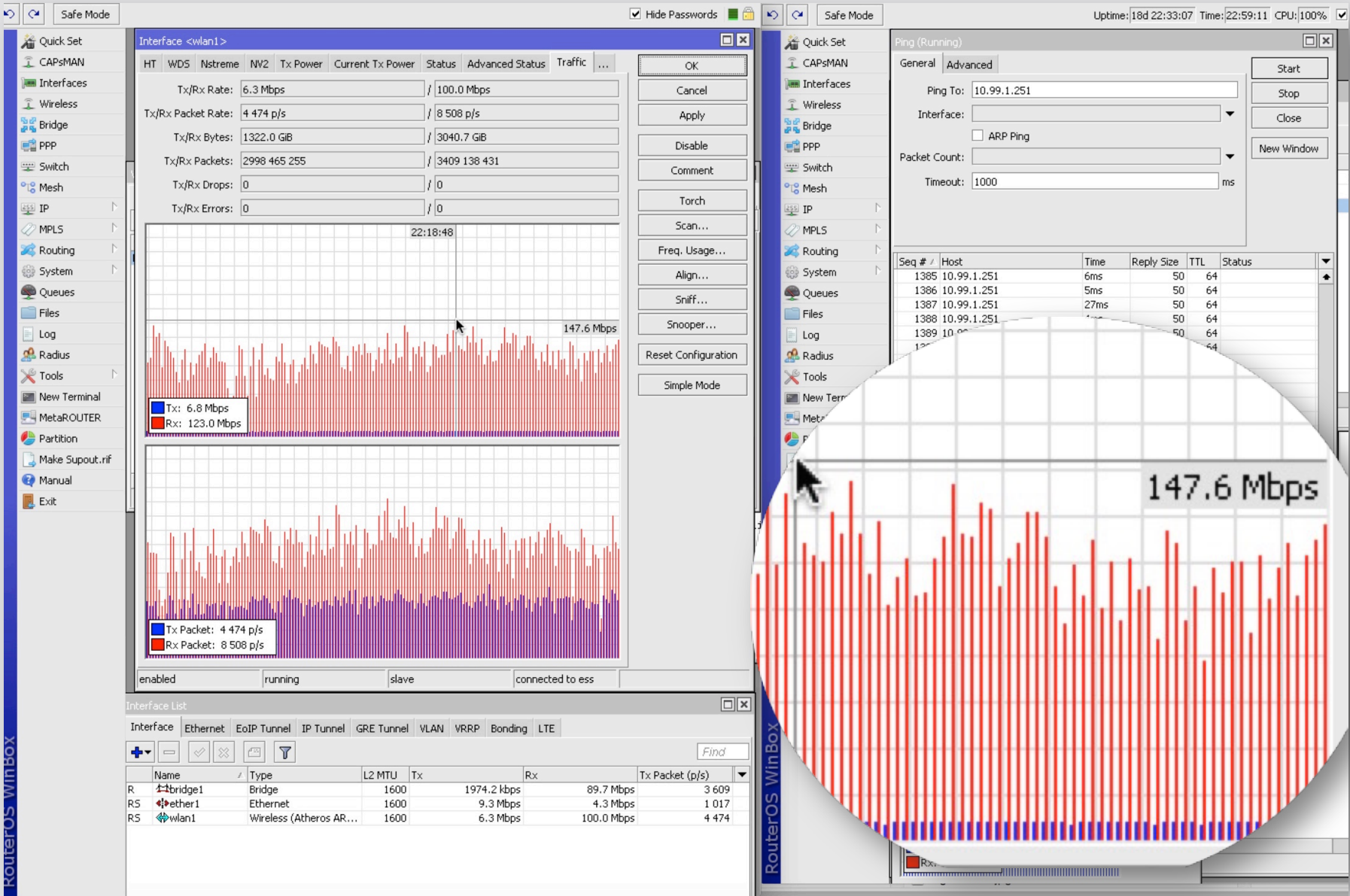
- Bandwidth demand raised up to 40% in 3 months



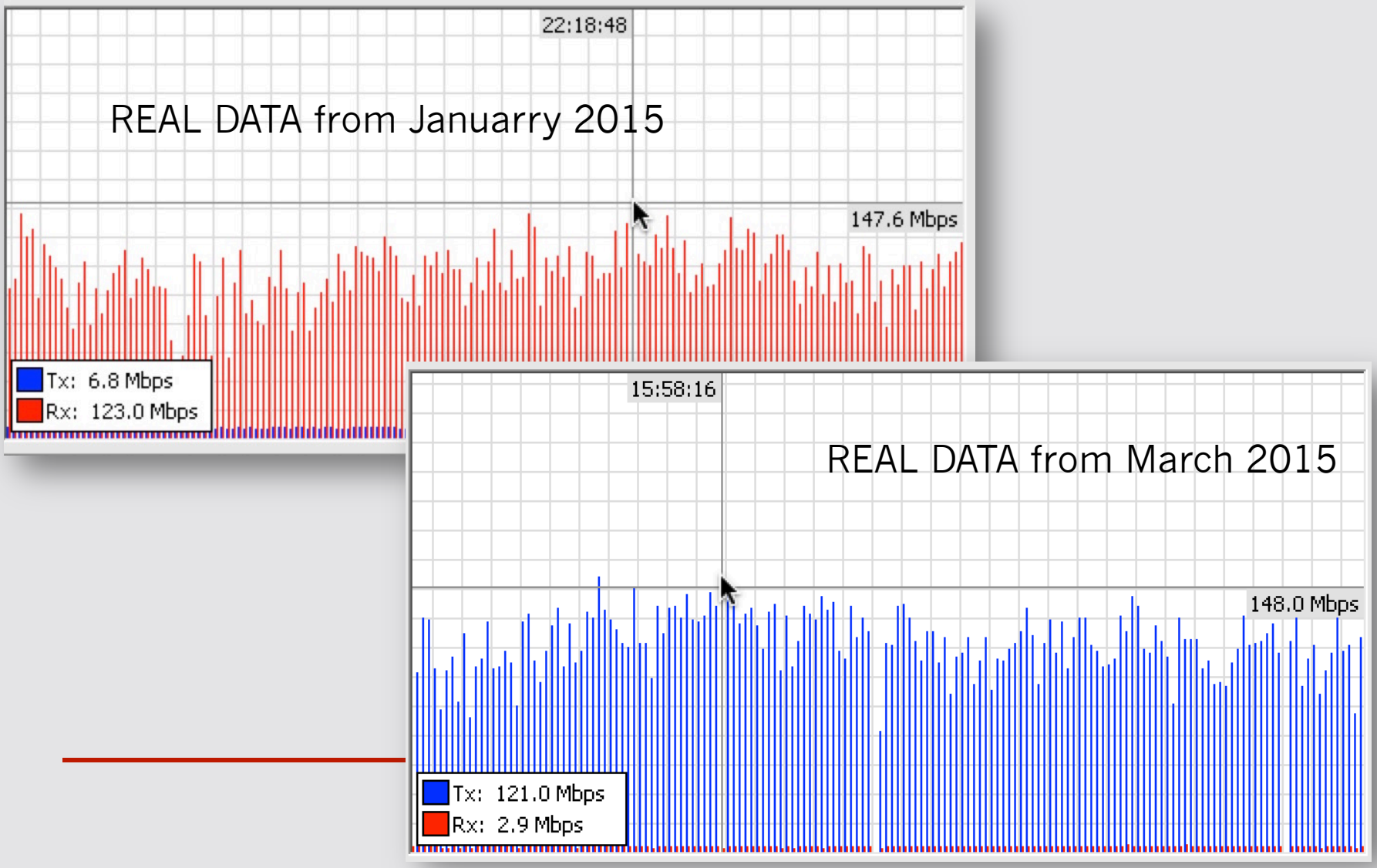
- Latency:
  - Without nv2 better latency in MediumLoad from 1-8ms but in HighLoad up to 200ms.
  - With nv2 latency even in the HighLoad (more than 120Mbps) stays stable

Seq #	Host	Time	F
478	10.10.1.20	17ms	
479	10.10.1.20	13ms	
480	10.10.1.20	19ms	
481	10.10.1.20	6ms	
482	10.10.1.20	11ms	
483	10.10.1.20	15ms	
484	10.10.1.20	3ms	
485	10.10.1.20	33ms	
486	10.10.1.20	11ms	
487	10.10.1.20	17ms	
488	10.10.1.20	4ms	
489	10.10.1.20	4ms	
490	10.10.1.20	7ms	
491	10.10.1.20	20ms	
492	10.10.1.20	6ms	
493	10.10.1.20	5ms	
494	10.10.1.20	9ms	
495	10.10.1.20	18ms	
496	10.10.1.20	42ms	
497	10.10.1.20	14ms	
498	10.10.1.20	6ms	
499	10.10.1.20	7ms	
500	10.10.1.20	26ms	
501	10.10.1.20	6ms	
502	10.10.1.20	41ms	
503	10.10.1.20	8ms	
504	10.10.1.20	8ms	
505	10.10.1.20	14ms	
506	10.10.1.20	8ms	

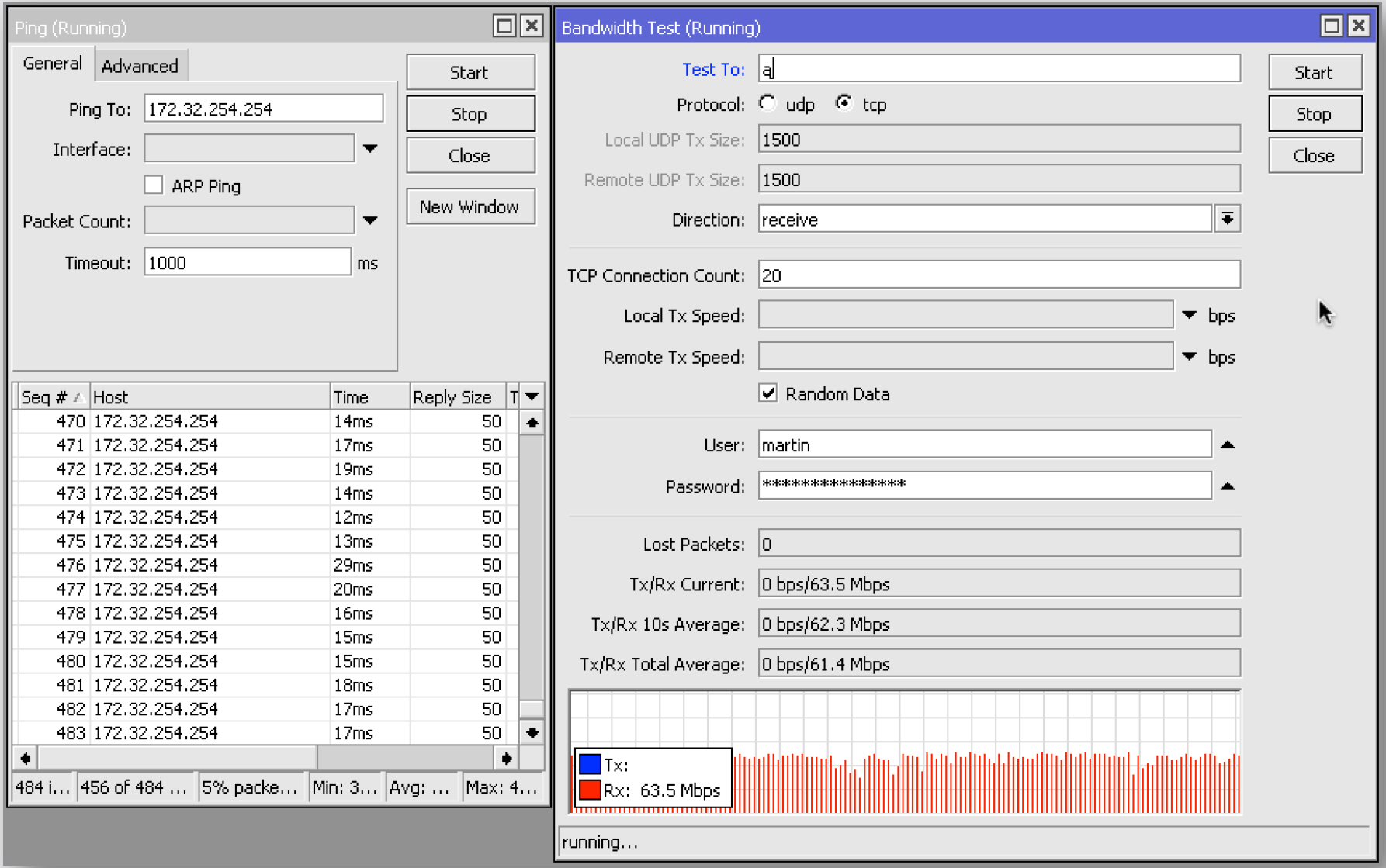
- PtP – SPEED Test with 802.11ac 8km 20MHz test



- PtP – Real trafic plus TCP Test for a 20MHz – country limitation – Stable performance over time

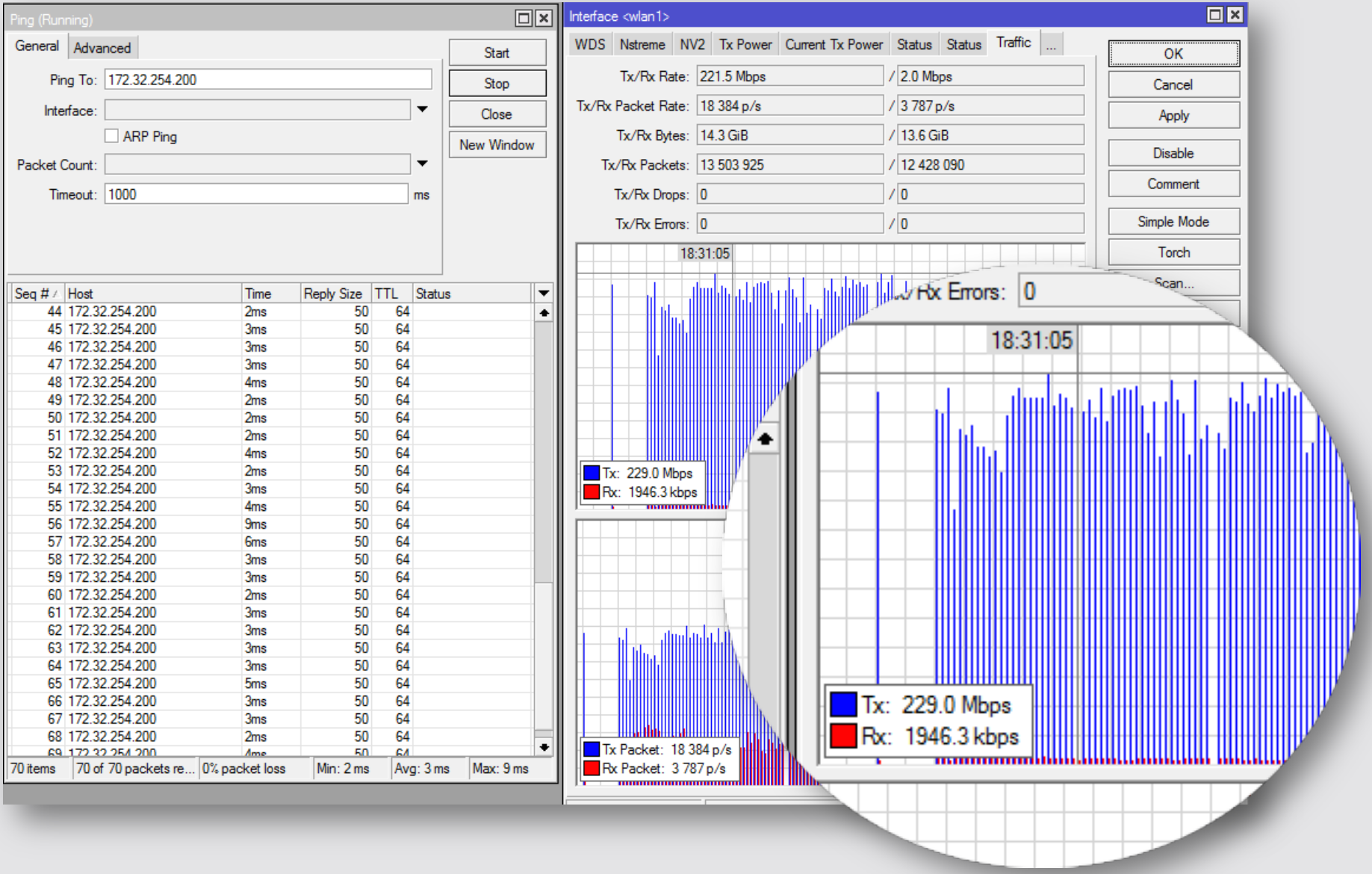


- PtMP – Old Devices - TEST

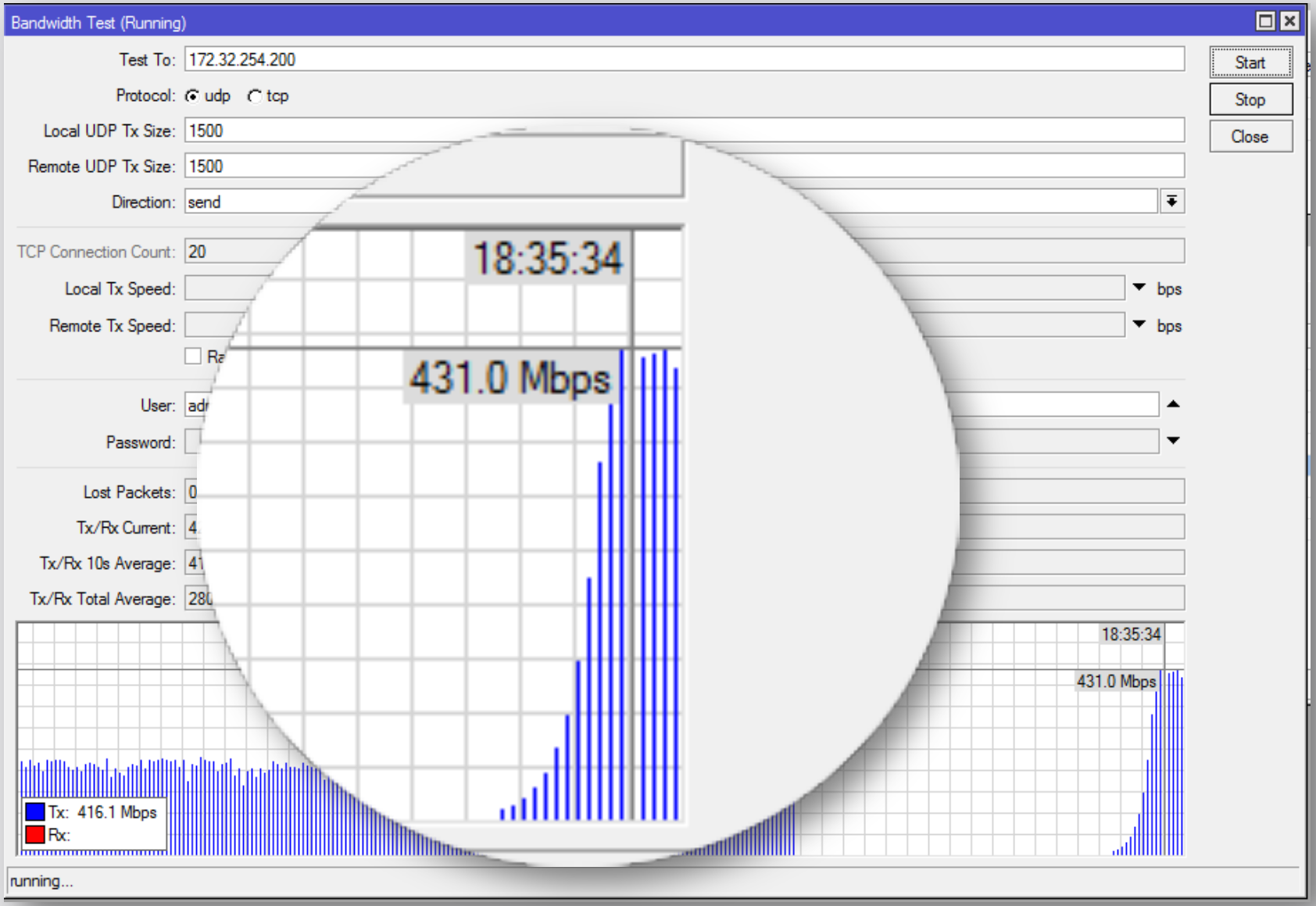


- PtMP – Replace
- First there needs to be done Preparation and Configuration
- Lets replace old devices for a 802.11ac
- Distance 320m

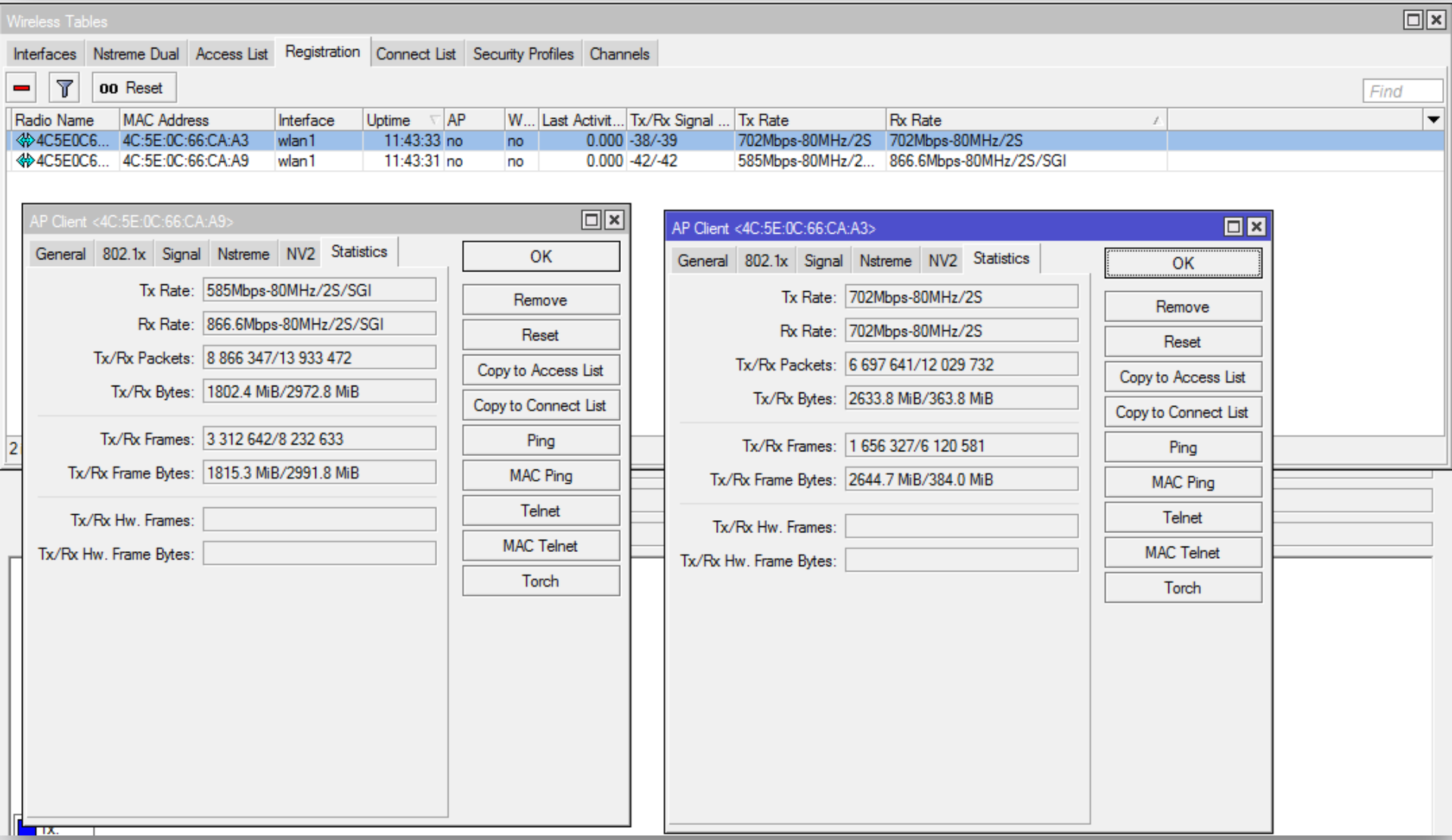
- PtMP – TCP test after Install with a one client



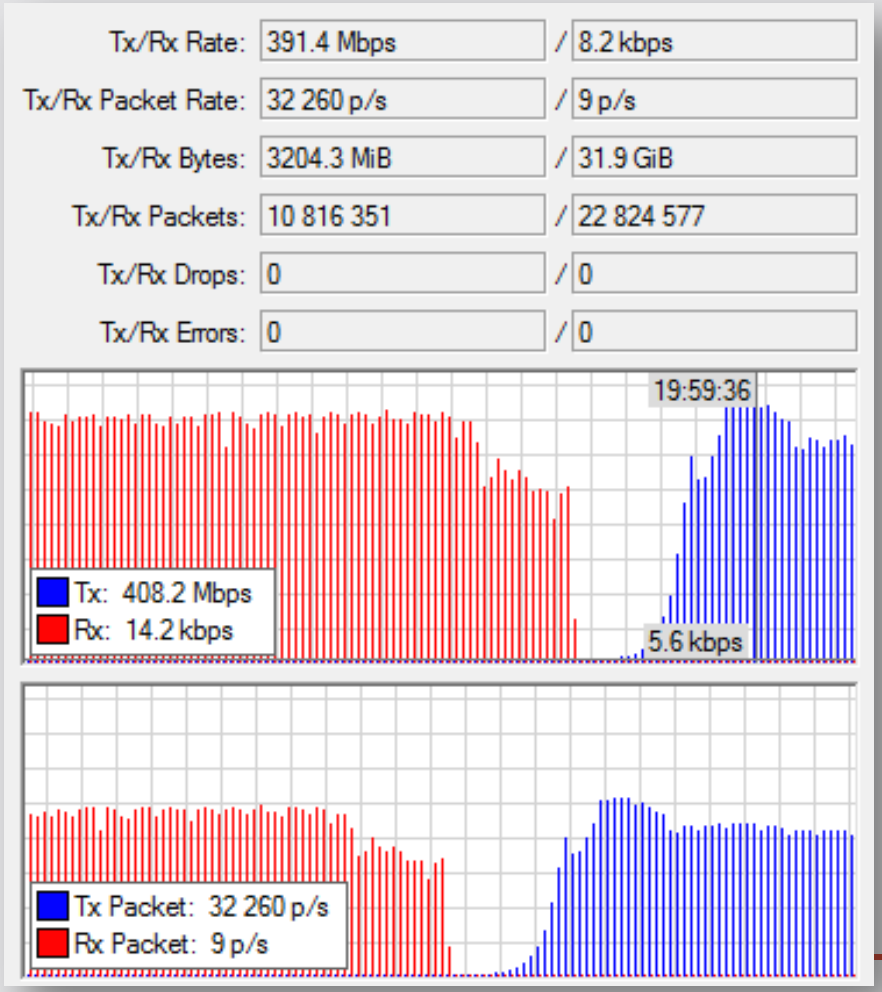
- PtMP – UDP test one client 80MHz

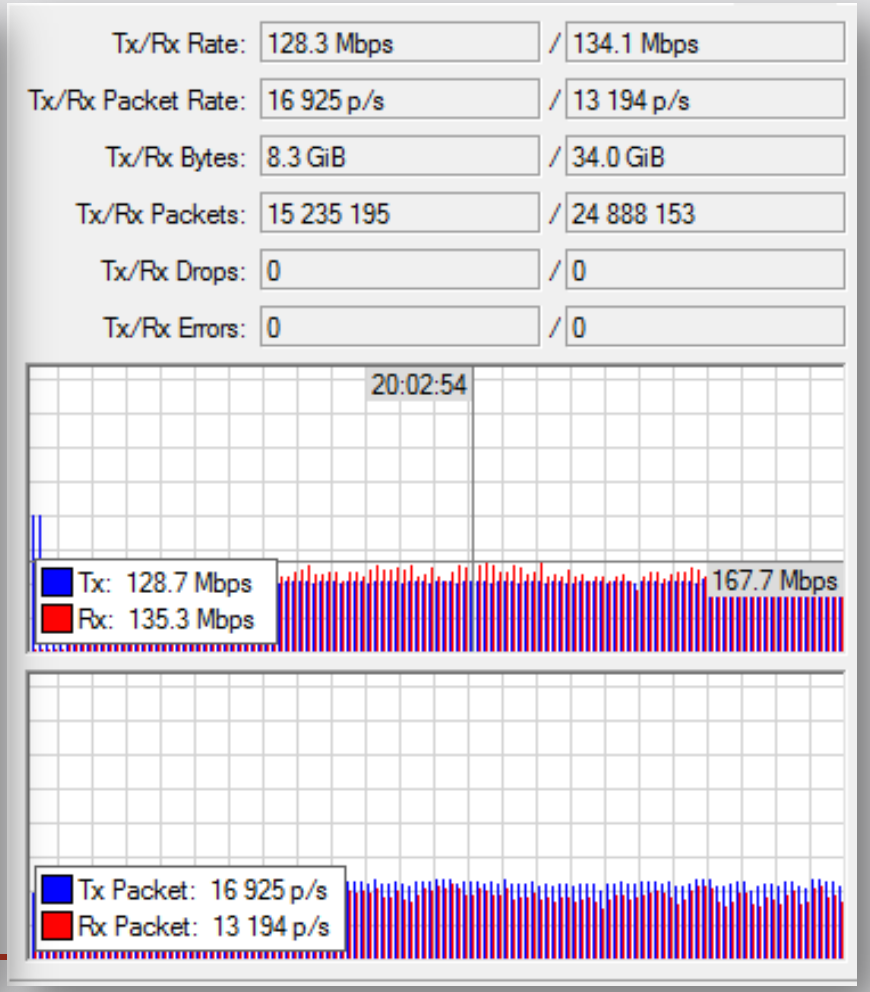


- PtMP – 2 clients – you need a close distance to maintain CCQ and the SNR really high for a High Speed connection.



- PtMP – 2 clients – speed test running from booth CCR's cross-over UDP and TCP – full duplex





Comparison - Results

- Point to Point test result

PLUS :

- Performance - up from 50Mbps to 120Mbps
- Latency - low latency in high LOAD

Minuses :

- Link stability - in High Noise will not find 80MHz
- Latency - some lagging can occur in high noise (standard link will disconnect / reconnect)

Regulations :

- Band-width - 20MHz outdoor

- Point to Multipoint

PLUS :

- Link stability - much beter in High Noise
- Performance - from 51 Mbps to 430Mbps UDP
  - from 27Mbps to 229Mbps TCP
  - 135Mbps Full Duplex TCP
- Latency - real low latency in high load

Minuses :

- Band-width - hard to find 80MHz free
- Price - is little higher than 802.11n
- Distance - need to have high CCQ and SNR

Thank You !

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