

MASSIVE DEPLOYMENT OF MIKROTIK ROUTER BOARDS FOR WIRELESS/CABLE SERVICE PROVISION IN A VERY NOISY ENVIRONMENT



URAN Association GN4 Campus Best Practice Project



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Organizations

Association of Users of Ukrainian Research and Academic Network: coordination and integration of efforts of the Association Members to ensure creation, development and usage of the Ukrainian National Research and Education Network http://uran.ua/~eng/frames.htm

Campus Best Practice is a part of the GÉANT project funded by the European Union. Campus Best Practice (CBP) aims to address key challenges for European campus networks.

http://services.geant.net/cbp/Pages/Home.aspx

Prerequisites

- Project Goal: Unlimited access to services for all inhabitants of a student's dormitory.
- Building parameters: 9 story concrete tower; leaving areas on floors 2 – 9; 16 rooms per floor, 128 rooms total; 500 – 600 dwellers.
- Building layout: staircase and elevators in the middle, two wings with 8 rooms in each, length of hallways on both sides approx 35 m.
- Technology : WiFi (full coverage of all leaving areas) and Cable (one connection) to every leaving room in the building

Why the Choice? – Initial Considerations

Priority list of equipment features:

- PoE (no separate power cables to equipment)
- Internal antenna (not possible to highjack the sticking out part)
- UTP ports (need to have cable connections to all rooms)
- Immediate availability in Ukraine (project launch deadline)
- Unit price fits budget limits (just as always never enough money)

Options considered: practically all available vendors, only one found to satisfy the above requirements: MikroTik RB951Ui-2HnD

Sometimes lack of knowledge leads to correct solutions!

The MikroTik RB951Ui-2HnD

Most important specifications (at the design stage of the project):

- PoE
- Internal Antenna
- Five 10/100 Ethernet ports
- Max Power consumption 7 W
- Suggested price \$59.95



Other parameters important, but not decisive

Physical Layout: Mounting

In order to provide full WiFi coverage 4 MikroTik RB951Ui-2HnD units were mounted on each floor of the building. Overall 32 devices were deployed.

One equipment rack on the 5-th floor:



Physical Layout: The Circuit



UTP cabling to rooms and WiFi Coverage

Logical Structure of Network

Uniform for all 32 MikroTik devices:

- Internal VLAN for Monitoring-Management of MikroTik router boards and distribution switches
- Separate VLAN for service provision
- Real IP address for each device
- Gray IP addresses for device management
- Routing provided by access server
- NATed address space for users
- MotSpot for both WiFi and Cable access
- User Area WEB server
- Access controlled by Billing server

Monitoring and Management

 Dude & MikroTik tools used for Monitoring and Management

But: performing some tasks is not straightforward, e.g. checking wireless and cable registrations at a glance

 Self-coded API-based applications used for monitoring specific parameters

Monitoring and Management: the Dude

Customized the Dude for our needs:



Monitoring and Management: API

- Coded in pure ANSI C using MikroTik provided API
- Runs on *NIX and Windows platforms
- Allows monitoring WiFi and Cable registrations + other data

PM91 PM0522 192.168.43.135 D0:DF:9A:D2:8B:5F WiFi http-pap 1h34m3s PM0488 192.168.43.143 9C:B7:0D:7C:77:7C WiFi mac-cookie 7m35s PM92 PM0103 192.168.43.178 C4:6E:1F:7A:48:41 Cable http-pap 1w2d22h3m16s PM93 PM0526 192.168.43.207 00:16:EA:B4:AB:E0 WiFi mac-cookie 1h12m13s PM0481 192.168.43.215 2C:D0:5A:16:83:63 WiFi http-pap 55m19s PM0456 192.168.43.221 20:89:84:EB:B7:F0 Cable http-pap 1h26m33s PM94 PM0163 192.168.43.243 6C:5F:1C:3E:3C:55 WiFi mac-cookie 2m40s PM0491 192.168.43.247 64:B3:10:BF:6E:58 WiFi http-pap 11h48m44s Stringlength of Table = 3526 #of connected users = 51 #of WiFi users = 34 Time is: 17-11-2015 10:10 C:\Windows\system32>

Monitoring and Management: WEB-Based

- Coded: PHP Thrift Java Scala Oracle + API
- Integrated with a tool-set on a Management Website

User	s Table				0	
	Login 🗘	IP	Device	Uptime	Inspected	
1	PM0017	192.168.40.198	PM33	36512	2	
2	PM0018	192.168.40.230	PM34	1013983	174	
3	PM0022	192.168.42.245	PM74	83069	176	
4	PM0023	192.168.42.248	PM74	1445403	176	
5	PM0040	192.168.43.84	PM83	77679	163	
6	PM0041	192.168.43.88	PM83	1467060	163	
7	PM0050	192.168.41.107	PM44	82849	1	
8	PM0058	192.168.40.201	PM33	1543	2	
9	PM0067	192.168.41.121	PM44	1116	1	
10	PM0094	192.168.41.61	PM42	829	169	
11	PM0103	192.168.43.178	PM92	1459543	177	
12	PM0104	192.168.42.25	PM61	3447	162	
13	PM0131	192.168.42.175	PM72	1730	166	
14	PM0158	192.168.43.68	PM83	548818	163	
15	PM0160	192.168.41.177	PM52	1437	3	

Monitoring and Management: Future Development

- Crowed-Sourced network performance assessment
- User devices used for gathering statistical information
- Cookie injection: adds or user site
- Processing: collected data + device and server logs
- Will provide a view from the users standpoint

The WiFi versus Cable Trend

Where the noise comes from

During the years of operation the number of connected WiFi devices (users) has grown rapidly, number of Ethernet connections (users) has decreased.

Extra% << What is this?



Percentage of connected WiFi and Ethernet users

Environment: the Noise

Spectral density measured on one of the devices



Environment: the Noise Source

Dude -> Tools -> Winbox -> Wireless -> Interface (Wlan1) ->Scan

Address	SSID	Band	Chan	Frequ	Signal Str	Noise Floor	Signal To Noise	Radio Name 📝	RouterC
C0:4A:00:7C:5E:B2	Warp	2GHz-B/G/N	2UMHz	2417	-91	-102	11		
C0:4A:00:7C:5E:B2	Warp	2GHz-B/G/N	20MHz	2457	-89	-101	12		
E8:94:F6:B7:C8:B0	Yalta	2GHz-B/G/N	20MHz	2442	-83	-95	12		
00:1A:70:47:BE:0D	ZTulupova	2GHz-B/G/N	20MHz	2442	-96	-95	-1		
10:FE:ED:9E:BC:F4	Zaparolen	2GHz-B/G/N	20MHz	2412	-91	-96	5		
BC:EE:7B:80:A2:B4	ami	2GHz-B/G/N	20MHz	2467	-89	-96	7		
82:36:8B:C8:33:8A	conyaka348	2GHz-B/G/N	20MHz	2412	-74	-96	22		
42:48:97:CA:85:C4	conyaka348	2GHz-B/G/N	20MHz	2412	-72	-96	24		
2E:B7:54:64:E5:AA	conyaka348	2GHz-B/G/N	20MHz	2412	-70	-96	26		
76:F8:8F:F0:7E:C8	conyaka348	2GHz-B/G/N	20MHz	2412	-68	-96	28		
90:F6:52:41:71:87	dexter	2GHz-B/G/N	20MHz	2437	-98	-102	4		
00:1C:F0:3D:6C:E9	dlink102	2GHz-B/G/N	20MHz	2437	-88	-102	14		
38:2C:4A:46:45:BC	gg	2GHz-B/G/N	20MHz	2472	-87	-104	17		
C4:A8:1D:DD:21:24	hostel	2GHz-B/G/N	20MHz	2452	-74	-102	28		
F8:D1:11:33:63:9E	iHome	2GHz-B/G/N	20MHz	2412	-90	-96	6		
AC:22:0B:8F:48:E4	karina	2GHz-B/G/N	20MHz	2412	-92	-96	4		
90:F6:52:C6:3D:65	ksenia	2GHz-B/G/N	20MHz	2472	-92	-104	12		
AC:22:08:8F:5A:7C	nam bez raznicu	2GHz-B/G/N	20MHz	2447	-78	-100	22		
54:E6:FC:F2:76:F8	ruslan	2GHz-B/G/N	20MHz	2442	-80	-95	15		
14:CC:20:88:25:AE	semka	2GHz-B/G/N	20MHz	2452	-84	-102	18		
90:F6:52:8C:36:C4	ytka	2GHz-B/G/N	20MHz	2437	-87	-102	15		
14:CC:20:96:0E:02	zoloto	2GHz-B/G/N	20MHz	2437	-82	-102	20		
4C:5E:0C:23:3F:1D	PM34	2GHz-B/G/N	20MHz	2412	-87	-96	9	4C5E0C233F1D	6.22
C.EE.0C.4E.CZ.CD	DM70	DOLLE DVC /KL	201411-	2472		104	CE.	ACEFOCAFC7CD	C 22
	Address UU:4A:UU:7U:5E:B2 C0:4A:00:7C:5E:B2 E8:94:F6:B7:C8:B0 00:1A:70:47:BE:OD 10:FE:ED:9E:BC:F4 BC:EE:7B:80:A2:B4 82:36:8B:C8:33:8A 42:4B:97:CA:B5:C4 2E:B7:54:64:E5:AA 76:F8:8F:F0:7E:C8 90:F6:52:41:71:87 00:1C:F0:3D:6C:E9 38:2C:4A:46:45:BC C4:A8:1D:DD:21:24 F8:D1:11:33:63:9E AC:22:0B:8F:54:7C 54:E6:FC:F2:76:F8 14:CC:20:88:25:AE 90:F6:52:8C:36:C4 14:CC:20:96:0E:02 4C:5E:0C:23:3F:1D	Address SSID UU:4A:UU:7U:5E:B2 Warp C0:4A:00:7C:5E:B2 Warp E8:94:F6:B7:C8:B0 Yalta 00:1A:70:47:BE:0D ZTulupova 10:FE:ED:9E:BC:F4 Zaparolen BC:EE:7B:80:A2:B4 ami 82:36:8B:C8:33:8A conyaka348 42:4B:97:CA:B5:C4 conyaka348 2E:B7:54:64:E5:AA conyaka348 90:F6:52:41:71:87 dexter 00:10:F0:3D:6C:E9 dlink102 38:2C:4A:46:45:BC gg C4:A8:1D:DD:21:24 hostel F8:D1:11:33:63:9E iHome AC:22:0B:8F:5A:7C nam_bez_raznicu 54:E6:FC:F2:76:F8 ruslan 90:F6:52:8C:36:C4 ytka 14:CC:20:88:25:AE semka 90:F6:52:8C:36:C4 ytka 14:CC:20:96:0E:02 zoloto 4C:5E:0C:23:F1:D PM34	Address SSID Band UU:4A:00:7C:5E:B2 Warp 2GH2-B/G/N 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90:F6:52:41:71:87 conyak:348 2GH2-B/G/N 20Hz 2412 -76 -96 -26 90:F6:52:41:71:87 dexter 2GH2-B/G/N 20Hz 2412 -76 -96 -26 90:F6:52:41:71:87 dexter</td></td<></td>	Address SSID Band Chan Frequ Signal Str Noise Floor Signal To Noise UU:4A:UU:7U:5E:B2 Warp 2GH2-B/G/N 2UMH2 2417 -91 -110 -111 C0:4A:00:7C:5E:B2 Warp 2GH2-B/G/N 20MH2 2427 -89 -101 -112 E8:94:F6:B7:C8:B0 Yalta 2GH2-B/G/N 20MH2 2442 -96 -955 -111 10:FE:ED:95:BC:F4 Zaparolen 2GH2-B/G/N 20MH2 2412 -91 -966 -955 BC:EE:78:80:A2:B4 ami 2GH2-B/G/N 20MH2 2412 -91 -966 -222 42:48:97:CA:B5:C4 conyaka348 2GH2-B/G/N 20MH2 2412 -77 -966 -224 24:49:97:CA:B5:C4 conyaka348 2GH2-B/G/N 20MH2 2412 -70 -96 -224 24:49:97:CA:B5:C4 conyaka348 2GH2-B/G/N 20MH2 2412 -70 -96 -244 26:F8:B7:F0:7E:C5 dink102 <td< td=""><td>Address SSID Band Chan Frequ Signal St Noise Floor Signal To Noise Radio Name CU:4A:0U7/C5E:B2 Warp 2BH2-B/G/N 2UHz 2417 -91 -102 11 CU:4A:0U7/C5E:B2 Warp 2GH2-B/G/N 20Hz 2442 -83 -101 12 E8:94:F6:B7:C8:B0 Yalta 2GH2-B/G/N 20Hz 2442 -96 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Why the Choice? – Production

- Extremely reliable: once set-up does not require interventions
- Recovers after power outages!
- Management & Monitoring Apps available
 the Dude + MikroTik tools
- BUT! No further development of Dude
- APIs for multiple programming languages
- Leaves up to specifications in very noisy environments

System Users Perspective

- Availability of Management Monitoring tools for MikroTic
- Very high resilience of Router Boards: no on-site servicing required
- Customized system PHP front end;
 Scala/Oracle back end with Thrift and Protobuf in the middle
- Oustomized Radius for AAA and DHCP

End Users Perspective

- Self registration for new customers: Login-password credentials (Federation access in future)
- HotSpot access to services
- Secure on-line payments for services by credit cards
- Availability of URAN services
- Help desk

THANK YOU!

Questions welcome: Here and Now or slava@kar.net