Build your own Internet Service Provider (ISP) with Mikrotik

MUM Indonesia,
24 nov 2021

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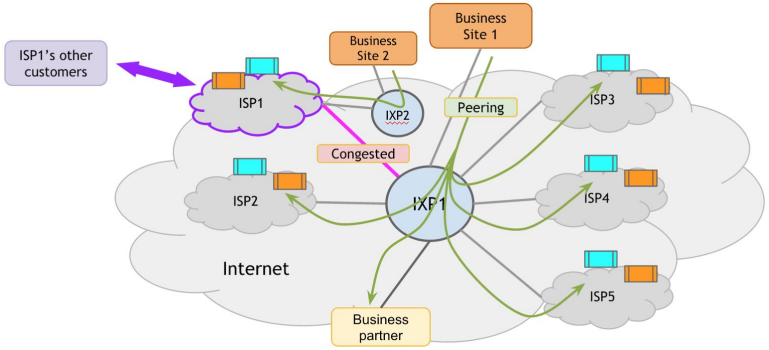


Source: proxim.com, aldrinisaac.blogspot.co.id

Agenda

- Introduction
- How internet works
- ISP topology
- ISP requirements
- ISP implementation
- ISP maintenance
- ISP troubleshooting
- Tips and trick
- Q & A

introduction

What is GLC?

- Garda Lintas Cakrawala (www.glcnetworks.com)
- Based in Bandung, Indonesia
- Areas: Training, IT Consulting
- Certified partner for: Mikrotik, Ubiquity, Linux
- Product: GLC radius manager
- Regular event

Trainer Introduction

- Name: Achmad Mardiansyah
- Base: bandung, Indonesia
- Linux user since 1999, mikrotik user since 2007, UBNT 2011
- Mikrotik Certified Trainer (MTCNA/RE/WE/UME/INE/TCE/IPv6)
- Mikrotik/Linux Certified Consultant
- Website contributor: achmadjournal.com, mikrotik.tips, asysadmin.tips
- More info: http://au.linkedin.com/in/achmadmardiansyah

Past experience

- 2021 (**Papua New Guinea, Malaysia**): network migration to routed network, radius/billing integration
- 2020 (**Congo DRC, Malaysia**): IOT integration, network automation
- 2019, **Congo (DRC)**: build a wireless ISP from ground-up
- 2018, **Malaysia**: network revamp, develop billing solution and integration, setup dynamic routing
- 2017, **Libya (north africa)**: remote wireless migration for a new Wireless ISP
- 2016, **United Kingdom**: workshop for wireless ISP, migrating a bridged to routed network

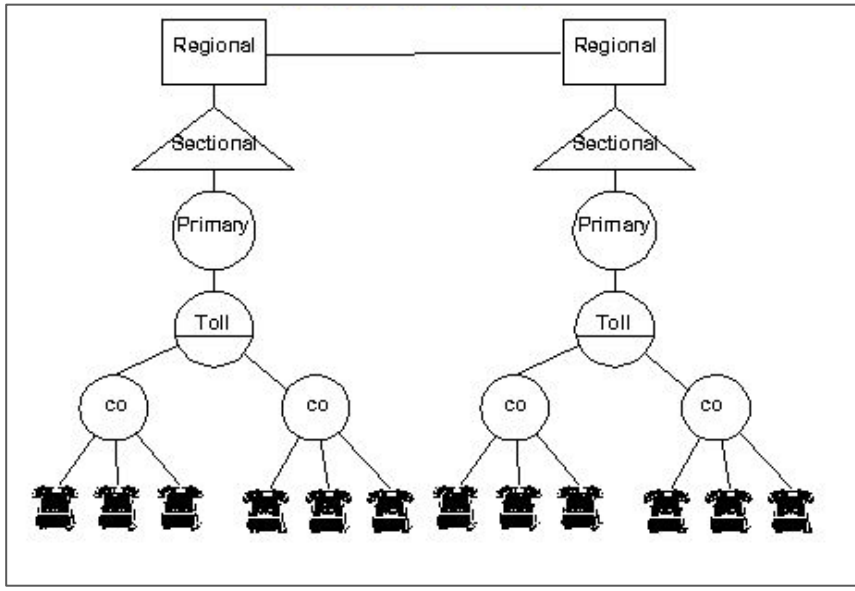
Prerequisite

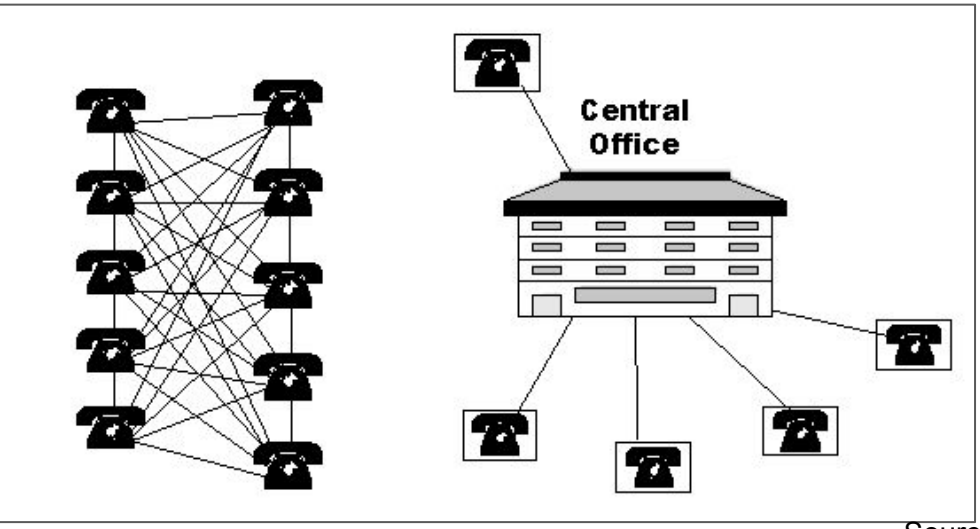
- This presentation some prerequisite knowledge
- We assume you already know:
  - Networking in general
  - Computer network

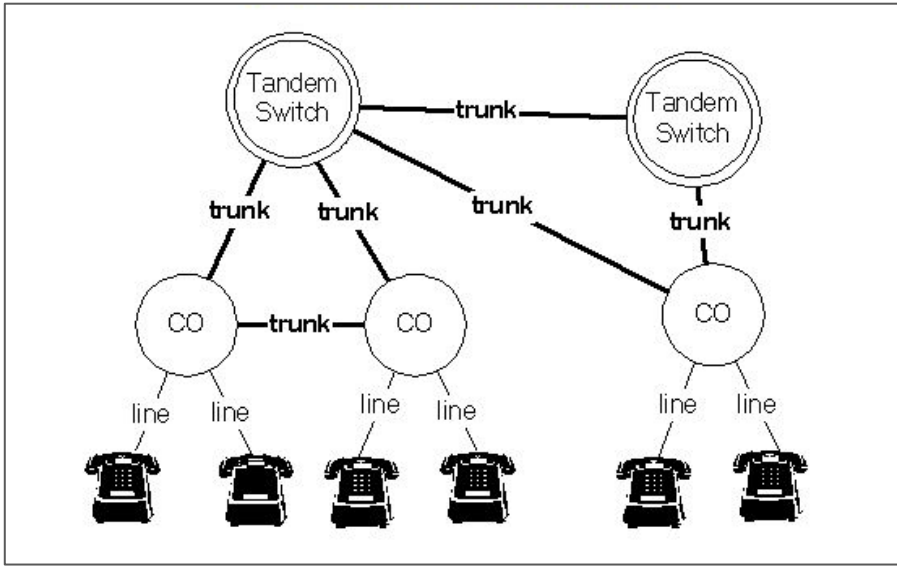
How internet works

We start from telecommunication

- Star topology
- Nodes:
  - Customer Premise Equipment (CPE)
  - Central Office (CO)
- Links:
  - Local-loop (access network)
  - trunk



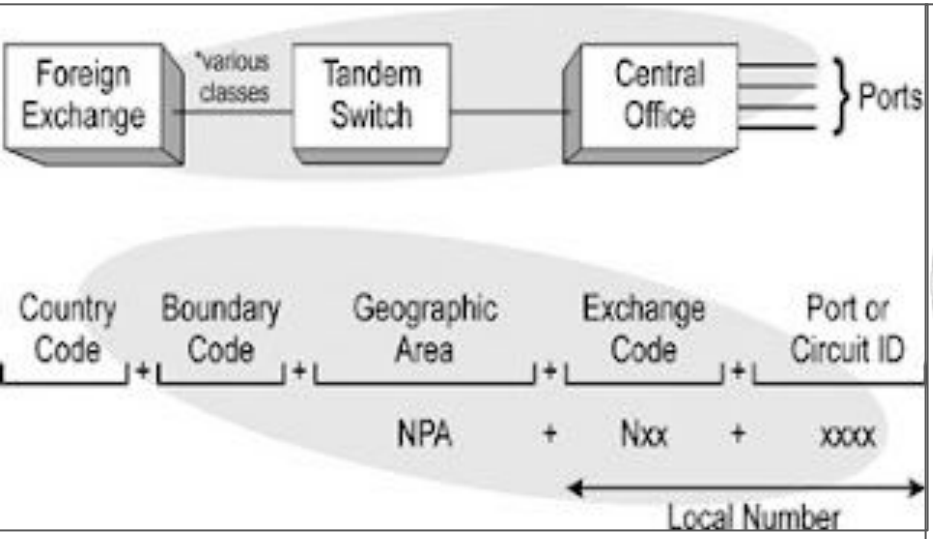


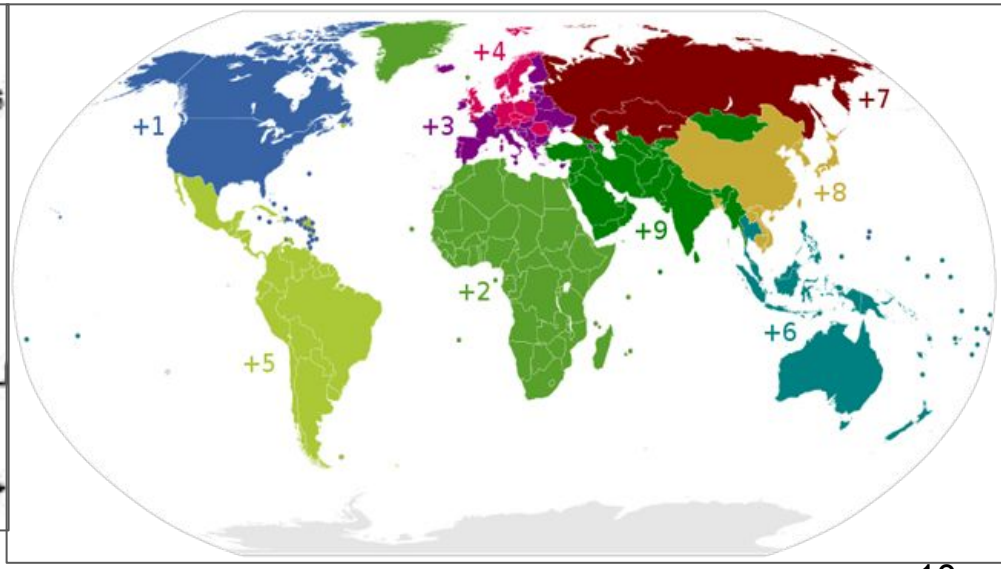


Source: www.mikundan.com

Telecommunication addressing (numbering plan)

- Objective:
  - To identify subscriber
  - As basis for routing
- Recommendation: ITU-T E160-163
- Schemes: Open scheme, Semi open, closed





GLCNetworks

www.glcnetworks.com

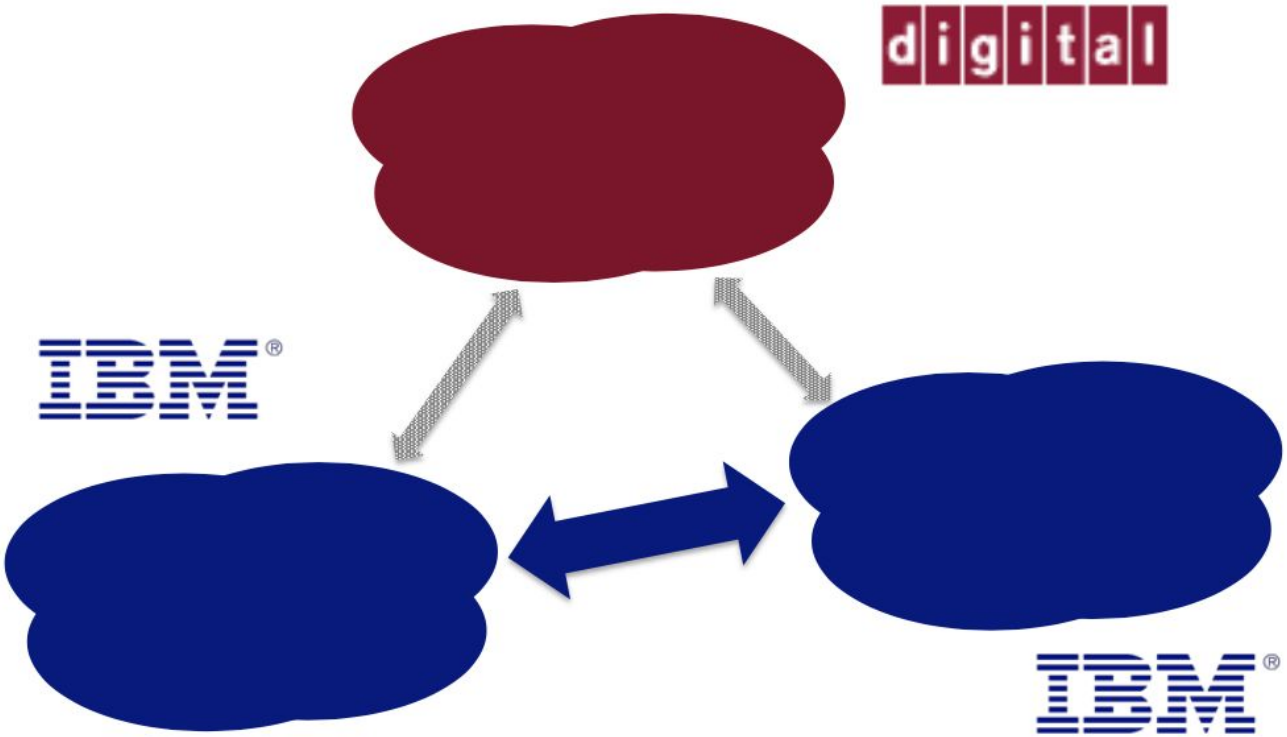
A bit of history...

- Initially, research project (’70-’80s) – Open, cooperative, public domain
  - “Rough consensus and running code”
- Then, product of liberalisation (’90s) – Also, catalyst for deregulation
  - Commercial, competitive environment
- Now, public utility and critical infrastructure (since 2000 and beyond)
  - “Internet governance” is a recent afterthought

Source: APNIC

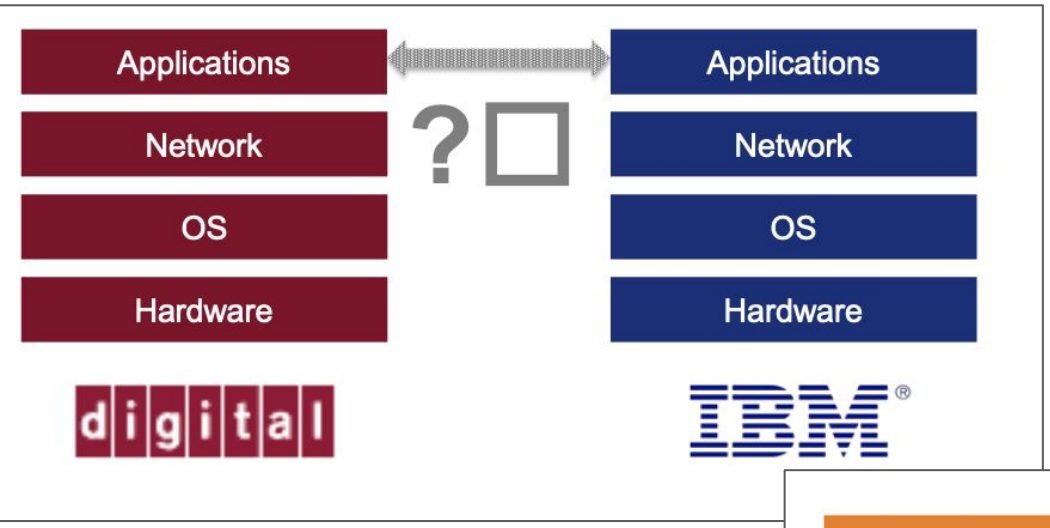
Before internet...

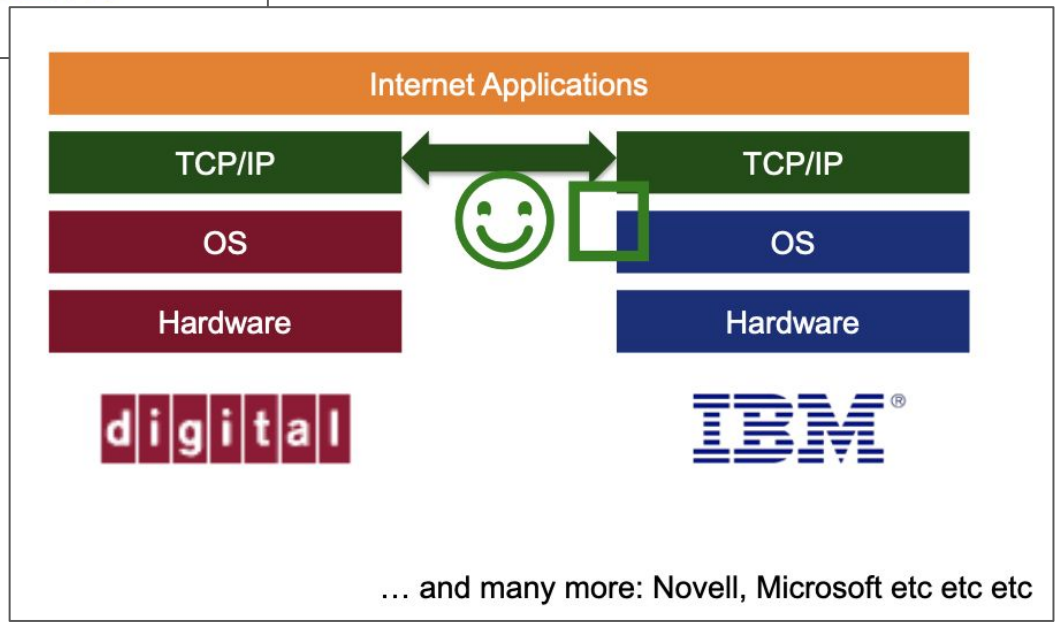
- Computer networking already exist… but many are proprietary



Source: APNIC

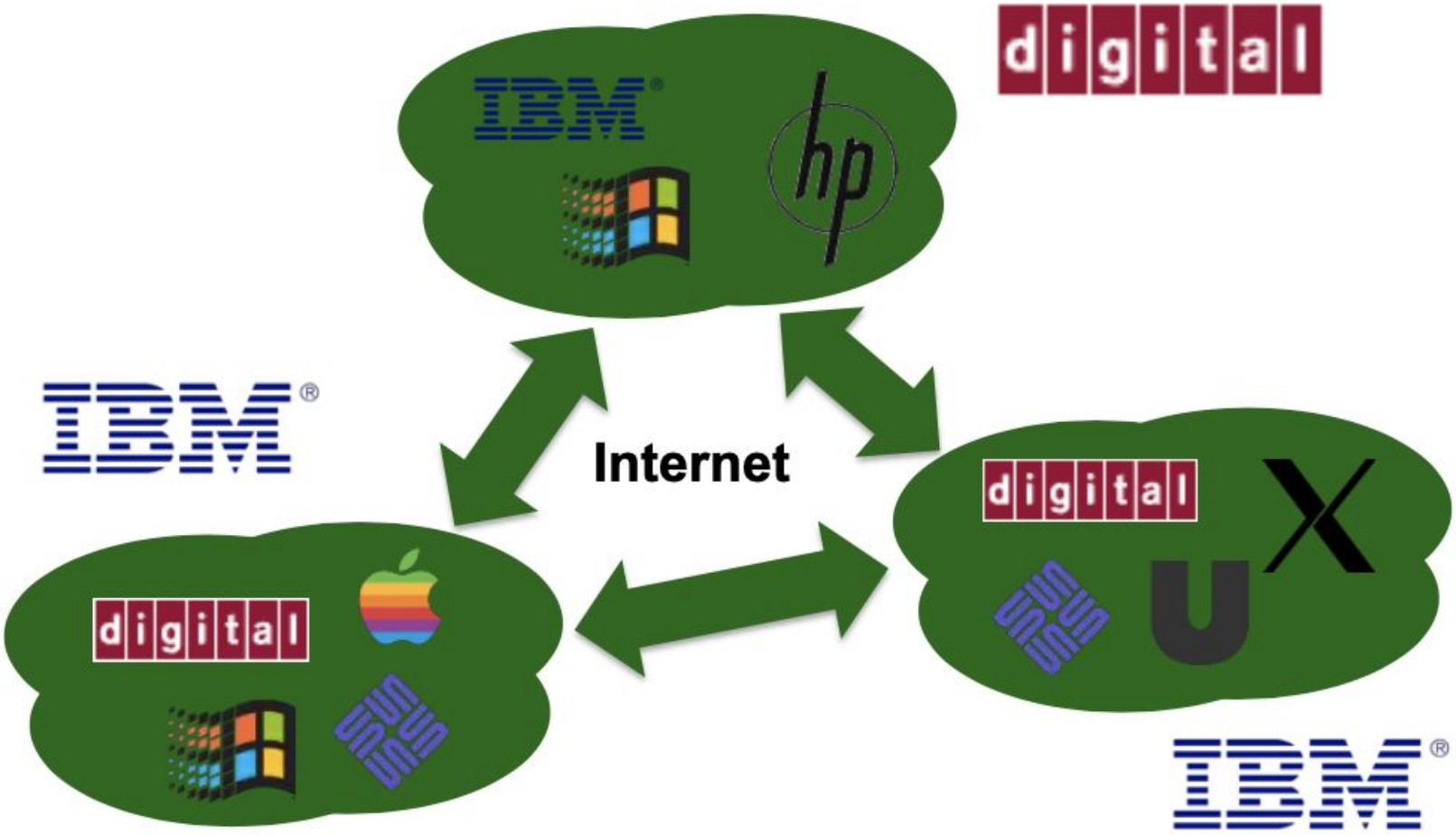
Internet defines a standard for communication





Source: APNIC

After internet...



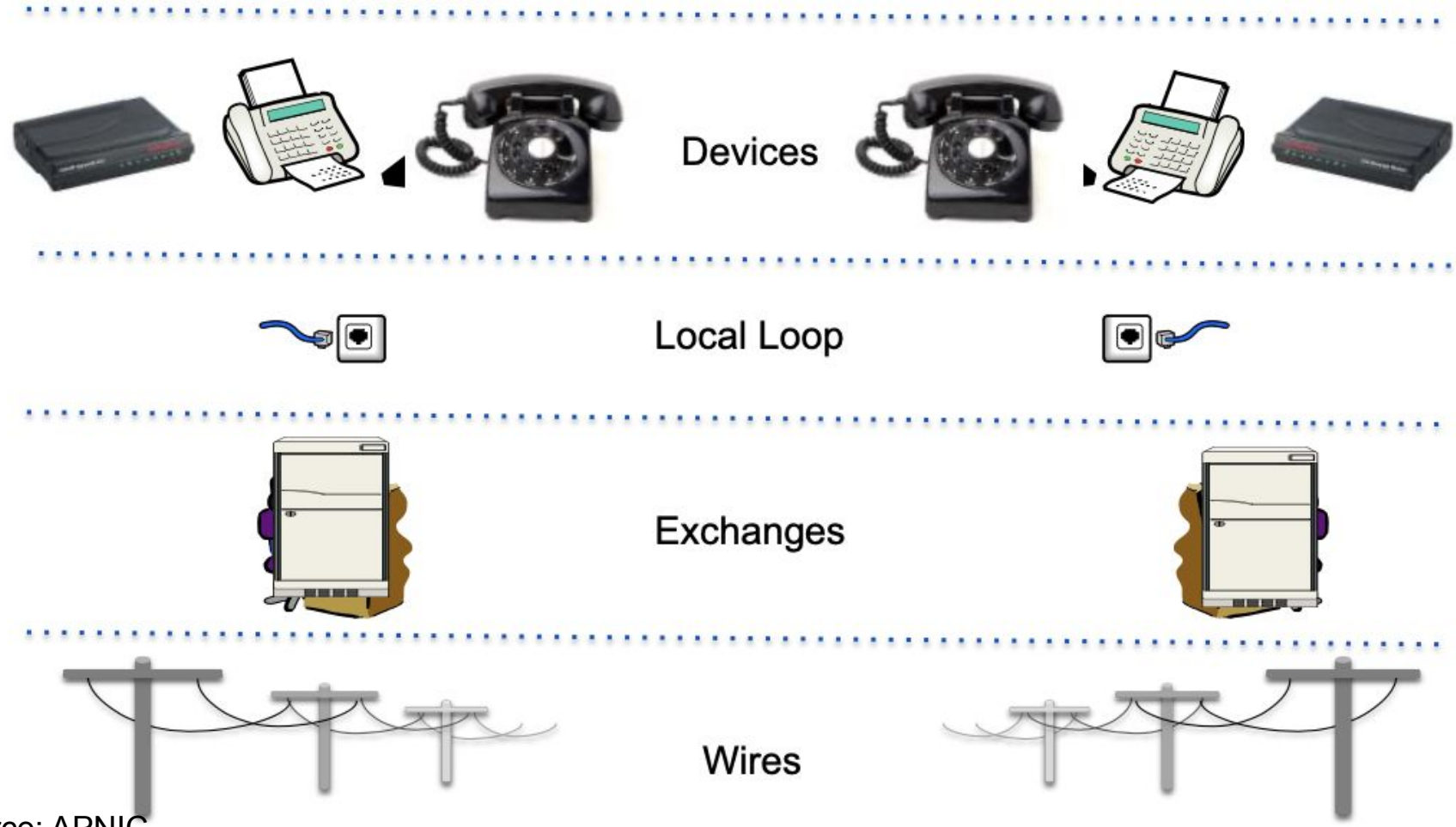
Source: APNIC

Why use internet

- Open
  - Free standards and implementations – Low barrier to entry
- Lightweight
  - “Dumb”: simple and efficient
  - Intelligence at the edges: in applications and devices
- Global
  - Uniform, “End-to-End”
- Neutral
  - By default

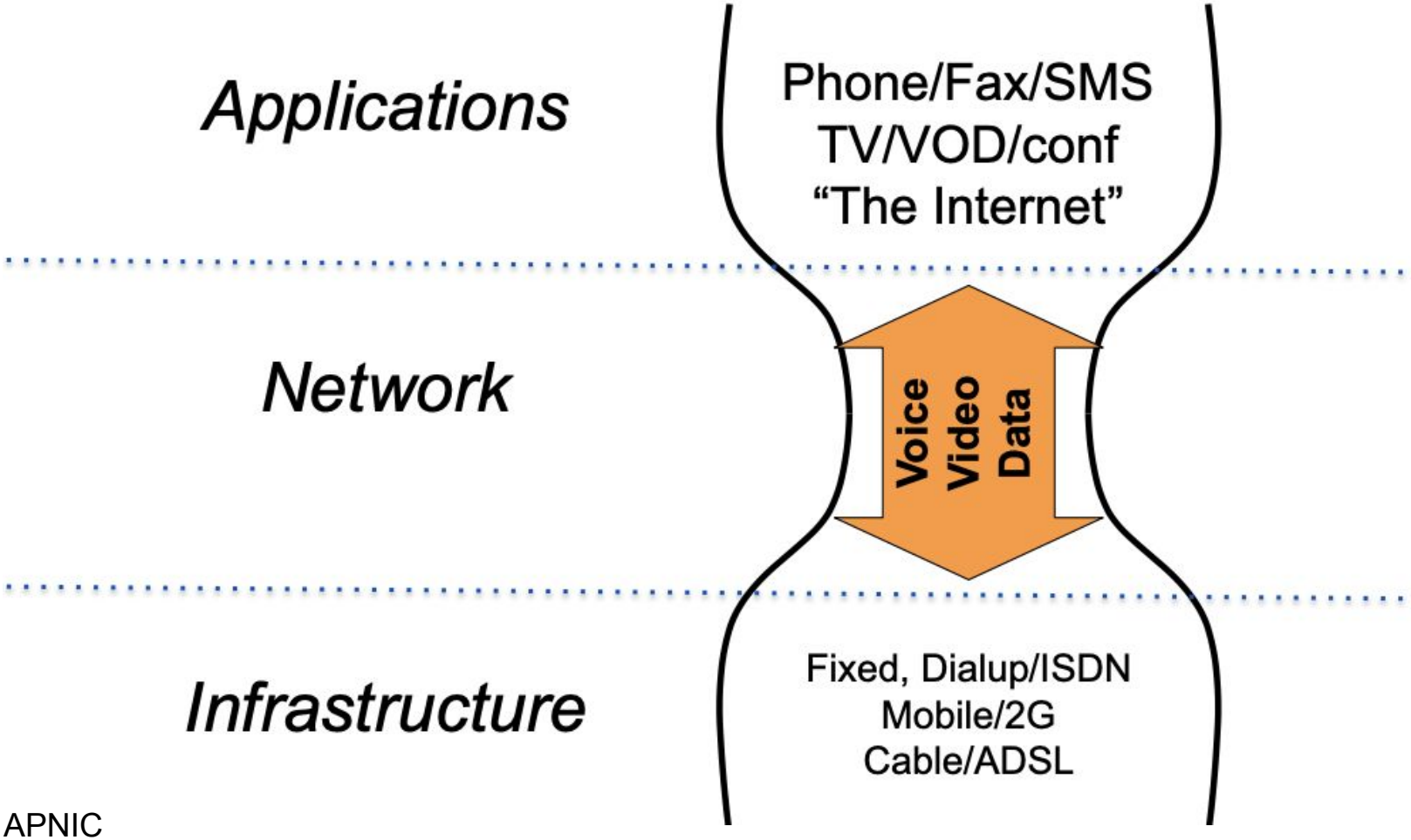
Source: APNIC

Layers in telecommunincations



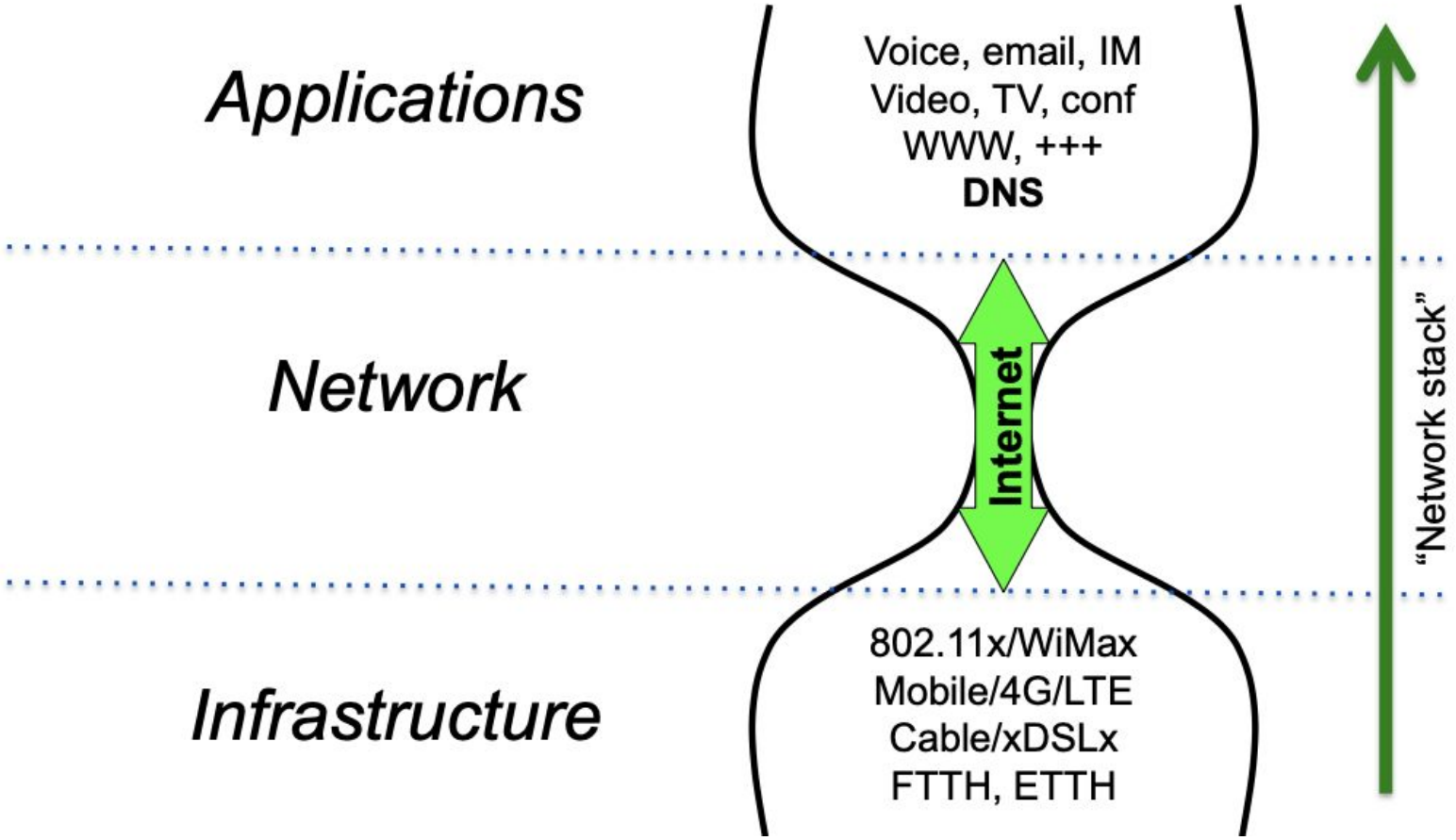
Source: APNIC

Layers in traditional communication



Source: APNIC

Layers in internet communication



Source: APNIC

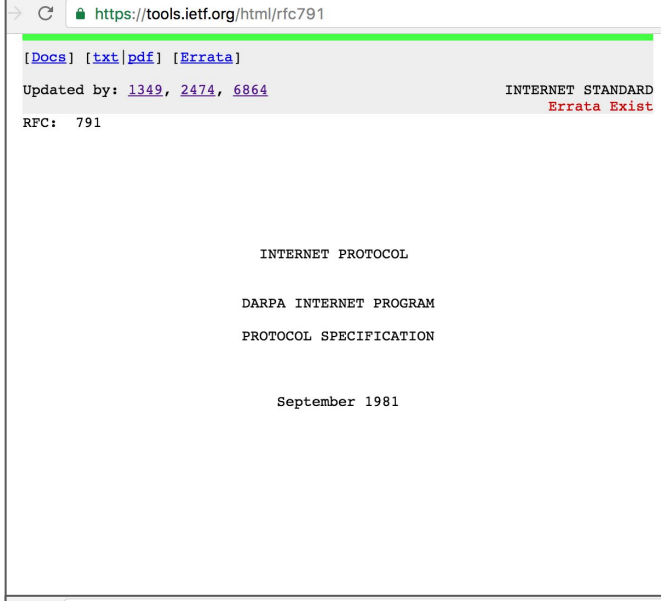
We need standards

- Standards operate at different levels of the network “stack”
  - in fact they define the stack
- A standard (or protocol) is simply an **agreement**
  - among members of a community,
  - on a set of guidelines or rules,
  - which allow cooperation (interoperability),
  - sometimes, in a forum such as ISO, ITU, W3C or IETF.
- An open standard is a standard which is
  - Developed through open and accessible processes
  - Freely accessible, implementable and usable
  - Available without barriers such as licenses and fees.
  - ... “ideally”, at least.

Source: APNIC

We need Addressing (identification) and Routing

- Addressing has to be unique. just like your id, phone,
- Internet is based on IP (internet protocol) addressing scheme -> RFC791
- Every organisation must have IP address block to join the internet and build a routing scheme among their equipment
- IP address needs to be grouped into subnet → similar like **area code**
-


https://tools.ietf.org/html/rfc791

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Updated by: 1349, 2474, 6864 INTERNET STANDARD
Errata Exist

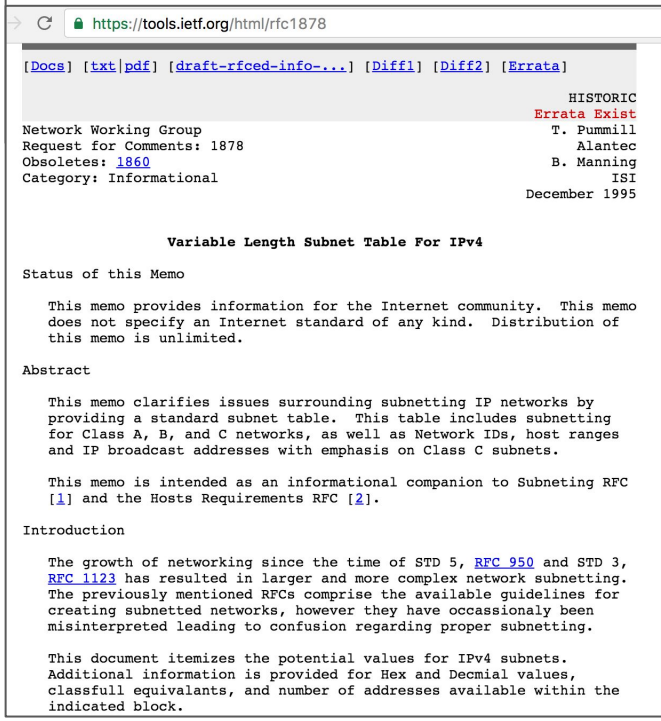
RFC: 791

INTERNET PROTOCOL

DARPA INTERNET PROGRAM

PROTOCOL SPECIFICATION

September 1981


https://tools.ietf.org/html/rfc1878

[Docs] [txt|pdf] [draft-rfced-info-...] [Diff1] [Diff2] [Errata]

HISTORIC
Errata Exist

Network Working Group — T. Pummill
Request for Comments: 1878 — Alantec
Obsoletes: 1860 — B. Manning
Category: Informational — ISI
December 1995

Variable Length Subnet Table For IPv4

Status of this Memo

This memo provides information for the Internet community. This memo does not specify an Internet standard of any kind. Distribution of this memo is unlimited.

Abstract

This memo clarifies issues surrounding subnetting IP networks by providing a standard subnet table. This table includes subnetting for Class A, B, and C networks, as well as Network IDs, host ranges and IP broadcast addresses with emphasis on Class C subnets.

This memo is intended as an informational companion to Subneting RFC [1] and the Hosts Requirements RFC [2].

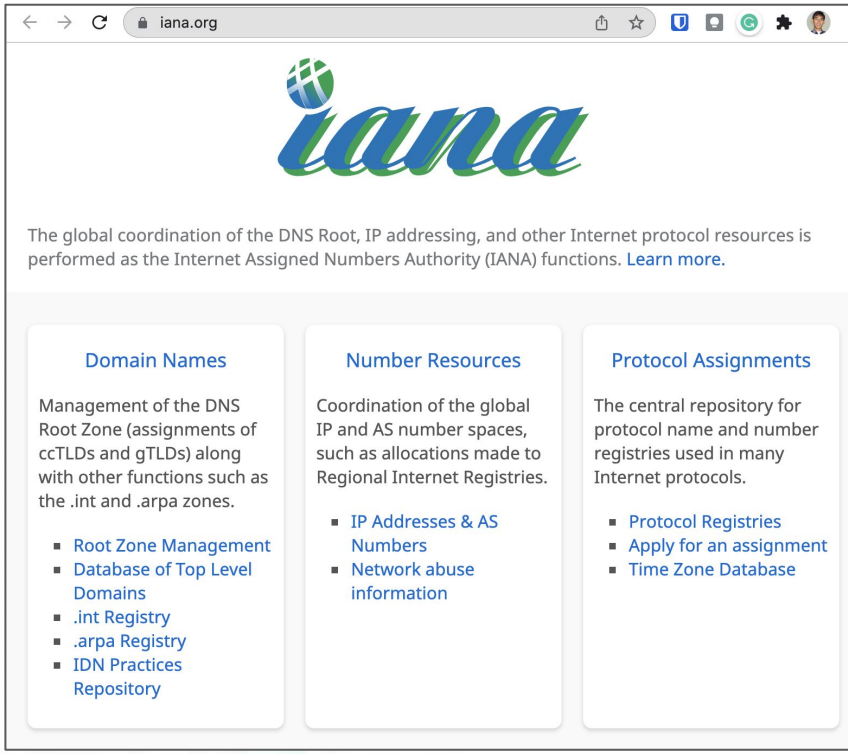
Introduction

The growth of networking since the time of STD 5, RFC 950 and STD 3, RFC 1123 has resulted in larger and more complex network subnetting. The previously mentioned RFCs comprise the available guidelines for creating subnetted networks, however they have occassionaly been misinterpreted leading to confusion regarding proper subnetting.

This document itemizes the potential values for IPv4 subnets. Additional information is provided for Hex and Decmial values, classfull equivalants, and number of addresses available within the indicated block.

IANA and RIR

- We need an international body that regulates IP addressing -> IANA (Internet Assigned Number Authority)
- IANA delegates (some of its authority) to RIR “Regional Internet Registry”
- RIR delegates to country’s
-



Motivation to build ISP

Motivation to build ISP with mikrotik

Why build ISP?

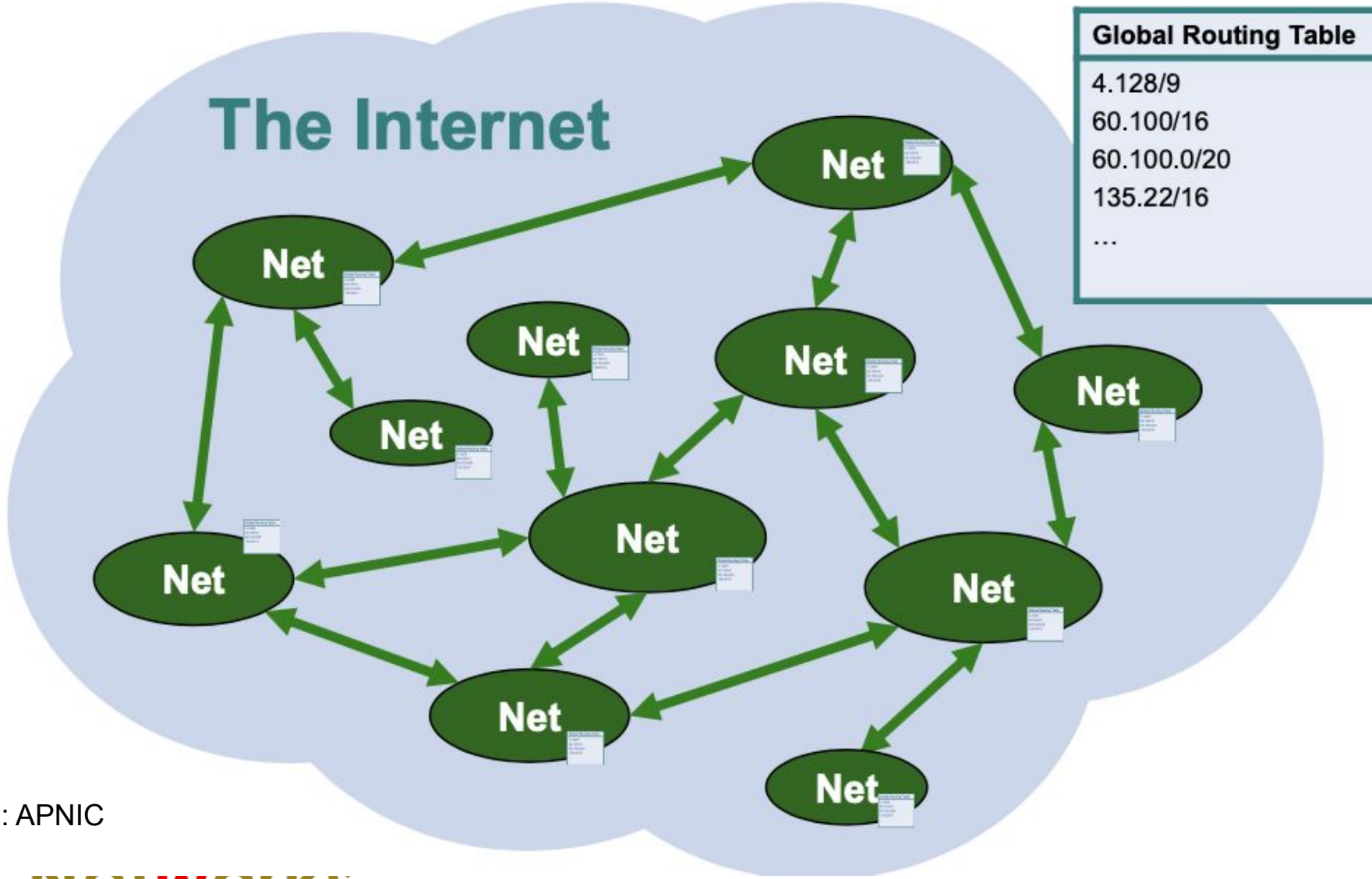
- Can be a source of income (Commercialisation), high demand
  - Residential services
  - Business services
  - Other services
- A cheaper way to access internet (sharing connection)
- Extend current network

Why mikrotik?

- Affordable price
- Feature rich
- Better margin

ISP topology

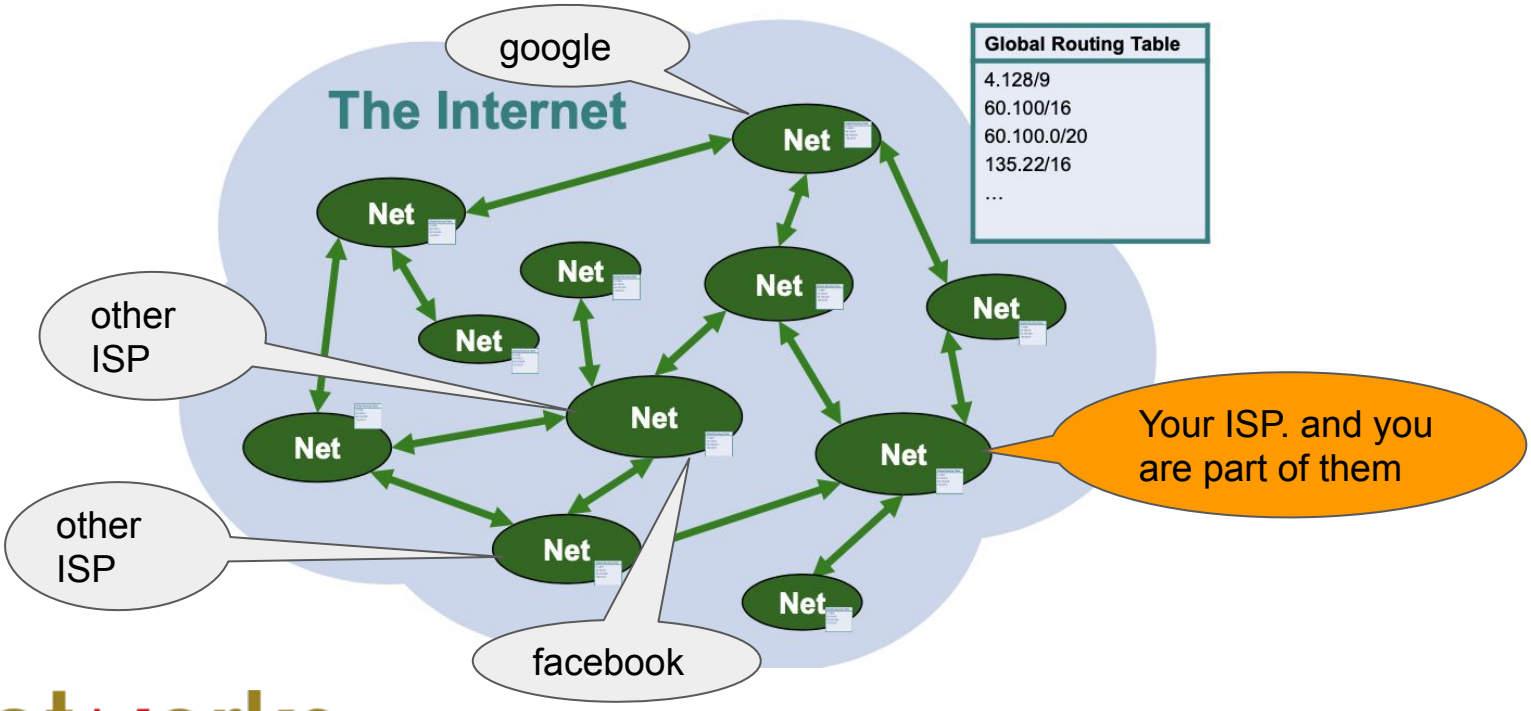
Inter-connected networks



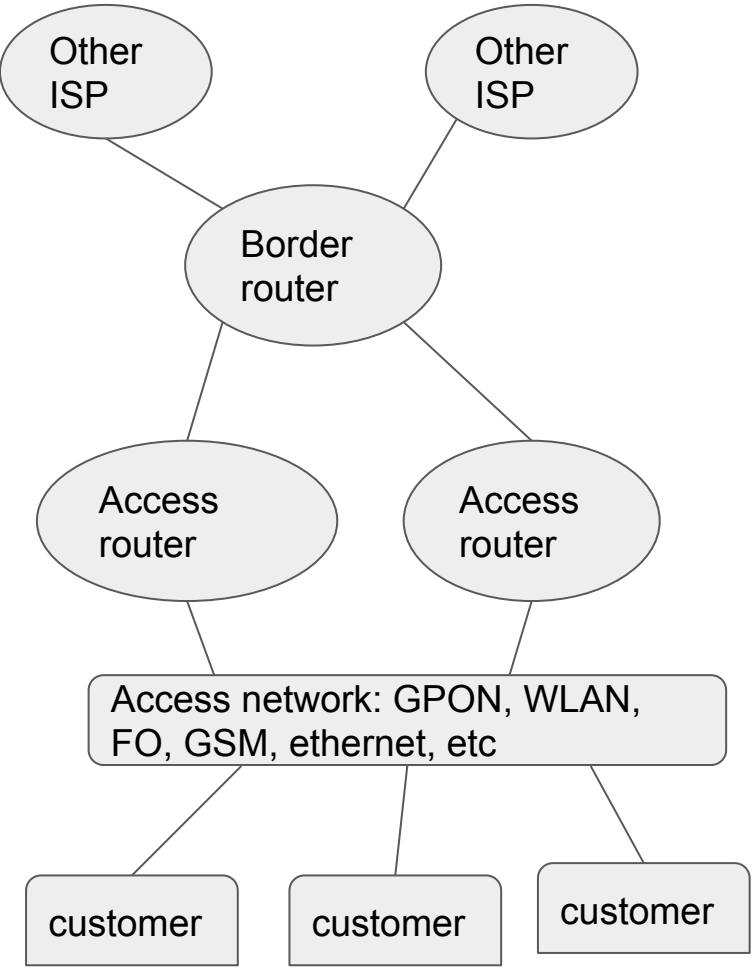
Source: APNIC

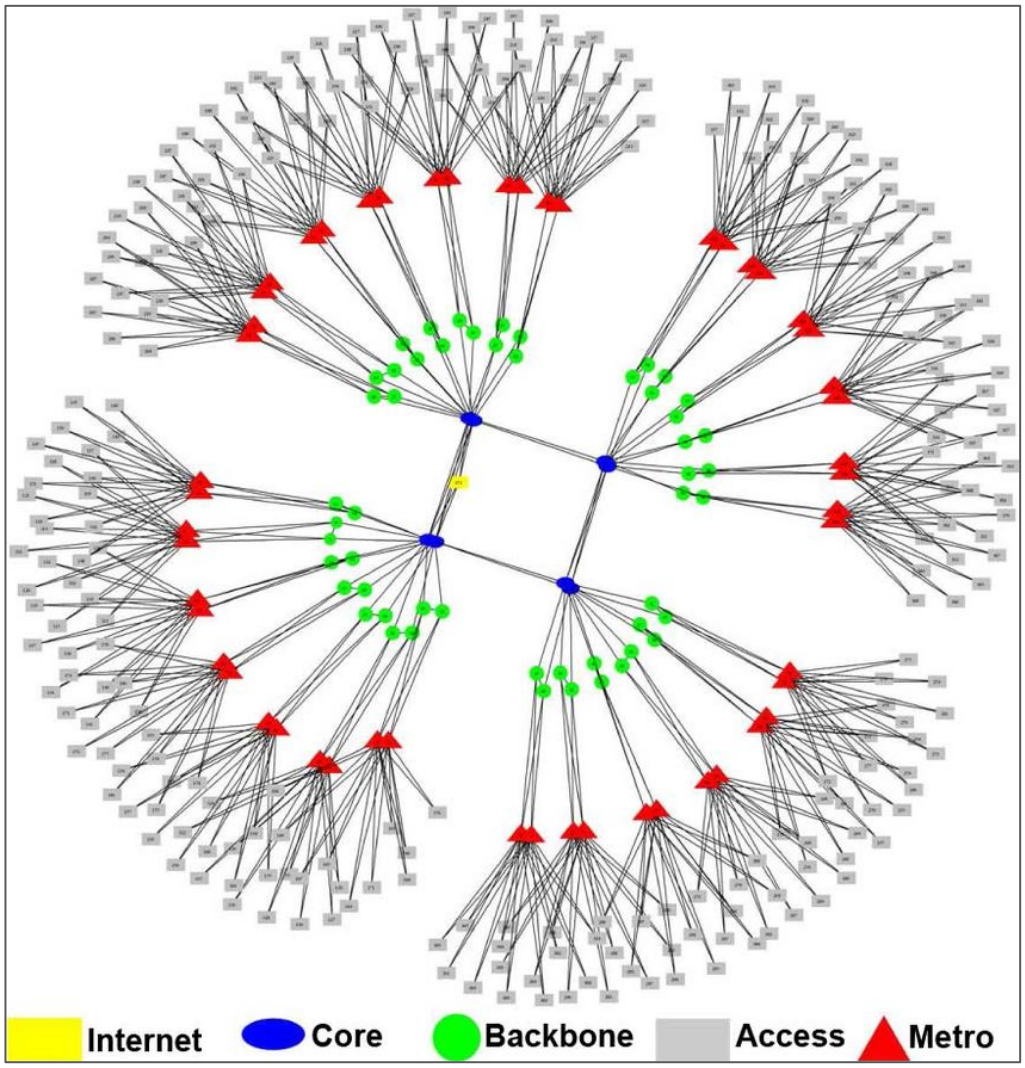
Your ISP and you

- ISP is an organisation that is part of internet that provides connectivity to their customers
  - Identified by their AS (Autonomous System) number
  - Identified by their IP address block
- When you connect to internet, you will use your ISP's address



At your ISP (physical connection)





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ISP requirements

Requirements

- Technical
  - Upstream bandwidth (important!!)
  - Hardware
    - Routers, switch, cables, access point, CPE
    - Physical topology
  - Software
    - Addressing (ip address block, AS number)
    - Logical topology (IP planning)
    - Routing (IGP vs EGP)
    - Billing
    - Monitoring
    - automation
  - Brainware
    - Skilled engineer
- Non-tech
  - Services: pppoe, hotspot, dhcp
  - Legal: business registration
  - Money: Investor, loan

Legal requirements… (from KBI indonesia)

61921	Internet Service Provider	Kelompok ini mencakup usaha jasa pelayanan yang ditawarkan suatu perusahaan kepada pelanggannya untuk mengakses internet, atau bisa disebut sebagai pintu gerbang ke internet
61923	Jasa Internet Teleponi Untuk Keperluan Publik (itkp)	Kelompok ini mencakup usaha jasa untuk mentransmisi panggilan melalui jaringan Internet Protocol (IP). Kegiatan ini menyelenggarakan internet teleponi yang bersifat komersial, dihubungkan ke jaringan telekomunikasi
61924	Jasa Interkoneksi Internet (nap)	Kelompok ini mencakup kegiatan menyelenggarakan akses dan atau ruting bagi penyelenggara jasa akses internet. Dalam menyelenggarakan akses bagi penyelenggara jasa akses internet, penyelenggara jasa interkoneksi internet dapat menyediakan jaringanh untuk transmisi internet. Penyelenggara jasa interkoneksi internet wajib saling terhubung melalui interkoneksi. Penyelenggara jasa interkoneksi melelkukan pengaturan trafik penyelenggaraan jasa akses internet
61994	Jasa Jual Kembali Akses Internet	Kelompok ini mencakup usaha penyelenggaraan jasa jual kembali akses internet seperti Warung Internet/Internet Cafe.
63121	Portal Web Dan/atau Platform Digital Tanpa Tujuan Komersial	Kelompok ini mencakup: - Pengoperasian situs web tanpa tujuan komersial yang menggunakan mesin pencari untuk menghasilkan dan memelihara basis data (database) besar dari alamat dan isi internet dalam format yang mudah dicari. - Pengoperasian situs web yang bertindak sebagai portal ke internet, seperti situs media yang menyediakan isi yang diperbarui secara berkala tanpa tujuan komersial. - Pengoperasian platform digital dan/atau situs/portal web yang melakukan transaksi elektronik berupa kegiatan usaha fasilitasi dan/atau mediasi pemindahan kepemilikan barang dan/atau jasa dan/atau layanan lainnya melalui internet dan/atau perangkat elektronik dan/atau cara dengan sistem elektronik lainnya tanpa tujuan komersial.

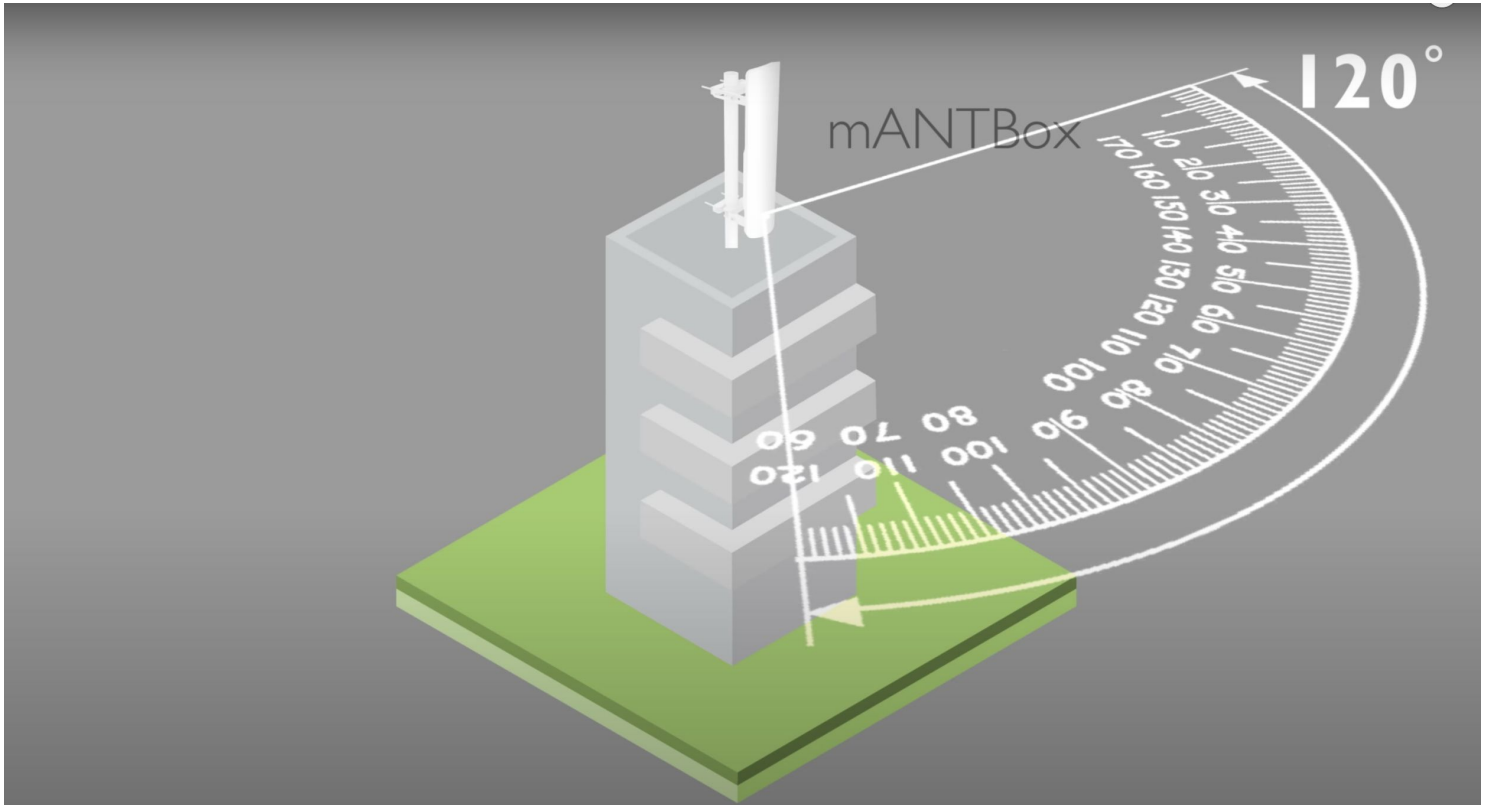
ISP deployment

Deployment steps

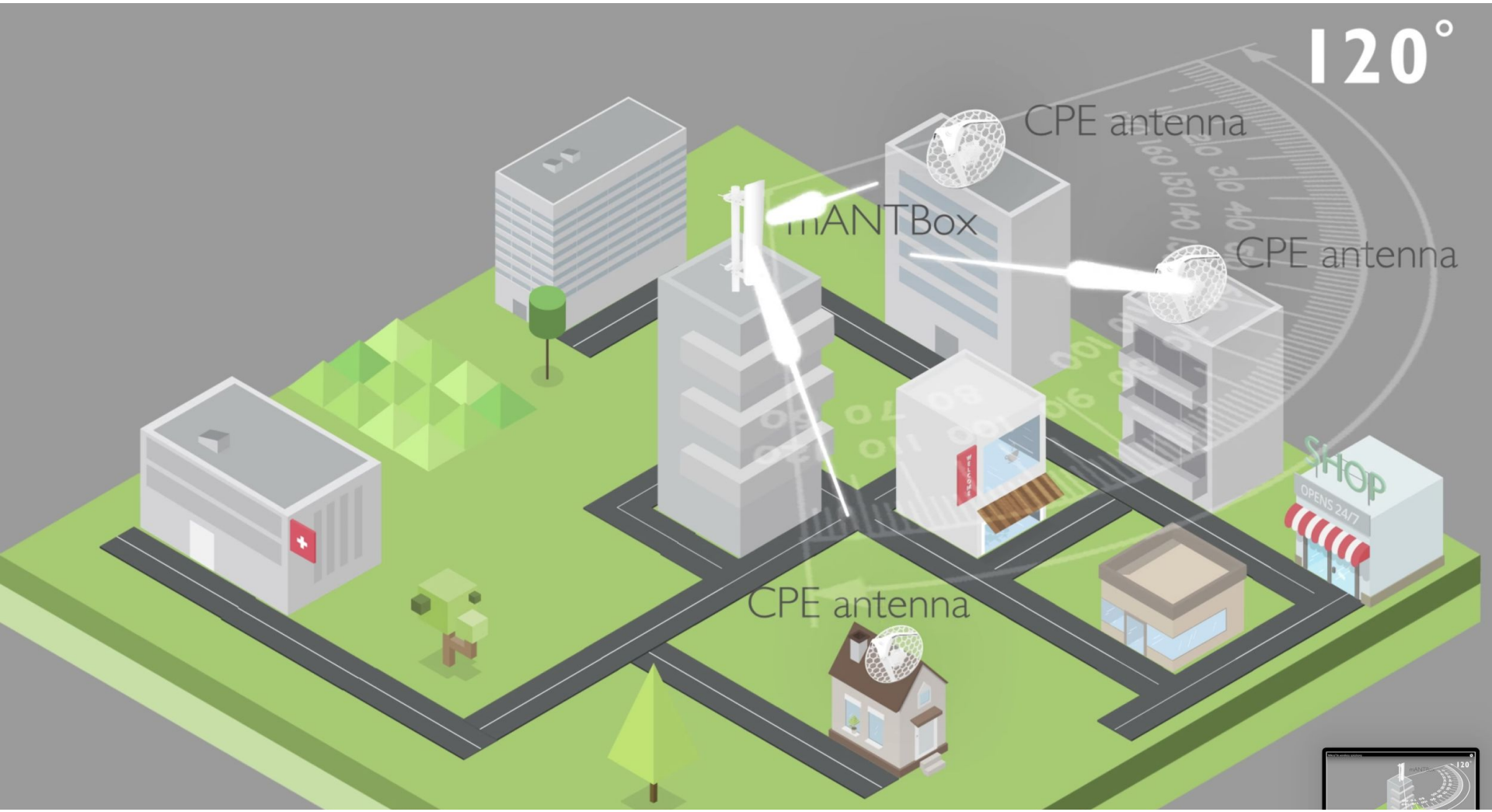
- Planning
  - Physical topology
  - Logical topology
- Installation
  - Network devices: router, switches
  - Links:
    - Wired: copper, fiberoptic
    - Wireless
      - Unlicensed frequency (802.11xx)
        - Can be very crowded
      - Licensed frequency

Wireless ISP (WISP) example

Start with an Access Point (Sectoral antenna)



Connect it to customer (CPE)



At customer site

Example equipment

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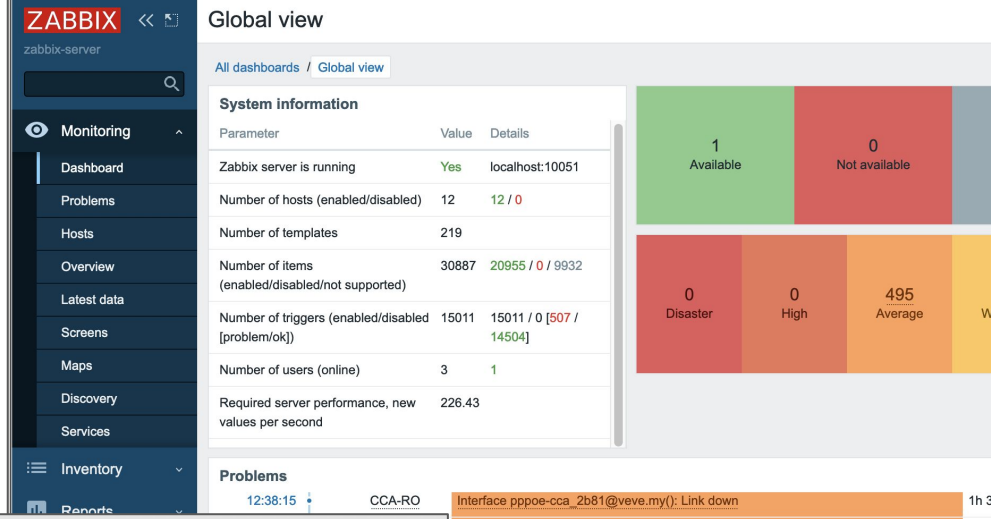
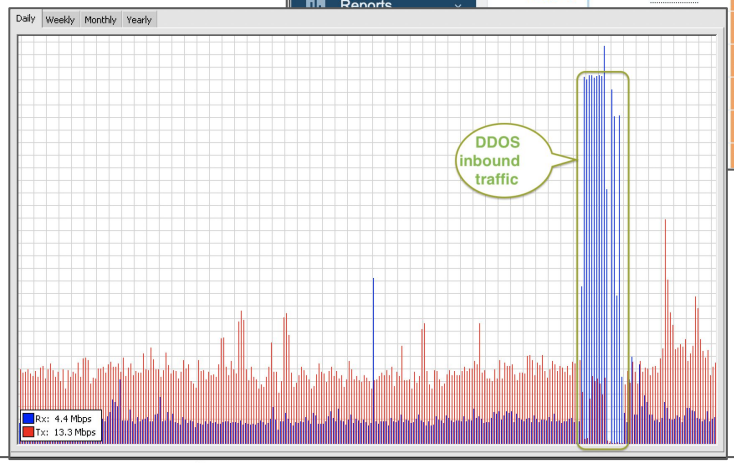
www.glcnetworks.com

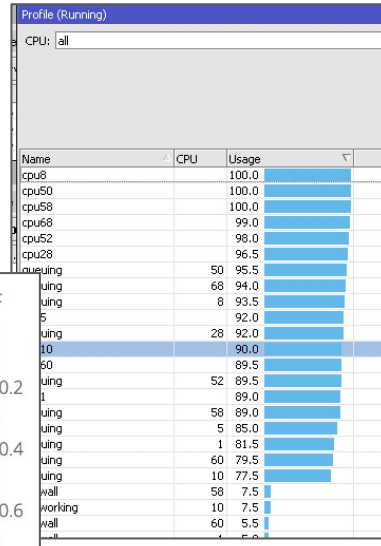
ISP operation

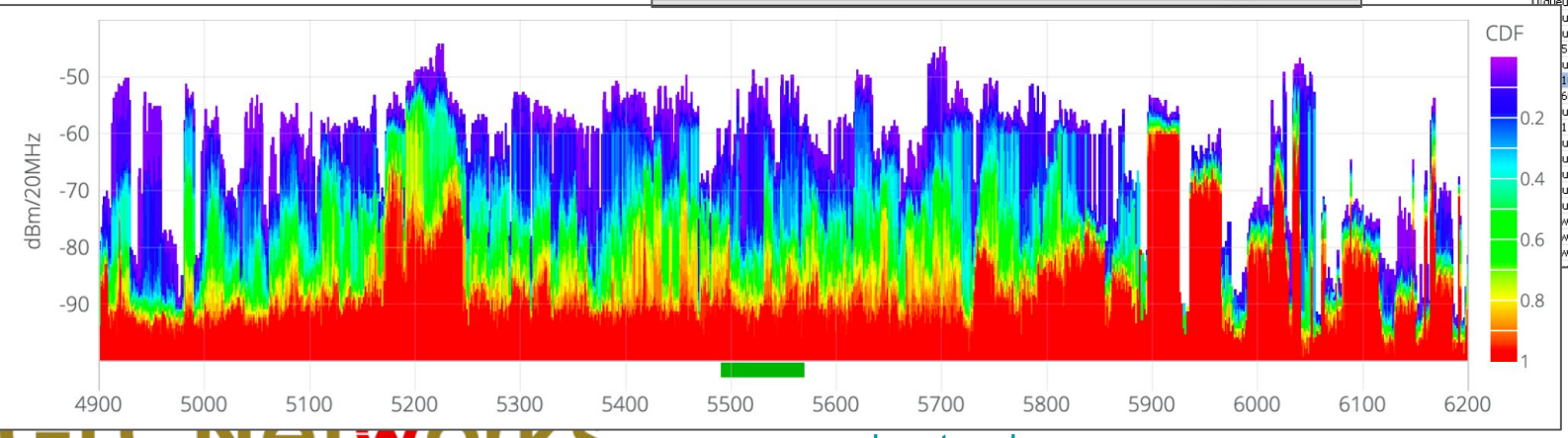
Operation: monitoring

- FCAPS
  - Fault
  - Configuration
  - Accounting
  - Performance
  - Security
- Mikrotik tools:
  - Profiling
  - Freq usage
  - Spectrum analyzer
  - The dude



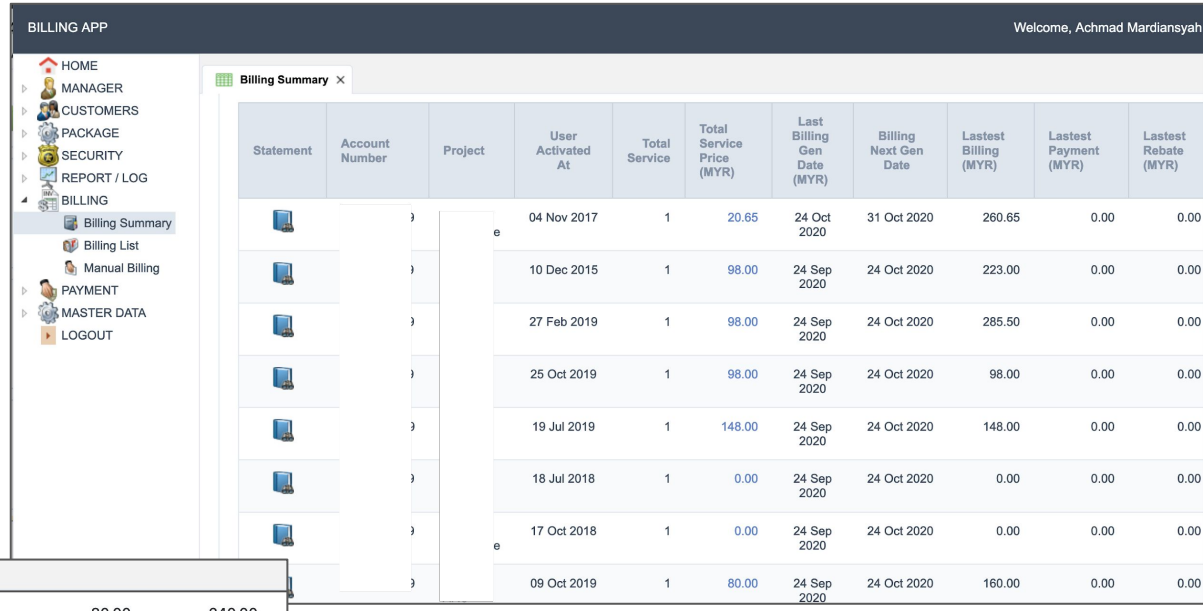


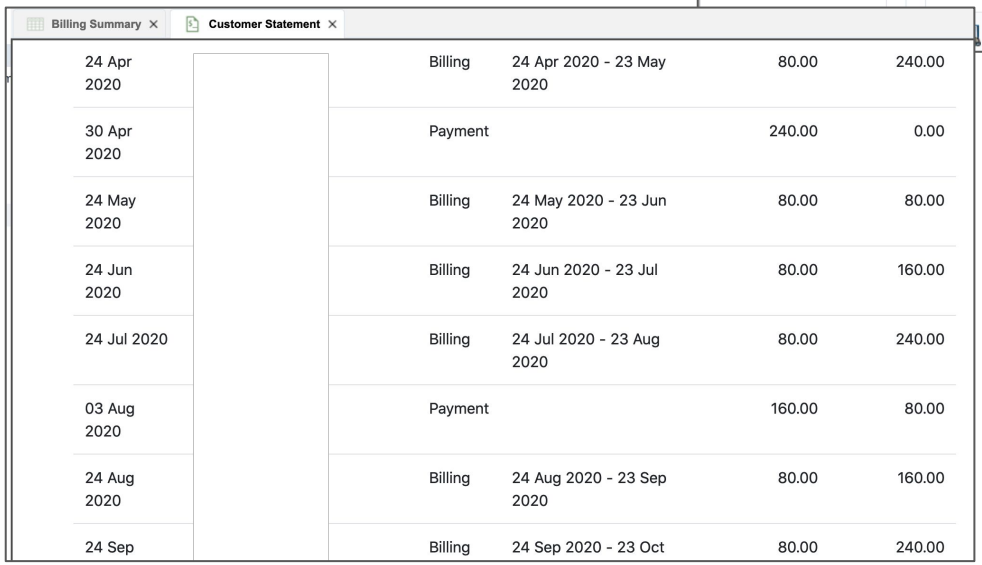




Operation: billing

- Money collection
- Invoice
- Balance inquiry
- Integration with payment gateway

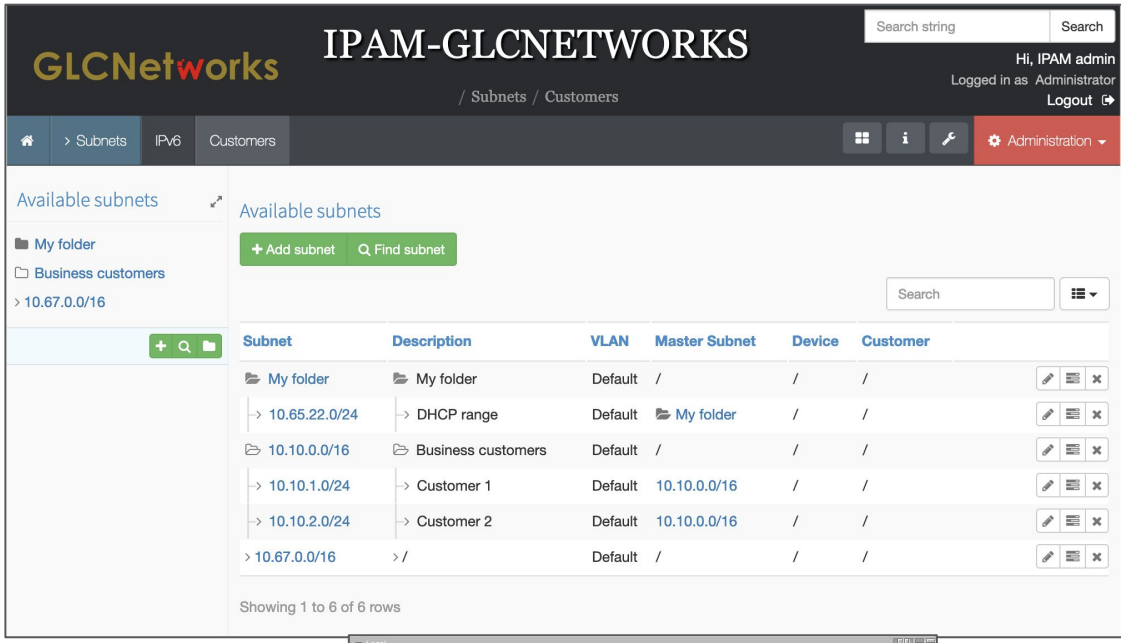


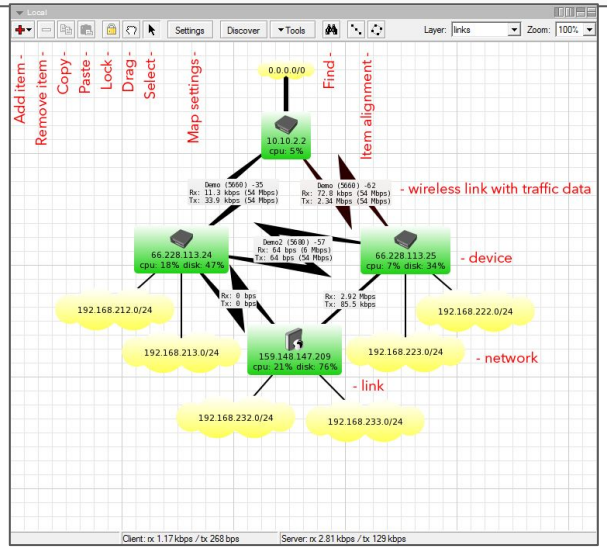


Operation: planning

- Hardware
- Physical topology
- Logical topology
  - Subnet
  - Routing
  - NAT

No ms excel please, use proper tool

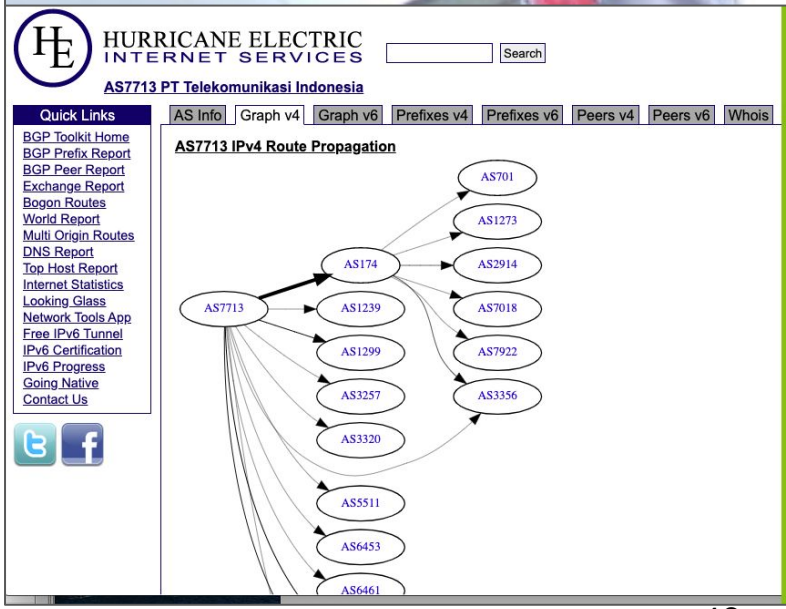




ISP troubleshooting

Troubleshooting

- Sometimes problem is not originate from our ISP
  - Google is down. YES, youtube had a downtime
  - Connection to blah is down
  - Customer itself
- Skills needed:
  - Technical skill
  - Soft Skill: calm down angry customers
- Tools:
  - Ping
  - Traceroute
  - Protocol analyzer (K15, wireshark)
  - Remote desktop
  - notification
-



Tips and trick

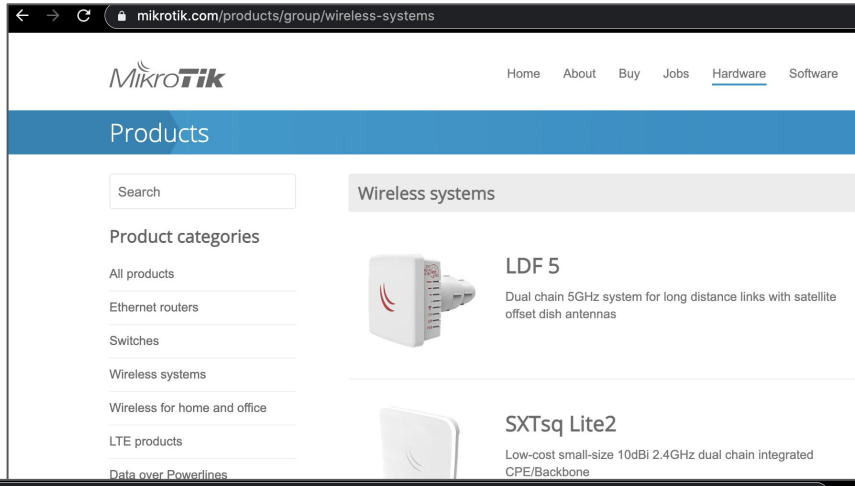
Tips to choose mikrotik product

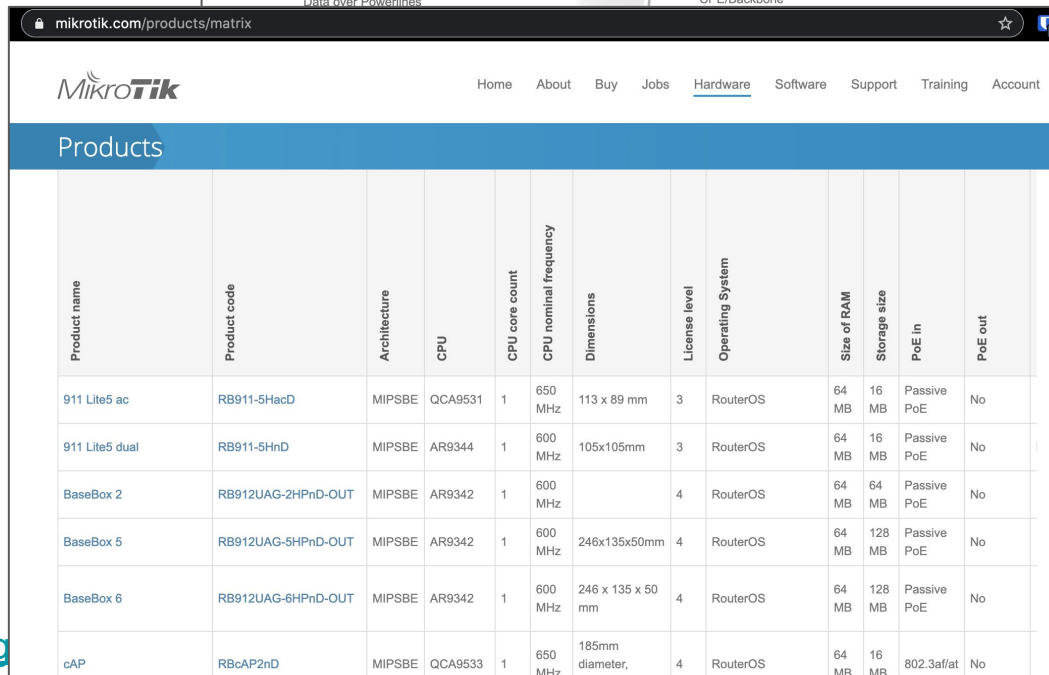
- Know what you want to do
- Allocate your budget
- Use feature selection on mikrotik website
- Mikrotik **“Can do”** ….
  - **doesn't mean** “must do”
  - **doesn't mean** appropriate
  - How can you use cheapest router for high traffic site?
- For outdoor wireless:
  - Understand RF
  - Use wireless product selection guide
  - Use wireless link calculator application
  -

Mikrotik wireless products

Wireless categories:

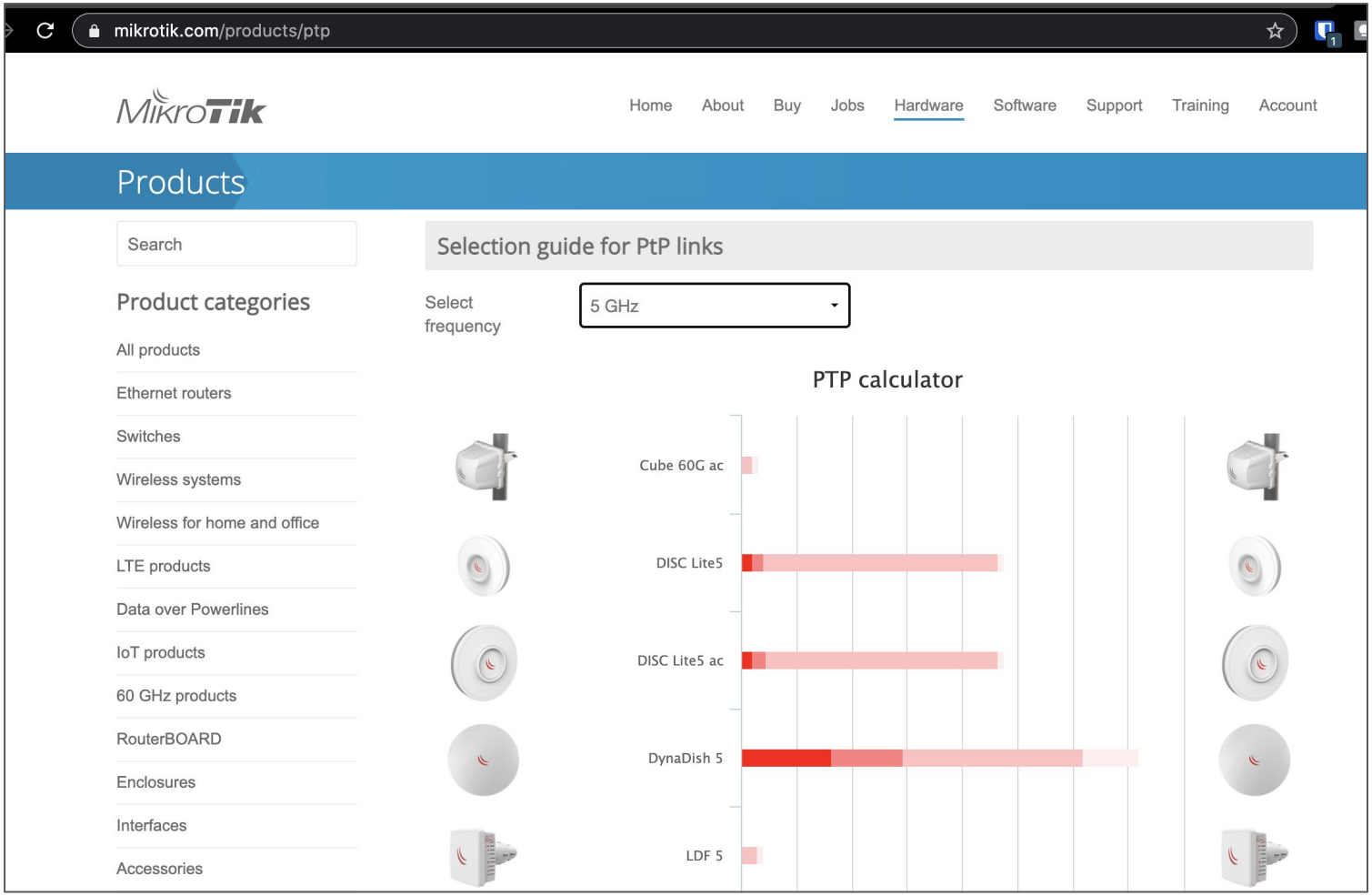
- Indoor
- Outdoor
  - Unit only (you buy antenna separately)
  - Built-in antenna



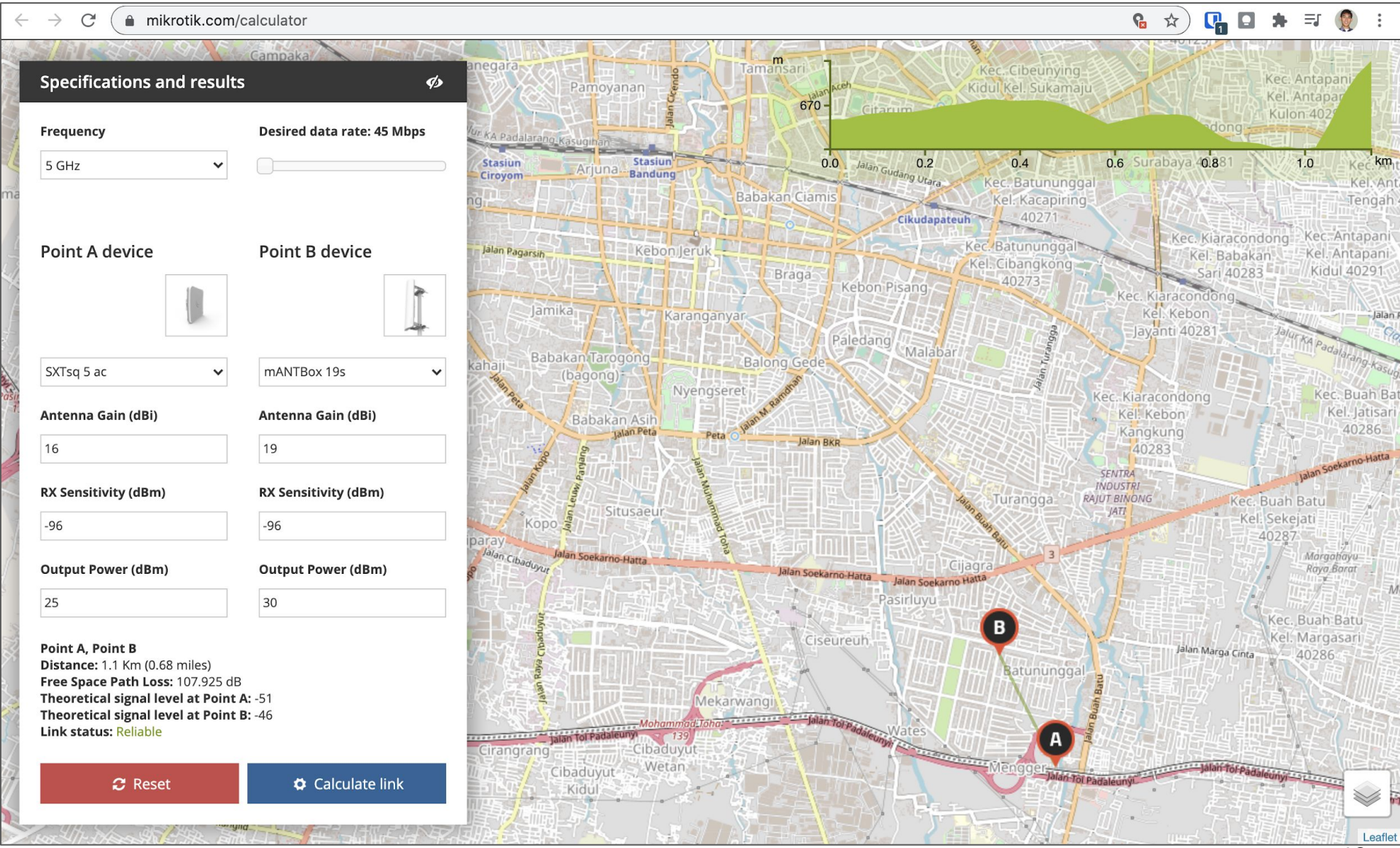


Product name	Product code	Architecture	CPU	CPU core count	CPU nominal frequency	Dimensions	License level	Operating System	Size of RAM	Storage size	PoE in	PoE out
911 Lite5 ac	RB911-5HacD	MIPSBE	QCA9531	1	650 MHz	113 x 89 mm	3	RouterOS	64 MB	16 MB	Passive PoE	No
911 Lite5 dual	RB911-5HnD	MIPSBE	AR9344	1	600 MHz	105x105mm	3	RouterOS	64 MB	16 MB	Passive PoE	No
BaseBox 2	RB912UAG-2HPnD-OUT	MIPSBE	AR9342	1	600 MHz		4	RouterOS	64 MB	64 MB	Passive PoE	No
BaseBox 5	RB912UAG-5HPnD-OUT	MIPSBE	AR9342	1	600 MHz	246x135x50mm	4	RouterOS	64 MB	128 MB	Passive PoE	No
BaseBox 6	RB912UAG-6HPnD-OUT	MIPSBE	AR9342	1	600 MHz	246 x 135 x 50 mm	4	RouterOS	64 MB	128 MB	Passive PoE	No
cAP	RBcAP2nD	MIPSBE	QCA9533	1	650 MHz	185mm diameter,	4	RouterOS	64 MB	16 MB	802.3af/at	No

Wireless product guide



Wireless link calculator



GLCNetworks

www.glcnetworks.com

A new (internship) opportunity

- Job desc: network engineer level 1 (basic skill is OK)
- Location: **overseas**
- Duration: 1-3 months
- Benefits: visa, transport, accomodation, pocket money
- Requirements
  - Have/will have a passport
  - Basic english
  - Able to do physical work
  - Able to operate mikrotik
  -

LIVE practice

Q & A

Interested? Just come to our training...

- Topics are arranged in systematic and logical way
- You will learn from **experienced teacher**
- Not only learn the materials, but also sharing experiences, best-practices, and networking

End of slides

- Thank you for your attention
- Please submit your feedback: http://bit.ly/glcfeedback
- Find our further event on our website : https://www.glcnetworks.com/en/
- Like our facebook page: https://www.facebook.com/glcnetworks
- Slide: https://www.slideshare.net/glcnetworks/
- Discord (bahasa indonesia): (https://discord.gg/6MZ3KUHHBX)
- Recording (youtube): https://www.youtube.com/c/GLCNetworks
- Stay tune with our schedule
- Any questions?