Regional Area Network (RAN) Architecture

Presentation to

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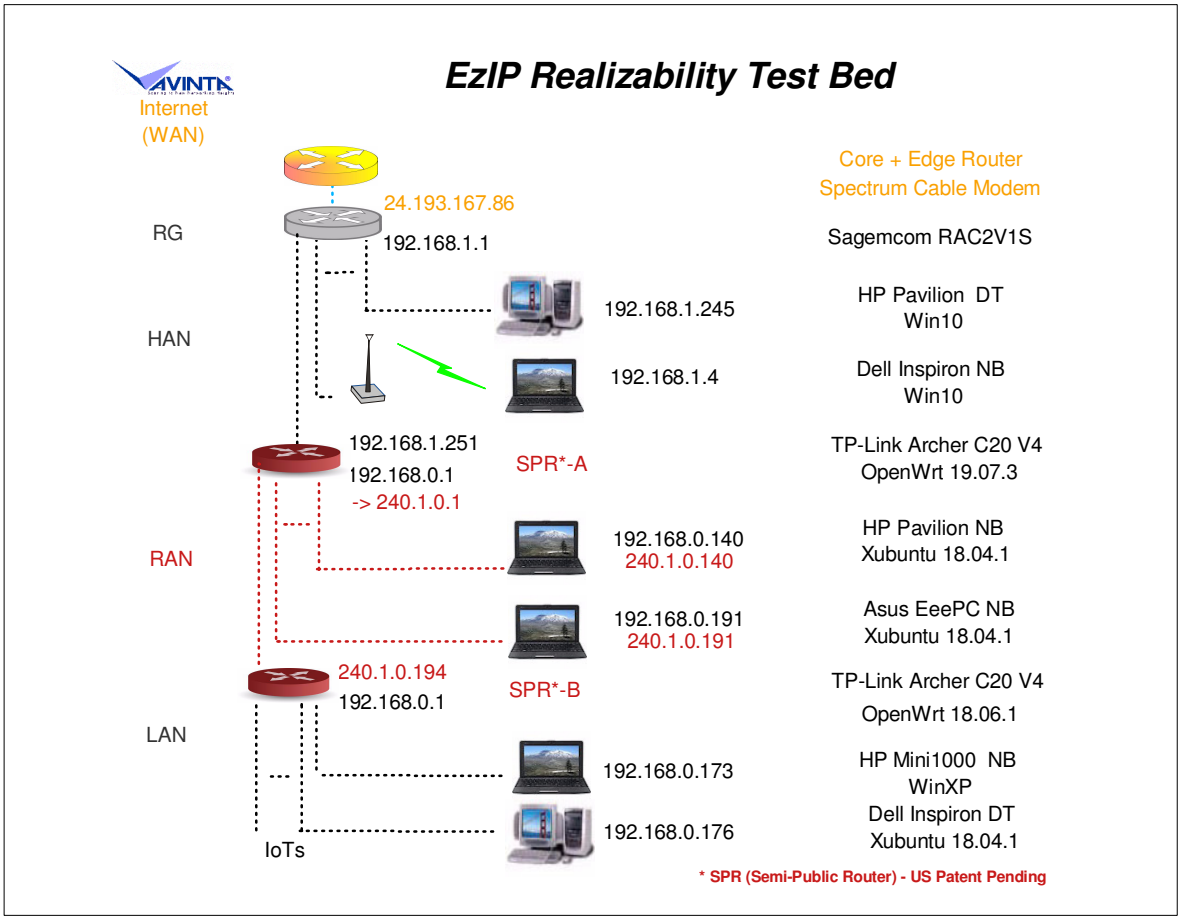
- This presentation describes a basic EzIP (phonetic for Easy IPv4) deployment configuration called RAN (Regional Area Network) for materially expanding the assignable public IPv4 address pool.
- We will begin with an EzIP realizability demonstration on an existing private network, utilizing a new router pair operating with the long-reserved but hardly-used 240/4 netblock addresses between them.
- While IoTs on the additional private networks may need to go through two extra stages of routers to access the Internet, general operation characteristics should be unaffected.
- A fresh RAN installation with its entire set of equally positioned entities will appear to be one ordinary private network on a single IPv4 public address. It has just one extra router stage in the Internet access chain from an IoT on any premises. Since part of the EzIP goals is to substitute the current CG-NAT function, there will be no net addition to the number of routers from the perspective of an IoT, after all.
- Since each RAN serves 256M entities from one single IPv4 address, general deployment of RANs will resolve the IPv4 address shortage issue.
- ***Note***: Certain device(s) may require specific startup procedure(s) upon hardware configuration and/or software setting changes. This could be distracting at times. For example, RGs normally expect an active WAN service during boot-up to receive DHCP client address. Yet, DOCSIS based cable modems may only provide such interaction within a short period of time upon its own power up.
- References:
  - https://tools.ietf.org/html/draft-chen-ati-adaptive-ipv4-address-space-07
  - https://www.avinta.com/phoenix-1/home/EzIPenhancedInternet.pdf



- To demonstrate the EzIP operation, we will work from a private network (HAN) with several IoTs, such as PCs (192.168.1.245 & .4) served by an ordinary RG (Routing / Residential Gateway - 192.168.1.1) accessing the Internet (WAN) via a broadband modem (24.193.167.86).
- SPR-A is an enhanced RG, such as a TP-Link Archer C20 V4 Router loaded with OpenWrt 19.07.3, capable of utilizing 240/4 netblock in addition to the three conventional private netblocks (10/8, 172.16/12 or 192.168/16) in its DownStream (LAN) port. Setting the SPR-A LAN port to 192.168.0.1 to avoid conflicting with that of the RG, and keeping its UpStream (WAN) port as a default DHCP client, plug SPR-A into RG to receive address assignmentn(192.168.1.251).
- Any IoT capable of operating with all of the four above-mentioned netblocks are suitable for operating under SPR-A. For the transition experiment, it is advisable to have IoTs capable of operating with two (one DHCP plus one Static) IP addresses simultaneously, such as PCs loaded with Xubuntu 18.04,1 OS, or later. These PCs (192.168.0.140 & .191) can verify 240/4 connectivity utilizing their 240/4 addresses, while the environment is still operating with the 192.168.0/24 netblock. After basic networked functions such as PING, file transfer and playing video between the client PCs as well as accessing the Internet are verified, only the SPR-A's LAN starting address needs be changed to 240.1.0.1 for the environment switch-over. Then, repeat the networked operations again to confirm that the upgrade is successful.
- SPR-B is a RG capable of functioning as a 240/4 DHCP client (240.1.0.194), such as a TP-Link Archer C20 V4 Router loaded with OpenWrt 18.06.1 or later. By default, LAN port of SPR-B is not on the 240/4 netblock. So, it can be used on SPR-A without manual configuration.
- Common IoTs, such as PCs set to DHCP client mode (192.168.0.173 & .176) on the SPR-B LAN (192.168.0.1) should operate as a conventional private network. Verify all above described networked activities are normal on these PCs, as well.

EzIP Compatible Components

SPR-A: RG capable of establishing 240/4 DHCP LAN

Router with OpenWrt 19.07.3 or equivalent

RAN IoT: IoT capable of being a 240/4 client

PCs with Xubuntu 18.04.1 or equivalent
(for desired dual IP address capability)

SPR-B: RG capable of being a 240/4 DHCP client

Router with OpenWrt 18.06.1 or equivalent

SPR-C: (Combination of SPR-A & SPR-B) Generic SPR

Router with OpenWrt 19.07.3 or equivalent

- This slide summarizes the reference devices used in this demo. Below is a list of additional known EzIP compatible networking components.
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- SPR-A: RG capable of utilizing 240/4 netblock in its LAN port DHCP server
  - Raspberry Pi 3 1GB
  - Any Router loaded with OpenWrt 19.07.3 or higher (968+ commercially branded models supported)
    - https://openwrt.org/toh/start?dataflt%5BSupported+Current+Rel_releasepage*%7E%5D=19.07.3
  - ...
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- IoT for RAN (OSs supporting 240/4 netblock):
  - Ambian/Debian Linux: Asus TinkerBoard, FriendlyElec NanoPC-T4
  - Chromebook2: Toshiba CB35-C3350
  - Linux Mint9.3: FriendlyElec NanoPC-T4
  - Linux Mint19 tara (Ubuntu 4.15.0): Compaq LT
  - Mint 19 Linux: AMD FX-8320 DT
  - Mint 20 Linux: AMD Ryzen 3600 DT
  - Mint Linux 19.3: Toshiba LT
  - Mojave (OSX 10.14.1): Apple LT
  - Raspian/Debian Linux: Raspberry Pi 4 4GB, 8GB
  - Ubuntu 14.04.6: HP Pavilion NB
  - Ubuntu 19.04 (Ubuntu 5.0.0): Apple LT
  - ...
  - (Windows OSs are not compatible.)
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- SPR-B: RG with WAN port capable of being a 240/4 client
  - Sagemcom RAC2V1S
  - ...
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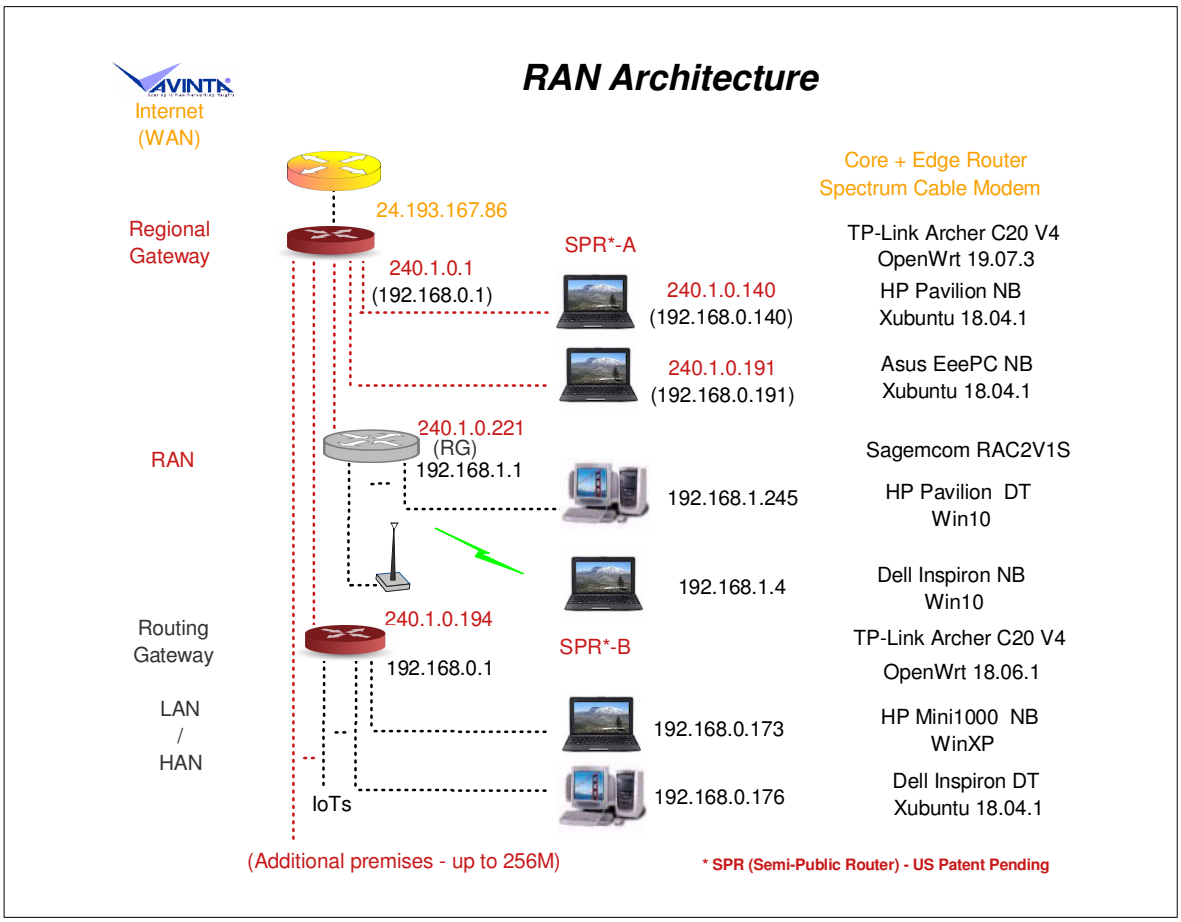
- Generic SPR: One single common type (without suffix) simplifies the RAN deployment.
  - Any Router operating with OpenWrt 19.07.3 or higher (See SPR-A above.)
  - ...



- By interchanging the sequence of RG and SPR-A in the router chain, the EzIP Realizability Test configuration becomes the basic RAN architecture.
- SPR-A (or a generic SPR) is an enhanced RG serving conventional LAN functions on its DownStream (LAN) port with the DHCP server utilizing the Semi-Public 240/4 netblock. With the resultant expanded addressing capability descrbed below, SPR-A may be called as a Regional Gateway (still could be abbreviated to RG).
- For each customer premises, a SPR-B (or a generic SPR) (240.1.0.194) is used to serve that private network. Any existing RG capable of being a 240/4 DHCP client may simply be connected to SPR-A as another client (240.1.0.221), thus fully retaining its original private network characteristics.
- The SPR-A LAN ports establish a private network based on only one IPv4 address from the Internet's perspective. On the other hand, with upto 256M assignable addresses, each pool is sufficient to support all IoTs in a region as large as Tokyo Metro (population ~39M, at ~6 IoTs/capita) or about 75% of the smaller nations around the world, via essentially a public network architecture.
- Making use of the three conventional private netblocks to manage small IoTs on customer premises will significantly reduce the demand for publicly identifiable addresses. This consolidation will free up many 240/4 addresses on each SPR-A,
- In brief, the simplest form of extending a public IPv4 address to begin an EzIP operation requires only inserting an SPR (SPR-A) between a broadband modem and its associated RG of an existing private network. Each SPR-A LAN port serves one new private premises through the use of an SPR-B.