



Streamline The Internet

Presentation to TWNOG 5

Taipei, Taiwan

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- Although the Internet achieved phenomenal advances during the last few decades, it is full of *confusions*, *contradictions*, *or even convolutions*, depending on one's perspective.
- ► The Internet promotes *leveling the playing field* for everyone. *US gets 4.9 IPv4 addresses per capita, while Zambia gets only 0.01*. The ratio is more than *2.6 orders of magnitude*. Some *other countries get no allocation, while Vatican City gets 21.4. Is this equality? Who is playing the God?*
- ► The Internet promised **end-to-end connectivity**. But, its current predominate operation model is CDN *(Content Delivery Network)* which has *a master-slave architecture* that impedes such.
- ► The Internet took issue with *telco monopoly and government regulation on PSTN*. Yet, we now have *multinational conglomerates* that each **dominates** a respective business sector to the point of *ignoring responsibilities and evading regulations*.
- ► Overall, the Internet is *vulnerable to security breaches*, ranging from harassment to ransomware.
- ► These days, any discussion can not avoid considering *IPv6* vs. IPv4. However, we will leave the former alone because its *lengthy address format is not user-friendly* for human use.
- ► A revisit of the overall environment suggests that there might be a fresh alternative. It not only could resolve the IPv4 address shortage situation, but also may mitigate a couple related issues while offering potential new capabilities.
- ► To see a whole picture, we need to look these far away from the earth, that is, 10K miles in the space, much more than the common wisdom of seeing a forest from an airplane at 30K ft.
- ► Today's talk, "Streamline the Internet" will describe what a scheme called EzIP (Phonetic for Easy IPv4) may contribute to the Internet. Internally, Phoenix is the code name for our project. .

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Outline

- A. Resources Hidden in Plain Sight
- **B. Simple Activation**
- **C. Utilize Existing Architecture**
- **D. Tethering Private Network**
- **E. Paralleling Overlay Network**
- F. Summary

		entation will focus on <i>high level concepts and system analyses</i> . With limited time, we have to future opportunities.
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**	В.	•••••
* *	C.	•••••
* *	D. A <i>loca</i>	I case will provide a visual idea about the approach.

► E. A *possible current application* example will be presented.



A.-a Resources Hidden in Plain Sight

- Reserved for "Future use" since 1981-09
- Not routable neither publicly nor privately
- Regarded by most as "forbidden zone"
- **■** Used by many unannounced projects
- Not impacting networks nor IoTs

- How many in the audience were born after 1981?

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A.-b Resources Hidden in Plain Sight

- Offers the potential of multiplying each current IPv4 public address by 256M fold
- An APNIC IETF Draft in 2008 proposed to redesignate 240/4 as Unicast, but limited to private use

In comparison, private netblocks under RFC1918 consists of
 10/8 Netblock: 16M
 172.16/12 Netblock: 1M

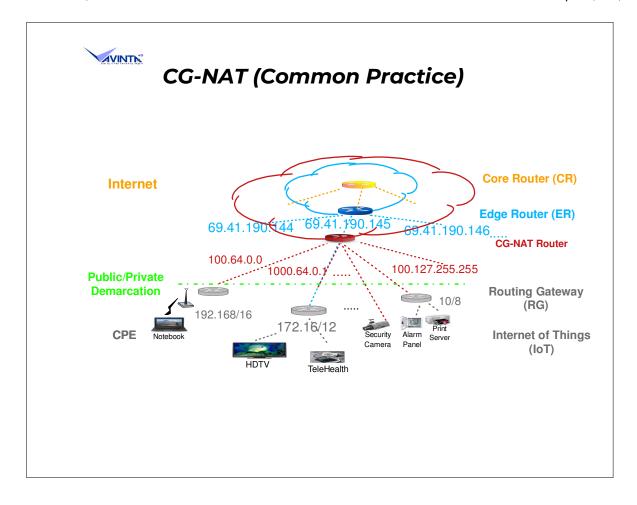
► 192.168/16 Netblock: 64K

Total: 17.064M addresses

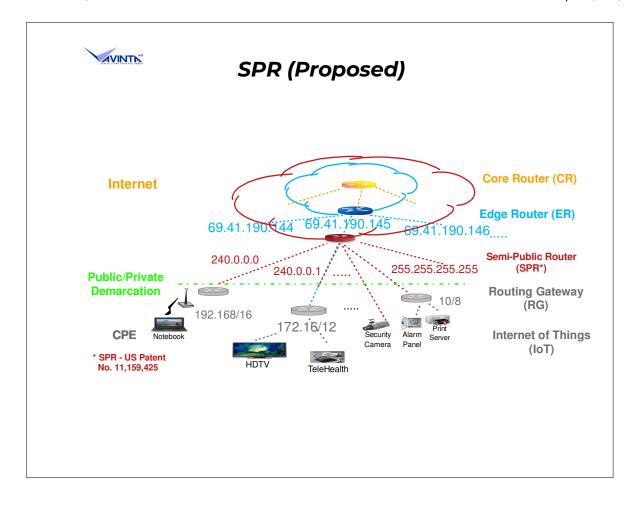
- CG-NAT:

► 100.64/10: 4M

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- Let's start with the basic Internet configuration: CR (Core Router) -> ER (Edge Router) -> RG (Routing Gateway) -> IoTs (Internet of Things).
- By inserting a CG-NAT router between ER and RG, each public IPv4 address is expanded by 4M fold.
- Putting CG-NAT around the Internet, the current predominate Internet architecture, CDN (Content Delivery Network) is formed.
- ► Each CG-NAT island has the limited address capacity of 4M.
- ► Within each isolated CG-NAT island with fewer than 4M subscribers, peer communication is possible.
- ► To make one CG-NAT island capable of serving more population, the 100.64/10 netblock has been reused dynamically, which defeats the peer communications goal.



- Let's start from the basic Internet again.
- By replacing the 100.64/10 netblock with 240/4, CG-NAT routers become SPRs each 256M address capacity.
- Deploying SPR all around the world, an extra layer of routers are formed.
- ► This address capacity increase by 64 times is significant. For example, if each person is assigned with one 240/4 address, only 4 countries in the world have populations exceeding the capability of one SPR.
- In addition, each household consists of three residents on the average (based on US statistics). If the SPRs focus on serving premises, only India and China have more premises than the capacity of one SPR.
- ► Note that these are ball park number estimates for orienting our minds about what is the realistic need for a practical IP address pool.



B.-a Simple Activation

- **■** Enable the use of the 240/4 netblock
 - <u>Disabling</u> program codes that have been disabling the use of the 240/4
- Use the 240/4 address as Semi-Public Unicast address

- ► For a long time, networking equipment blocked / dropped packets with 240/4 address, making such process appear to be a mystery. The actual mechanism is likely a very short screening code that recognizes the 240/4 address in an IP packet and then drops it.
- We have identified one such practical example. So, managers should take a note that software engineers declaring this as a complicated task may not know enough about their program codes.

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B.-b Simple Activation

- Simplify the 240/4 netblock administration
 - Static address assignment
 - Hierarchical network structure
- Deterministic addressing supports hierarchical and mesh routing

Note that dynamic addressing can not support hierarchical routing.



C.-a Utilize Existing Architecture

■ Apply 240/4 to CG-NAT for establishing a new set of router (SPR) between ER (Edge Router) and RG (Routing / Residential Gateway)

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C.-b Utilize Existing Architecture

- Enhance CG-NAT routers to use both 100.64/10 and 240/4 netblocks
- Address pool large enough for static assignment in each practical RAN (Regional Area Network)

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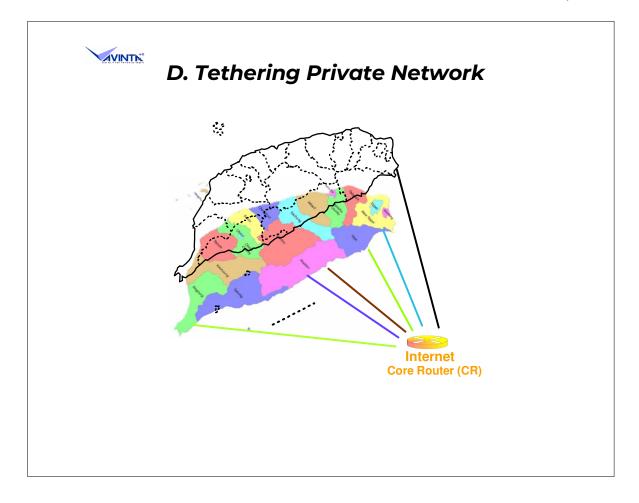
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- One of the most rudimentary communications system function is to provide peer communication (or end-to-end connectivity) for every subscriber. It requires every participant to have a unique / static address.
- The current CG-NAT operation uses dynamically assigned addresses that establish a master-slave architecture for serving the CDN (Content Delivery Network) purpose well, but impedes the peer communication.
- Current Taiwan population is about 24M. With 22 municipalities, each municipality on the average, has population of a little over 1M. The 4M addresses of one 100.64/10 netblock will be used up by just three municipalities. So, only a couple of municipalities may be served by one CG-NAT island to ensure peer communication. With the tight knit municipalities across Taiwan, this is obviously not practical.
- Since an SPR island is capable of serving everyone in Taiwan by one set of static 240/4 addresses, this establishes one single peer network called RAN for the entire Taiwan tethering over the existing Internet.



E. Overlay Network to The Internet



RANs form a Sub-Internet Parallel to the Internet core

■ The single RAN per country scheme can be applied worldwide. Except, a couple may need a few RANs. Together, they form a Sub-Internet,

■ that is parallel to the Internet Core, allowing capabilities and functions within each RANs be independently developed, as long as there are arms-length links among them through the CR for inter-RAN communication.

■ Let's look at this situation in a big picture from 10K miles away in the space.

► This graphics created by Dot-Connect-Africa depicts its long time disputes with ICANN about address allocation related issues. The floated African continent in the sky implies the disagreement.

■ Upon a closer look, other continents beyond Africa are also floating in the sky. This graphics may be interpreted as the bronze colored EzIP Sub-Internet hovering above the blue colored globe that represents the current Internet.



The Centralized Internet

- DNS function performed in datacenters, direct routing within a CG-NAT
- Conventional AS and BGP functions centralized to CDN
- With dynamic master-slave addressing, individual has no fixed identity to control activities over the Internet

■For faster and more efficient content delivery, distributed data centers are placed near or in key markets. This started by search engines, then adopted by content delivery services. Together, this configuration serves CDN well by not only improving performances, but also lowering cost.

- ■The side effect of this setup simplifies the routing services to be a local process without the use of AS and BGP functions. Essentially, the DNS in the CDN Gateways took over these tasks.
- From a casual user point of view, this scheme is fine for ordinary purposes. However, this configuration deprives Individual users of the identity that is essential to initiate and manage communication with one another directly, let alone the freedom to individually innovate..



Decentralize The Internet

- RANs form an overlay network with static addresses on existing Internet
- No router service required within a RAN
- **Enable direct peer communication**
- End users with permanent identities initiate and manage activities at will

- An RAN has an umbilical cord (IPv4 addressed transmission channel) to the Internet core.
- Unique static addresses enable **direct L2 routing** among subscribers without relying on router service.
- How many in the audience remember or know about Dial-up Modems over PSTN?
- Individuals are free to communicate with one another at will and to innovate.
- The Internet is **decentralized** because it is truly a communication backbone infrastructure supporting individualism from a user's perspective.



Progressive Transition

- Create RAN for peer communications (eMail, file sharing, video conference, etc.)
- CDN continues delivering content (video streaming, group game, etc.)
- CG-NAT may assume 240/4 addresses to release 100.64/10 netblock
- Merge the two to reunify the Internet

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■This RAN based facilit	y is like the traditional	postal and telephoni	V Services.

- while the existing Internet focuses on media distributions like the traditional broadcast and cable services.
- Since dynamic based operations do not mind using static address, CG-NAT can adopt the same static 240/4 addresses that subscribes are assigned under RAN operation.
- ► The 100.64/10 netblock can then be released back to the **general public address pool**.
- RAN & CDN operations can then be coordinated.



F.-a Summary

- Address expansion via 240/4 netblock
- Multiply each IPv4 address by 256M fold
- Network operation discipline Static and Hierarchical
- Inherent GeoLocation property for stronger CyberSecurity

■ The RFC1918 private network addresses can then be utilized by individual subscribers to expand respective private networks to handle on-premises IoTs.

- Overall Address Pool Philosophy: Instead of IAP (Internet Access Provider) commercializes IP addresses as private properties, regard them as shared public resources.
- Static address makes it harder for perpetrators to hide.



F.-b Summary

- Deployment Configuration
 Autonomous RANs Tethering off existing Internet
- Enhanced Architecture

 Overlay Sub-Internet
 Arm's length from existing Internet

■ Each RAN can operate independent of others.

■ The only requirement is to conform with established protocols when communicating with CR.

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F.-c Summary

- End-To-End connectivity within a RAN
- RAN for peer messaging (Data & Video)
- **CDN for entertainment (Streaming & Game)**
- **Extendable to worldwide (via RFC791)**
- Test beds for new Internet services
- Improve security, Reduce cost and expense
- All start from asking for a minor program code simplification

■ Communication within each RAN via **L2 routing**.

■ RAN: Personal communication.

■ CDN: Entertainment

- Utilize Option Word mechanism defined by RFC791 to route packets among RANs via two-level of IPv4 addresses (total of 64 bits). This is the same as the country code prefixes for international telephony. Details are in the References.
- Note: Since there are only fewer than 300 jurisdictions worldwide, two octets of (half of) one IPv4 address (64K combination) will be more than sufficient to identify all RANs. The rest can be used for Test beds.
- Static address makes perpetrators harder to hide, mitigates loss due to Cyber security breaches. EzIP approach offers minimum CapEx and significant OpEx savings
- Code Simplification

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References A. [Podcast] DNS is the new BGP

https://blog.apnic.net/2024/02/08/

podcast-dns-is-the-new-bgp-how-we-really-route-things-in-the-modern-internet/?utm_source=mailpoet&utm_medium=email&utm_campaign=apnic-blog-weekly-wrap_4

B. The rise and rise of CDN

https://www.youtube.com/watch?v=gxO73fH0VqM

C. Using 240/4 Unannounced

https://labs.ripe.net/author/qasim-lone/2404-as-seen-by-ripe-atlas/

D. Unicast Use of the Formerly Reserved 240/4

https://datatracker.ietf.org/doc/html/draft-schoen-intarea-unicast-240-06

E. RAN Building Blocks

https://openwrt.org/toh/start https://us.dlink.com/en/products/dgs-1210-28-28-port-gigabit-smart-managed-switch

F. Overview

https://www.avinta.com/phoenix-1/home/RevampTheInternet.pdf

- The first two references are closely related.
- A. This Podcast outlines how the Internet operation becomes relied upon CG-NAT.
- ► B. This **APRICOT 2024 YouTube** describes the public communication evolution to become **centralized around CDN**.
- C. This RIPE NCC (Réseaux IP Européens Network Coordination Centre -- Regional Internet Registry for Europe) Lab article reports that multinational conglomerates have been using 240/4 unannounced. Since they are difficult to detect, it demonstrates that using 240/4 is not perturbing normal Internet operations.
- D. IPv4 Unicast Extension Project proposes to reclassify 240/4 formerly Class E, among a few other netblocks, as Unicast for better utilization.
- ► E These are off-the-shelf networking equipment supported by open source code from OpenWrt to operate with 240/4 netblock. The first are RG level devices. These will buffer on-premises IoTs (including PCs) from the 240/4 environment. The D-Link GigaBit smart switch can be used to start experimenting SPRs and deploying RANs before any current CG-NAT router is upgraded.
- ► F. This whitepaper is an EzIP proposal from a more business prospective. It provides additional reference materials, such as how to make use of RFC791.





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Questions?
Comments?
Next Step?
Thank You!

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■ Questions?
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■Comments?
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■Next Step?

► Based on material presented so far, anytechnically capable person can deploy a RAN, even starting from one's basement or backyard, since the use of the 240/4 netblock will not disturb the current Internet nor private network. This is analogous to how UNIX based network routers quietly replaced those based on Windows.

Please drop a line to us about your thoughts and activities, so that your experiences may be shared with other parties with similar interests.

■ Lastly, allow me to share a layman's naive perspective. That is, if we treated the Internet as a packetized PSTN, the Internet could be easily streamlined.

► Thank You!