Revamp The Internet

Presentation to

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- **The Internet is full of contradictions, some are even convoluted. As a starter, the Internet promotes leveling the playing field for everyone. But, the address allocations turn out to be unfathomable:**
- **US gets 4.9 IPv4 address per capita, while**
- **Zambia gets 0.01 IPv4 addresses per capita.**
- **The IPv4 based Internet went through phenomenal growth during the last few decades. However, the future is dampened primarily due to the exhaustion of the assignable public address pool. After extensive study, the only solution seemed to be moving on to IPv6. However, IPv6 has not been delivering what was expected.**
- **Currently, the Dual-Stack approach has to be adopted to allow both to coexist. It does not relieve the need for IPv4 address while making equipment more complex.**
- **A recent review of the IPv4 suggests the possibility for a fresh alternative. It not only resolves the IPv4 address depletion situation, but also mitigates a couple related issues, plus offers potential new capabilities.**
- **The implication of the Phoenix icon will be apparent after this presentation.**

Outline

A. Resources Hidden in Plain Sight

B. Simple Activation

C. Utilize Existing Architecture

D. Tethering Private Network

E. Paralleling Overlay Network

F. Summary

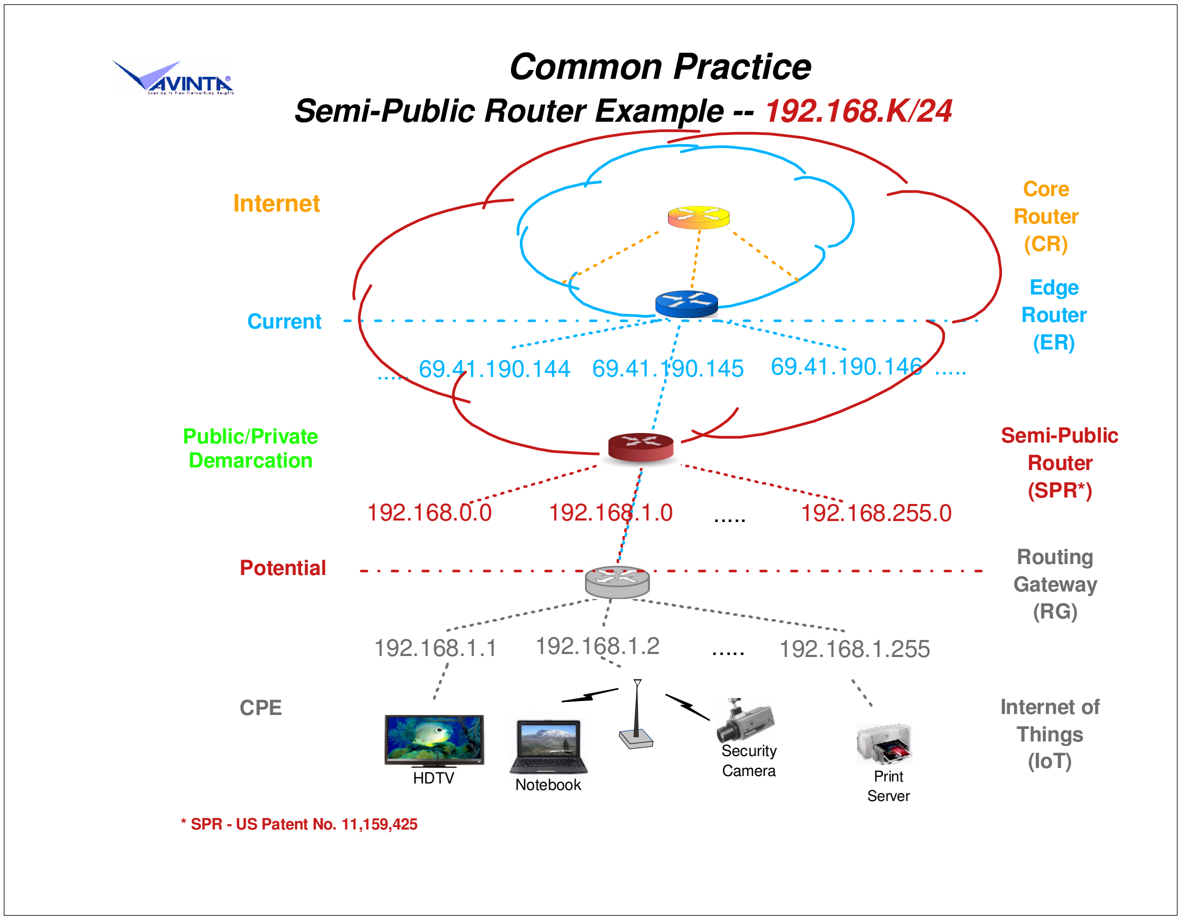
- **This presentation will focus on an overview of system level concepts and analysis. Later, we can explore related detailed topics of interest.**
- **We will start with identifying the IPv4 address resources, and what has it been doing.**
- **How to activate these resources, and**
- **How to deploy them.**
- **The initial deployment enhances but does not perturb the current Internet operation. The basic configuration actually is a simple extension to today's Internet in the form of private networks called RAN (Regional Area Network), making use of the core for inter-RAN communication.**
- **For the long term deployment, direct links among RANs can be established in response to traffic demand to form an overlay network layer called sub-Internet that is in parallel to and operates independently of the existing Internet core.**

A. Resources Hidden in Plain Sight

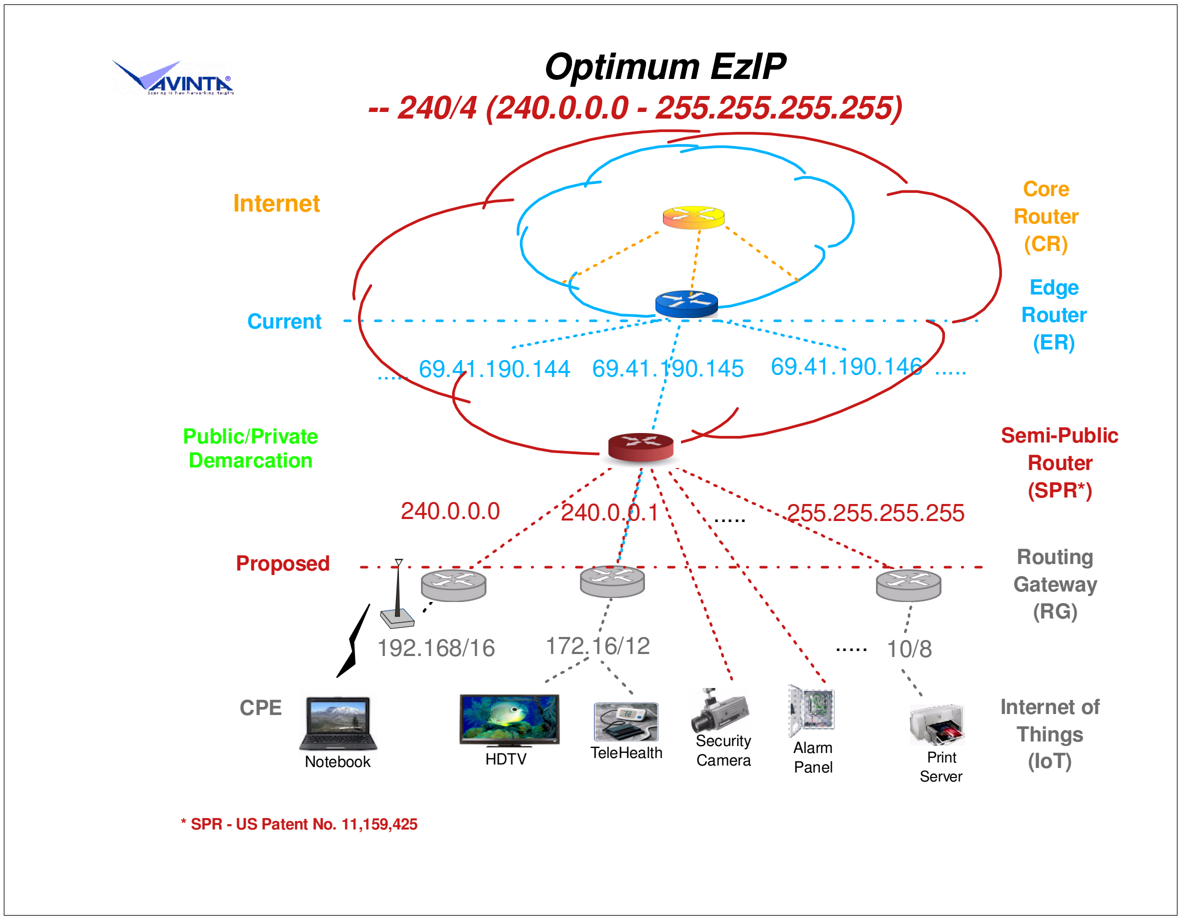
The 240/4 Netblock:

- **Reserved for "Future use" since 1981-09: Not routable - neither publicly nor privately.**
- **Regarded by most as "forbidden zone".**
- **Being used by many unannounced projects, not impacting public and private networks nor IoTs.**
- **Offers the potential of multiplying each current IPv4 public address by 256M fold.**
- **APNIC IETF Draft 2008 proposed to redesignate 240/4 as Unicast, but limited to private use.**

- **After being reserved for so long, most people regard 240/4 netblock as a forbidden zone without questioning it.**
- **In reality, being dropped by most networking equipment, 240/4 is ideal for unannounced private projects, because 240/4 addressed packets would only stay within those specific equipment that recognize them.**
- **Among many, the most notable proposal was the IETF Draft in 2008 by three senior APNIC officials:**
  - **https://datatracker.ietf.org/doc/html/draft-wilson-class-e-02**
- **Currently, IPv4 Unicast Extension Project is proposing to reclassify 240/4 to Unicast, yet without specific application in mind:**
  - **https://datatracker.ietf.org/doc/html/draft-schoen-intarea-unicast-240-03**



- Although everyday Residential Gateways (RGs) are allocated with a private network address block 192.168/16, most RGs are actually operating with the 192.168.K/24 convention, whereby K is a parameter between 0 and 255, with most common values being 0, 1, 2, 10, etc. preset in the factory. Under this condition, each private network is restricted to 256 addresses, available from the fourth octet.
- A group of RGs like the above, each with a different K value, may operate from the same public IPv4 address without conflict. This expands one IPv4 public address to serve 256 premises. The router that provides this function is one of the basic SPRs.
- Since the RGs have not changed nor moved, the conventional demarcation line will remain where it has been from a subscriber's perspective.
- Applying this configuration to every one of the 4B IPv4 addresses, we can expand the Internet by 256 fold to get the total of about 1000B assignable IPv4 compatible public addresses. The supply becomes 20 times of the 50B IoTs by Year 2020. Or, even the spare pool is now 19 times of the demand.
- This finding encouraged us to look further for similar and perhaps better resources. For conciseness in the discussion, we created a name, EzIP (phonetic for Easy IPv4) for representing various aspects of these efforts.



- Let's start with a basic Internet system diagram the same as the previous one, except showing a 172.16/12 private network.
- Making use of the 240/4 netblock, each SPR may expand an IPv4 public address to a publicly assignable pool of 256M addresses.
- The Demarcation line will similarly stay where it is currently at.
- The 4B Internet address pool is now expanded 256M fold to be 1000MB, or 20M times of the projected IoT demand (50B) by Year 2020.
- Since 256M (0.256B) addresses have to be reserved from the overall IPv4 pool first, the more accurate calculation of the above would be about 0.959BB ((4 - 0.256)B x 0.256B), or 959MB.

B. Simple Activation

- **Enable the use of the 240/4 netblock**
  - ***Disabling*** **program codes that have been** ***disabling*** **the use of the 240/4**
  - **Use the 240/4 address as Semi-Public Unicast address**
- **Streamline the 240/4 netblock administration**
  - **Static address assignment**
  - **Hierarchical network structure**

Although most networking equipment blocks / drops packets with 240/4 address and the process has not been looked at for a long time making it like a mystery, the actual mechanism is a short screening code that recognizes the 240/4 address in an IP packet and thus drops it.

This could be reversed as simple as disabling that one line code by commenting it out. Once this is done, the 240/4 can be used as any other public address.

Instead of DHCP, it is recommended to assign 240/4 addresses as static addresses and managed in hierarchical manner for a streamlined address administration operation.

Note that hierarchical addressing does not preclude mesh routing, while the reverse would not work.

The deterministic nature will make the network more robust against Cyber intrusion.

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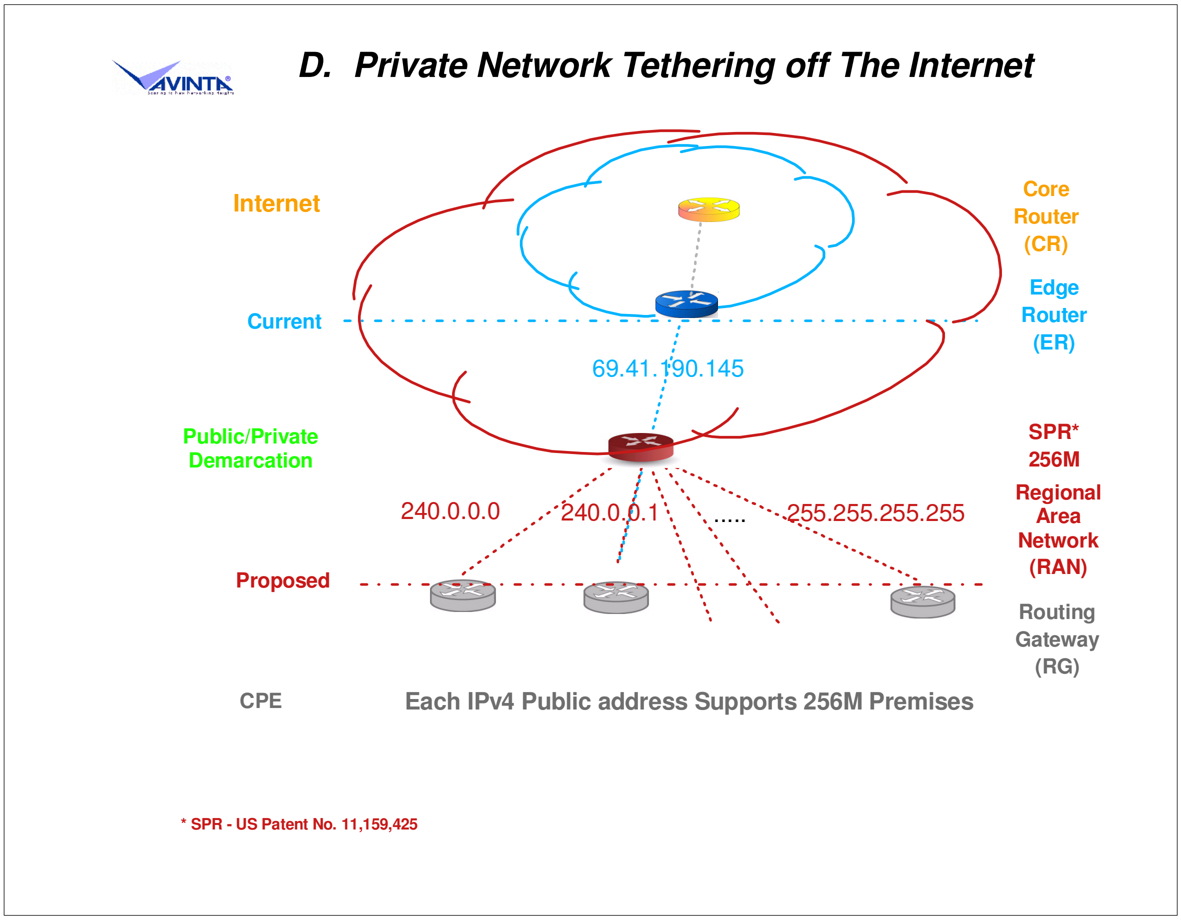
C. Utilize Existing Architecture

- **EzIP utilizes one new layer of router (SPR) between ER (Edge Router) and RG (Residential Gateway)**
- **CG-NAT / CDN already doing similarly**
- **Replace 100.64/10 netblock of RFC6598 with 240/4 netblock**
- **Address pool large enough for static assignment in any practical RAN (Regional Area Network)**

► **The basic deployment of SPRs (Semi-Public Routers) is inserting between ER and RG one layer of Semi-Public network that appears to be private to the Internet core.**

► **This architecture is essentially the same as that for CG-NAT or CDN. So, the actual SPR deployment is just to replace 100.64/10 netblock currently in use according to RFC 6589 with those from 240/4.**

► **Based on Cisco's estimate of each person may own up to 6.6 IoTs, each 240/4 netblock with 256M addresses can support a community up to about 40M people. Such a population is larger than the most populous city (Tokyo Metro. - 39M), or 75% of the smaller countries. For a community of this size, much of its activities would be confined within and served by local servers. Each of such a deployment configuration is called a Regional Area Network (RAN).**



► For a quick overview, this is how a RAN looks like.

► Although the proposed SPR was formulated from the existing private network configuration for expanding such, the resultant sheer size of each, i.e., one sixteenth of the entire IPv4 address pool, opens up intriguing potentials.

► A RAN configuration offers the following characteristics:

► A. Within a RAN, the communication would be like those on a current private premises from the Internet's perspective.

► B. All RAN traffic to and from the Internet will go through the root SPR on one single IPv4 public address umbilical cord.

► C. That is, the setup and operation within a RAN can be independent of the current Internet protocol, as long as it behaves like a common IoT over the umbilical cord.

E. Overlay Network Paralleling to The Internet

Interconnected RANs become a Sub-Internet
Overlaying on the existing Internet

- **This graphics created by Dot-Connect-Africa depicts its long time disputes with ICANN about addressing issues. The floating African continent in the sky implies the disagreement and segregation between the two.**
- **Since other continents beyond Africa are also floated in the sky, this graphics may be interpreted as a situation whereby all Internet users are floated above the globe which represents the current Internet governed by the ICANN.**
- **This extended perspective fits well with the sub-Internet configuration consisting of RANs based on the EzIP scheme.**
- **That is, RANs can be viewed as individual kites tethered with umbilical cords with the globe floating in the sky, relying only on the Internet core to communicate among them. When the RANs are interconnected among one anther, however, the RANs form an overlay network called Sub-Internet that essentially can operate independently of the Internet core.**

F. Summary

- **Address Expansion via 240/4 Netblock**
  Multiply each IPv4 address by 256M fold
- **Operation Discipline - Static and Hierarchical**
  Inherent GeoLocation Property for CyberSecurity
- **Deployment Configuration**
  Autonomous RANs - Tethering off Existing Internet
- **Enhanced Architecture**
  Overlay Sub-Internet - Independent of Existing Internet
- **Growth Potential (with full EzIP Protocol)**
  Test Beds for New Internet Services
- **All Start from Asking for a Minor Software Simplification**

- **Address Expansion: Each IPv4 public address may now serve a stand-alone area with population up to 40M (without utilizing the private network facility). Thus, most countries require only one public address to serve all needs - no more reliance on DHCP, NAT etc.**
- **Operation Discipline: Instead of being IAP owned private properties, regard IP address as public resource. So that its administration can mimic the PSTN practices for telephone numbers, mitigating the root-cause of CyberSecurity vulnerability.**
- **Deployment Configuration: Each RAN tethering off the Internet via one IPv4 address can operate autonomously within itself. It only makes use of the IPv4 umbilical cord for sharing information with other RANs.**
- **Enhanced Architecture: With direct links among RANs, an overlay network is formed that can operate totally independent of the current Internet core.**
- **Growth Potential: The additional assignable addresses will enable operations that are not currently possible, such as realistic test bed for now protocols.**
- **Reference Components:**
  - **https://openwrt.org/toh/start**
  - **https://us.dlink.com/en/products/dgs-1210-28-28-port-gigabit-smart-managed-switch**

Soaring to New Networking Heights

Revamp The Internet

Questions?

Comments?

Next Step?

Thank You!

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