

Raiders of the lost Ark

(read: “in search for the lost CE”)

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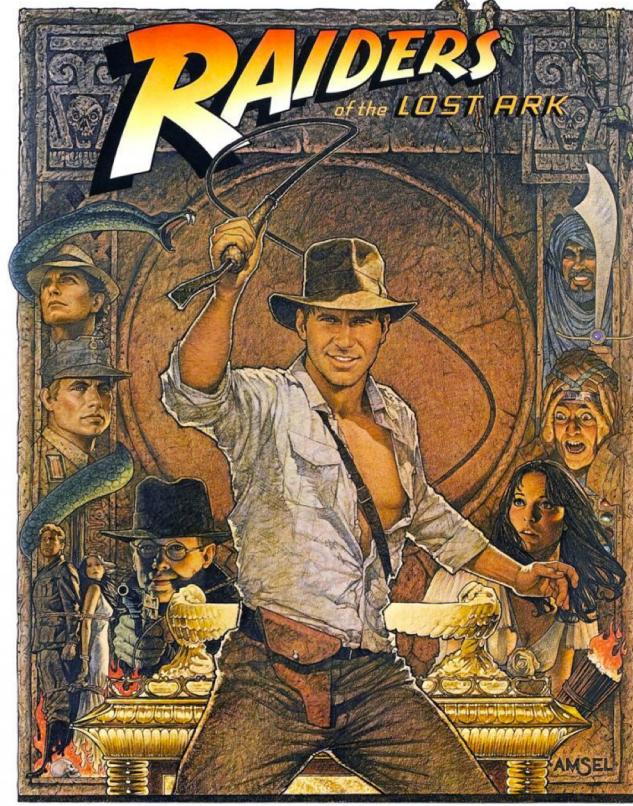
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@JordiPalet

(jordi.palet@theipv6company.com)

Just like Indiana Jones ...

The Return of the Great Adventure.



- One of the difficulties to get IPv6 deployed has been the lack of CEs with good IPv6 support
 - Dual-stack
 - Transition mechanisms
- RFC6204 (2011), obsoleted by RFC7084 (2013), helped
 - “Basic Requirements for IPv6 Customer Edge Routers”
 - Only partially
 - transition was not key
- Meant for a world that can deploy dual-stack or IPv6-in-IPv4 (6rd, others)

The fight of the smaller

- Big ISPs are able to customize the CEs to their own needs ...
 - Tell me what you want!
- Small and medium ISPs can't buy big quantities
 - Need to buy in the retail market
 - You get what is there
 - no special features, not all the needed RFCs/protocols
 - Different models/vendors = different features = more complex O&M



- Lack of pressure to CE vendors
 - Lack of required features

Surprise ... no more IPv4

- We run out of IPv4 ...
- Dual-stack and IPv6-in-IPv4 (6rd, others) are no longer an option !
 - CGN is not an option
 - Expensive boxes
 - You IP ranges in the CGN will get soon black listed
 - You recycle them
 - You need to invest again in acquiring new IPv4 blocks ...



We are tied ...

- IETF to the rescue!
- Can we survive in an IPv6-only world ?
 - New transition mechanisms allow
 - IPv6-only access networks
 - IPv4-as-a-Service (IPv4aaS)



Wait a minute ... not yet done!

- The CEs need to support that ...
- Small ISPs will not get it that easy
- Need to update RFC7084



My journey started in 2016

- RFC7084-bis adopted by v6ops (Chicago, March 2017)
- Push-back in July 2017 (Prague)
 - Discussed several options (4 new I-Ds)
- New ID, not related to RFC7084, in Singapore (Nov. 2017)
 - Adopted as WG item in March 2018 (London)
- 8 new versions later ... Last call in August 2018!



The IPv6 CE with IPv4aaS

- Specifies the IPv4 service continuity requirements for an IPv6 Customer Edge (CE) router, either provided by:
 - the service provider
 - retail market
- Provisioning of IPv6 transition services for the support of "IPv4 as-a-Service" (IPv4aaS) by means of new transition mechanisms



- Required in a world where IPv4 addresses are no longer available, so hosts in the customer LANs with IPv4-only or IPv6-only applications or devices, requiring to communicate with IPv4-only services at the Internet, are still able to do so

RFC8585

- Specifies the IPv4 service continuity mechanisms to be supported by an IPv6 Transition CE Router, and relevant provisioning or configuration information differences from [RFC7084]
- NOT a recommendation for service providers to use any specific transition mechanism
- Automatic provisioning of more complex topology than a single router with multiple LAN interfaces may be handled by means of HNCP [RFC7788]
- An ISP MAY specify a different set of features

If you're a Vendor

- Since it is impossible to know prior to sale which transition mechanism a device will need over its lifetime, the IPv6 Transition CE Router intended for the retail market **MUST** support all of them



IPv4aaS Transition Requirements

- Key target: Support of IPv6-only WAN access and legacy IPv4 functionality
 - IPv4-only devices or apps in customer LANs
1. MUST support the DHCPv6 S46 priority options [RFC8026] (Unified IPv4-in-IPv6 Softwire Customer Premises Equipment (CPE): A DHCPv6-Based Prioritization Mechanism)
 2. MUST have a GUI, CLI and/or APIs
 3. MUST allow appropriate subnetting if more than one LAN

Configuration Steps:

1. Request transition config options and keep them disabled
2. Check for a valid priority match to enable them
3. If no match, keep all them disabled

Transition Mechanisms

- 464XLAT
- DS-Lite
- Iw4o6
- MAP-E
- MAP-T

464XLAT Requirements

1. MUST perform IPv4 NAT unless a dedicated /64 is available for the stateless NAT46 translation
2. SHOULD support IGD-PCP IWF [RFC6970] (UPnP Internet Gateway Device - Port Control Protocol Interworking Function)
3. If PCP [RFC6887] is implemented, MUST also implement [RFC7291] (DHCP Options for the PCP)
4. MUST implement [RFC7050] (Discovery of the IPv6 Prefix Used for IPv6 Address Synthesis)
5. If PCP is implemented, MUST follow [RFC7225] (Discovering NAT64 IPv6 Prefixes Using the PCP)
6. [RFC8115] MUST to discover a valid NAT64 prefix
7. Implements a priority for the NAT64 prefix
8. A valid NAT64 means 464XLAT is prioritized following [RFC8026]

DS-Lite Requirements

1. MUST support configuration with DHCPv6 [RFC6334]
2. SHOULD support IGD-PCP IWF [RFC6970]
3. If PCP [RFC6887] is implemented, MUST also implement [RFC7291]
4. MUST NOT perform IPv4 Network Address Translation (NAT)

Iw4o6 Requirements

1. MUST support configuration of Iw4o6 via the Iw4o6 DHCPv6 options [RFC7598] (DHCPv6 Options for Configuration of Softwire Address and Port-Mapped Clients)
2. MUST support the DHCPv4-over-DHCPv6 (DHCP 4o6) transport [RFC7341] (DHCPv4-over-DHCPv6 Transport)

MAP-E Requirements

1. MUST support configuration of MAP-E via the MAP-E DHCPv6 options [RFC7598]
2. MAY support Dynamic Allocation of Shared IPv4 Addresses [RFC7618] (Dynamic Allocation of Shared IPv4 Addresses)

MAP-T Requirements

1. MUST support configuration of MAP-T via the MAP-T DHCPv6 options [RFC7598]
2. MAY support Dynamic Allocation of Shared IPv4 Addresses [RFC7618]

Other Requirements

1. If IPv4 multicast services are supported, then it MUST support [RFC8114] (Delivery of IPv4 Multicast Services to IPv4 Clients over an IPv6 Multicast Network) and [RFC8115] (DHCPv6 Option for IPv4-Embedded Multicast and Unicast IPv6 Prefixes)
2. UPnP support related
3. 6rd no longer supported (vendors may keep it)

Code Considerations

- Adding support in existing CEs for those transitions mechanisms, requires around 10-12 Kbytes
 - Most of the code base is shared among several transition mechanisms
 - Single data plane is common
- Typically means about 0,15% of the existing code size in popular CEs already in the market
- New requirements don't have extra cost in terms hardware (RAM, CPUs, etc.)
- Example: OpenWRT

Further Reading

- NAT64/464XLAT Deployment Guidelines in Operator and Enterprise Networks

<https://datatracker.ietf.org/doc/draft-ietf-v6ops-nat64-deployment/>

Conclusions

- Indiana Jones was looking for the “lost ark”
 - We finally found the “lost CE” for an IPv6-only Internet
- If you’re an ISP, make sure too look for this (soon RFC) in your new CE acquisitions:
 - RFC8585
 - Will make your life easier and reduce you O&M costs



- If you’re a vendor, you will have many more business opportunities complying with it
 - Simplify your manufacturing process, less firmware versions, all them work for any ISP, same as for the retail market
 - Reduce R&D costs!

Thanks!

Contact:



@JordiPalet

jordi.palet@theipv6company.com