464XLAT/NAT64 Optimization

draft-ietf-v6ops-464xlat-optimization-04

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Problem Statement

- In IPv6-only networks using NAT46 (464XLAT, MAP-T), IPv4-only devices flows to dual-stack CDNs/Caches/services are terminated as IPv4, which means extra translations and the subsequent unnecessary overload
  - In many cases this may become a show-stopper
- In equivalent IPv4-only CGN use cases, the CDNs accept “private” addresses (typically 100.64.0.0/10) to avoid exactly the same issues

Typical 464XLAT Deployment

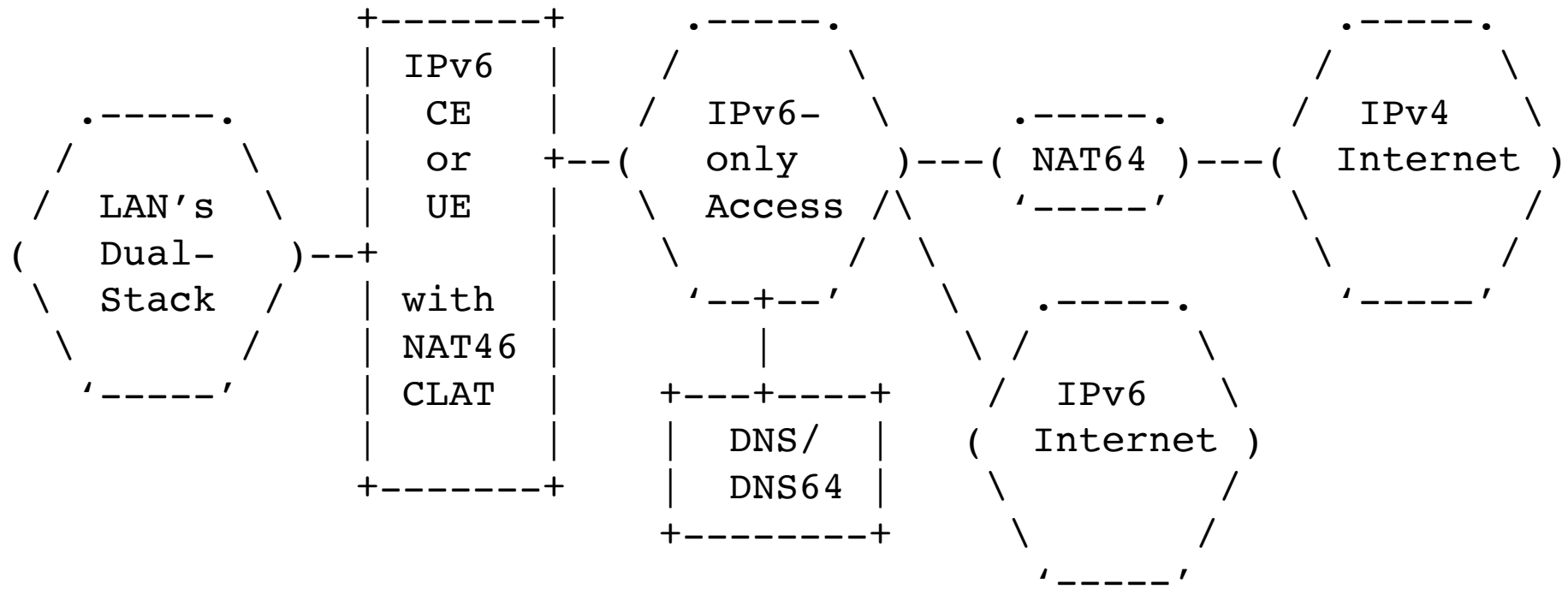
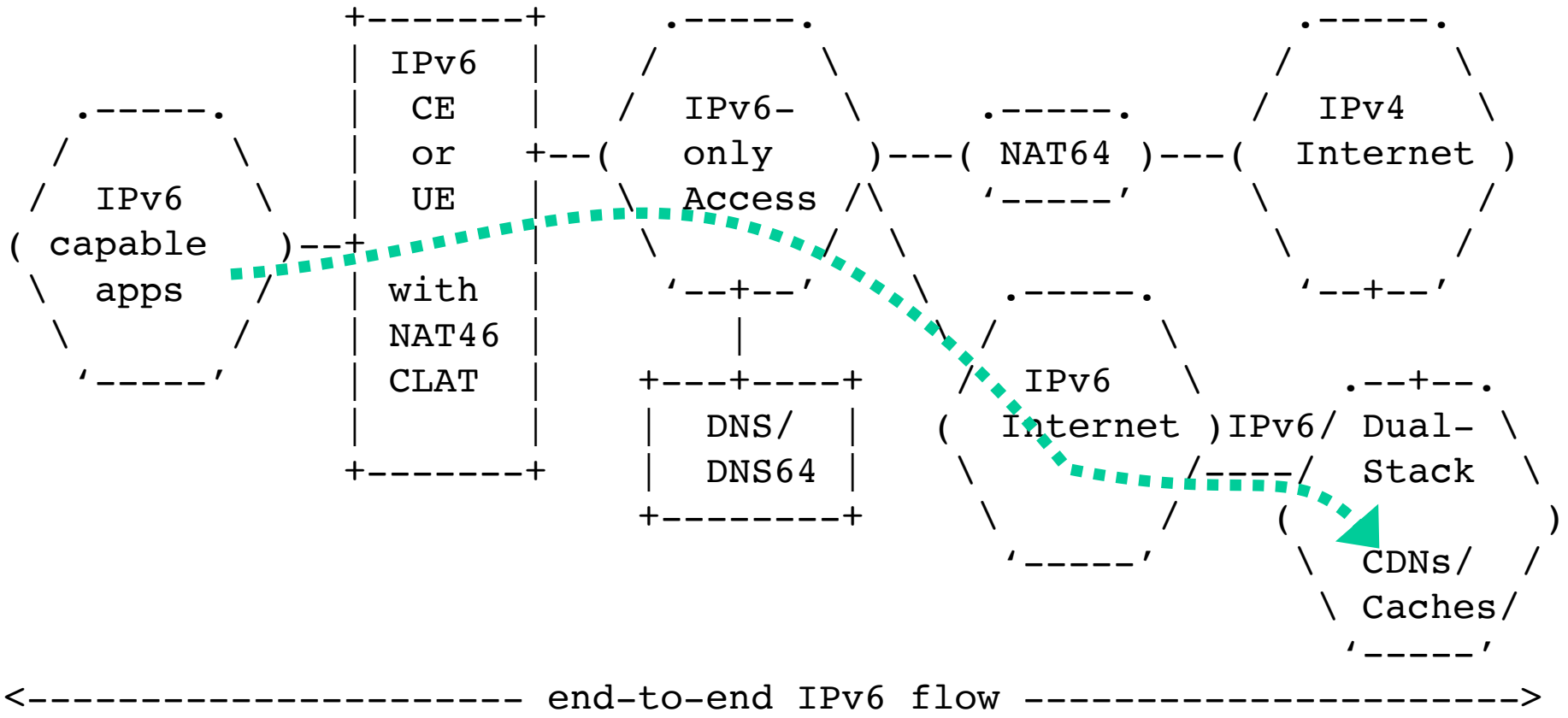
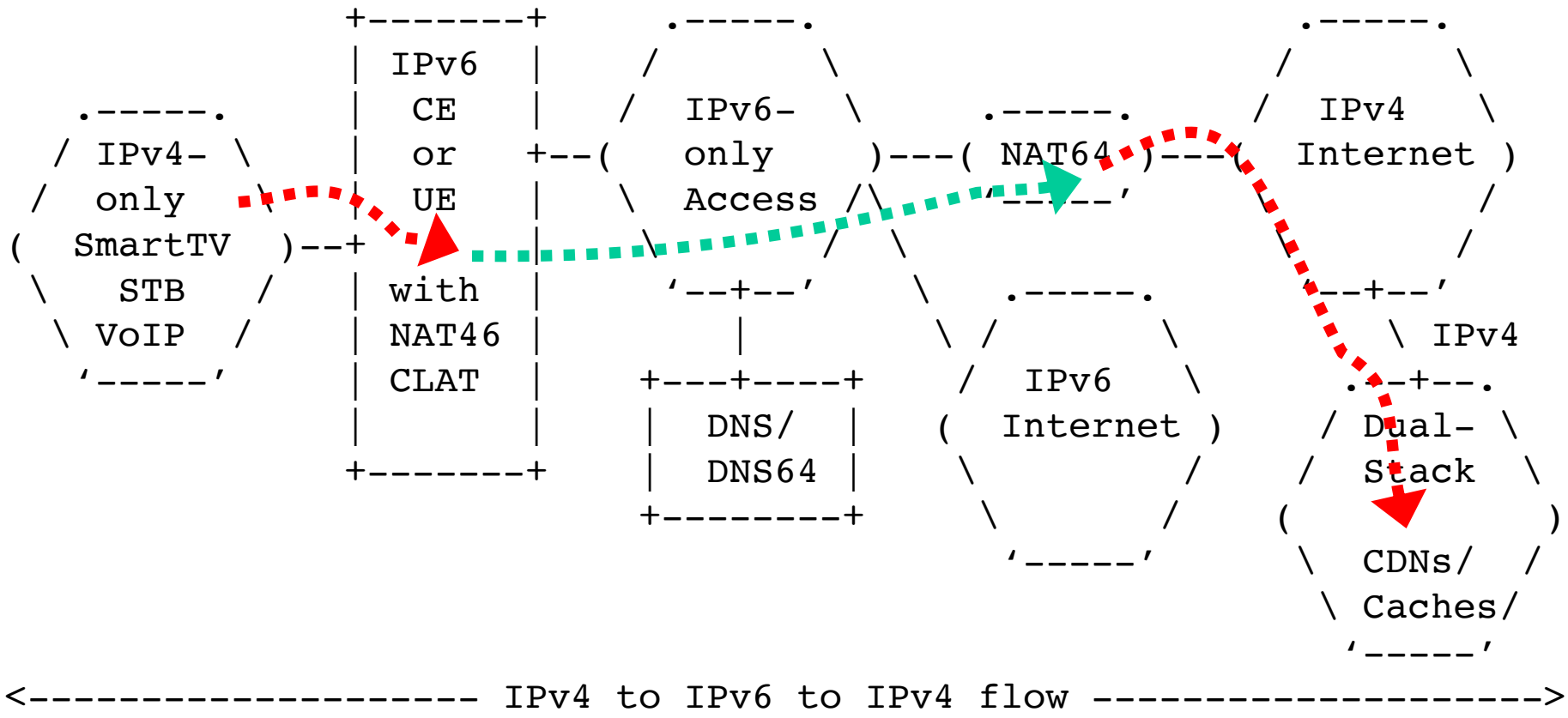


Figure 1: Typical 464XLAT Deployment

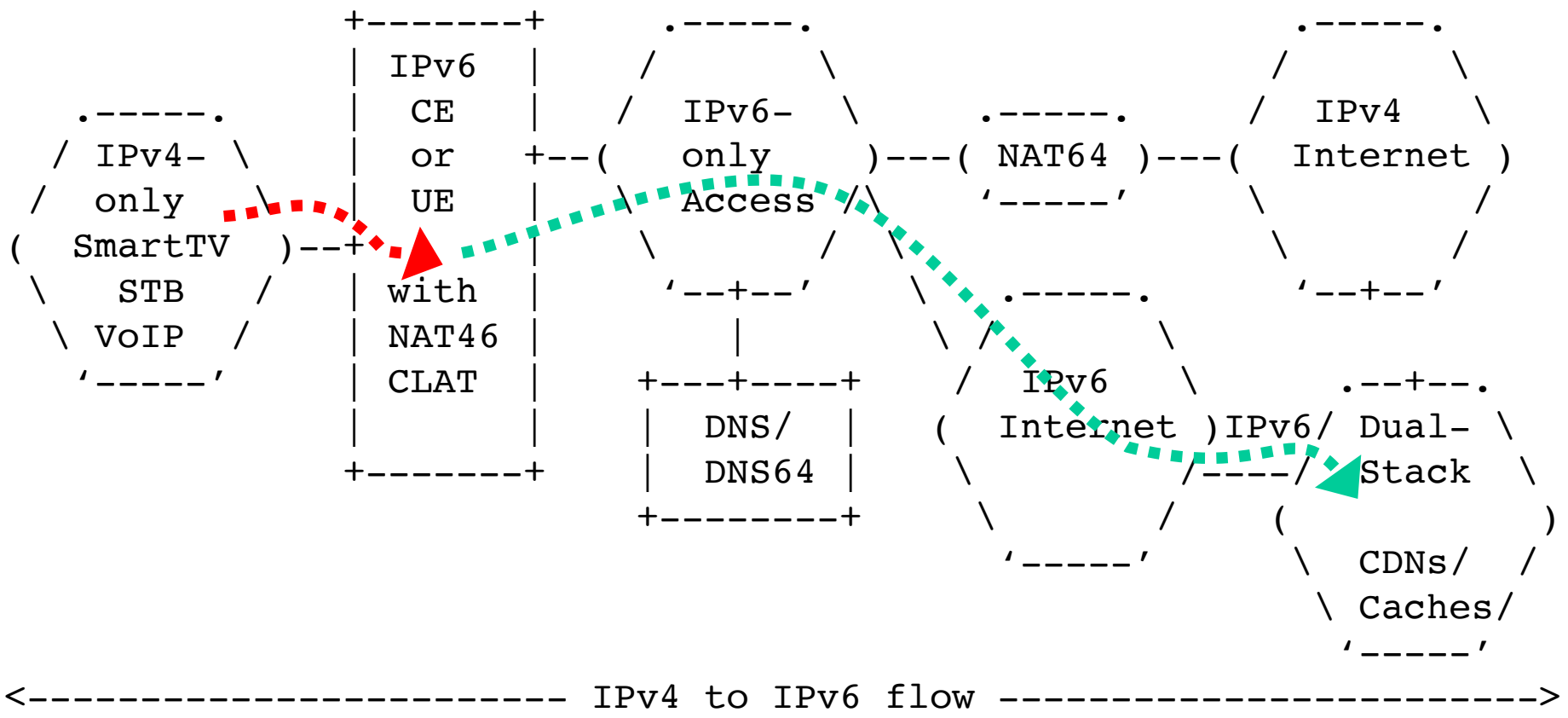
IPv6-Capable device



IPv4-only device



IPv4-only device (optimized)



Approach 1: DNS/Routing-based

- CLAT translate A records into AAAA:
  - WKP::A or NSP::A
- CDN/Cache provider configures dedicated interfaces to match WKP::A or NSP::A

www.example.com	A	192.0.2.1
CLAT translated to		64:ff9b::192.0.2.1
CDN IPv6 interface must be		64:ff9b::192.0.2.1
Operator must have a specific route to		64:ff9b::192.0.2.1

- Issues:
  - Only works if “local/private” connectivity
  - CDN/Cache provider needs to do “something”

Approach 2: CLAT/DNS-proxy-EAMT

- NAT46/CLAT/CE is also a DNS proxy/stub resolver, so an internal interaction can be created.
- This approach uses existing IPv4 and IPv6 addresses (A, AAAA RRs), so no additional complexity for services.
- Steps:
  - Detection of IPv4-only devices
    - Same MAC bound only to IPv4 address, not IPv6.
  - Detection of IPv6-enabled service
  - Creation/maintenance of extended EAMT (RFC7757)
  - Forwarding path for existing EAMT entries via stateful NAT46

Approach 2 Example

- Example

www.example.com	A	192.0.2.1
	AAAA	2001:db8::a:b:c:d
EAMT entry	192.0.2.1	2001:db8::a:b:c:d
NAT64/CLAT translated to		2001:db8::a:b:c:d
CDN IPv6 interface already is		2001:db8::a:b:c:d
Operator already has specific route to		2001:db8::a:b:c:d

1. A query for www.example.net A RR is received
2. www.example.net A 192.0.2.1
3. www.example.net AAAA 2001:db8::e:e:f:f
4. A conflict has been detected
5. The existing EAMT entry for 192.0.2.1 is set to stale

(it can be used to continue existing previous connections, but not new ones)

Approach 2: Additional Considerations

- Behavior in case of multiple A/AAAA RRs
- Behavior in case of presence/absence of DNS64
- Behavior when using literal addresses or non IPv6-APIs
- Behavior in case of Foreign DNS
  - Devices/apps using other DNS
  - DNS privacy/encryption
  - DNS modified by user in OS
  - DNS modified by user in CE
  - Combinations of above
- False detection of a dual-stack host as IPv4-only
- Behavior in presence of HE
- Troubleshooting implications

Approach 3: CLAT-provider-EAMT

- Similar to previous one, but no ”automated” EAMT
- Operator must push or CE must pull the table
- It will work even if user change DNS for STB, SmartTV, …
- More control from the operator
  - EAMT pairs may be built “apart” from DNS
- Issues:
  - Increase complexity
    - Is the benefit worth for it?
  - The CDN/cache provider needs to provide API to update the EAMT, or the operator use their own caches to build it

Questions?

- Optimization disabled by default?
  - If there is no 464XLAT being used is not enabled.
  - If there is no NAT64 discovered is not enabled.
- Clients ignoring the TTL
  - TTL is being used by the EAMT
- Consumer electronics using alternate resolvers
  - Supported
- Security considerations
  - We still don’t see any additional security issue created by this approach