

Labels and Names taking over Addresses

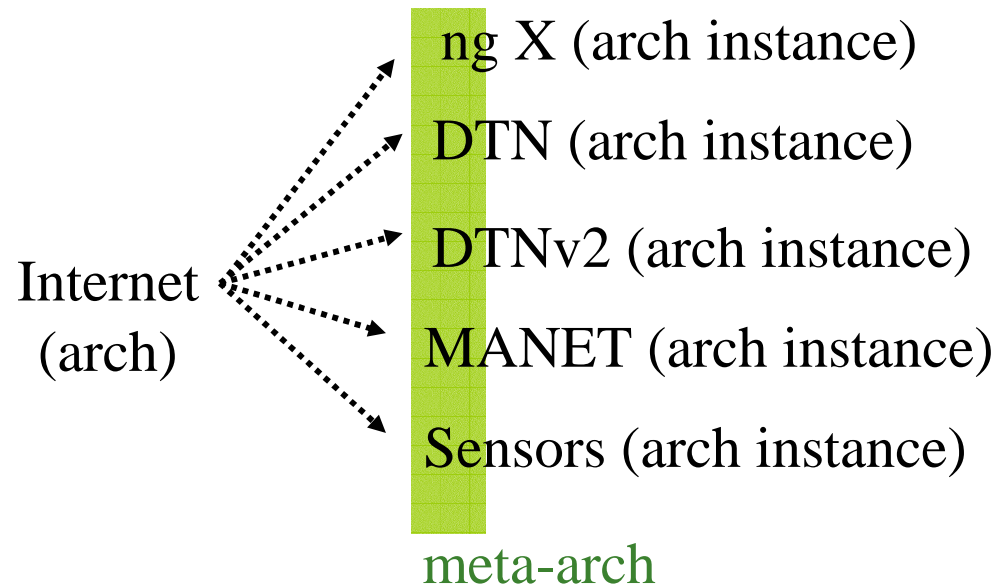
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Dagstuhl Seminar on Naming and Addressing for
Next-Generation Internetworks – Oct/Nov. 2006

Context: ANA Project (Autonomic Network Architecture)

- ◆ How much of an architecture can evolve over time?
 - ◆ hypothesis: no more "one size fits all" network
 - ◆ what must remain stable? what is the least common denominator, i.e. the meta-arch?



- ◆ Must addresses be explicitly defined/supported by a network architecture? (should it be address-centric?)

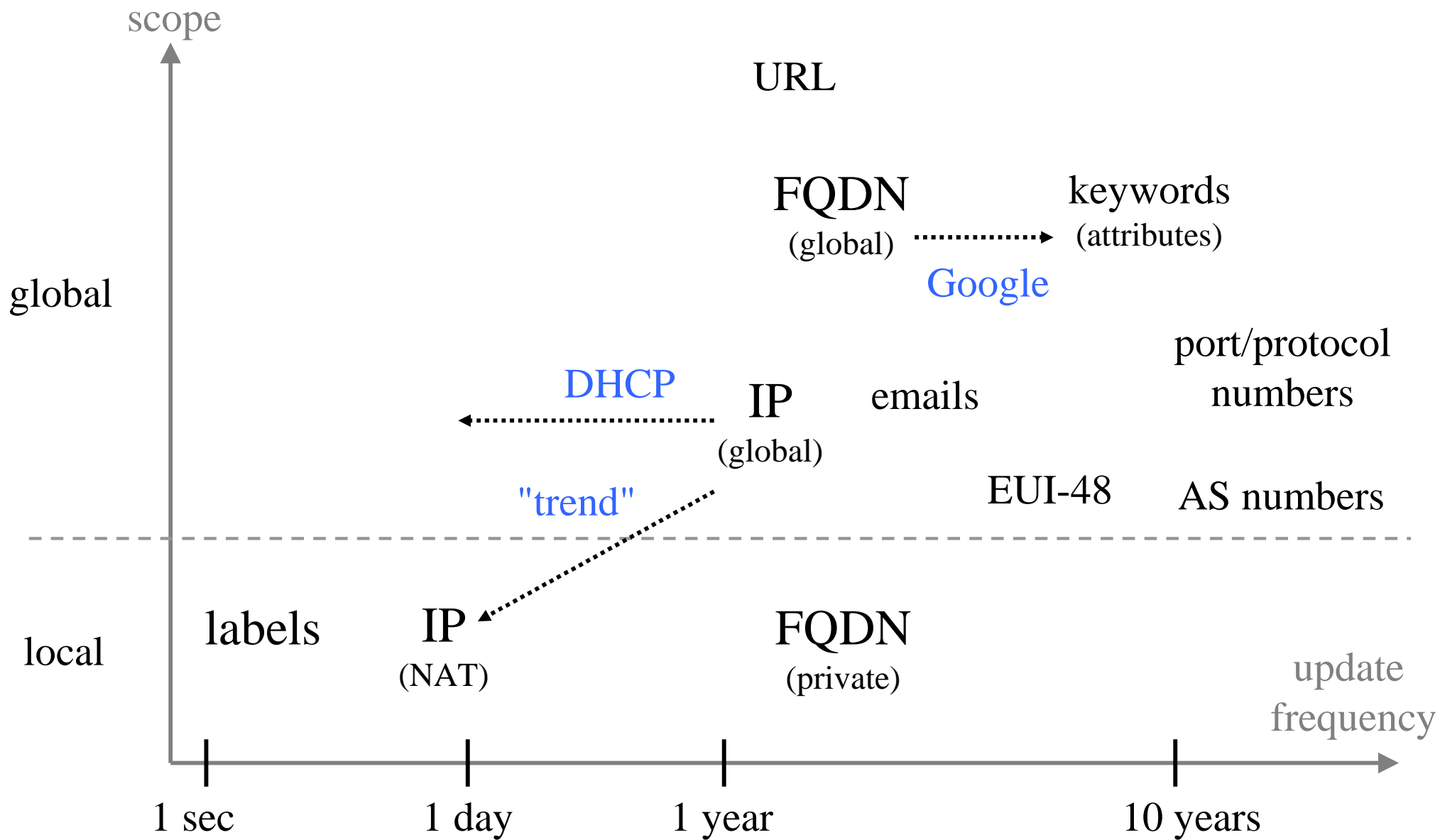
Plan

- ◆ When addresses ruled the Net
- ◆ Lifetime and scope of addresses and names
- ◆ Trends for naming and addressing
- ◆ Labels and names taking over addresses?
- ◆ A small-scale example for MANETs

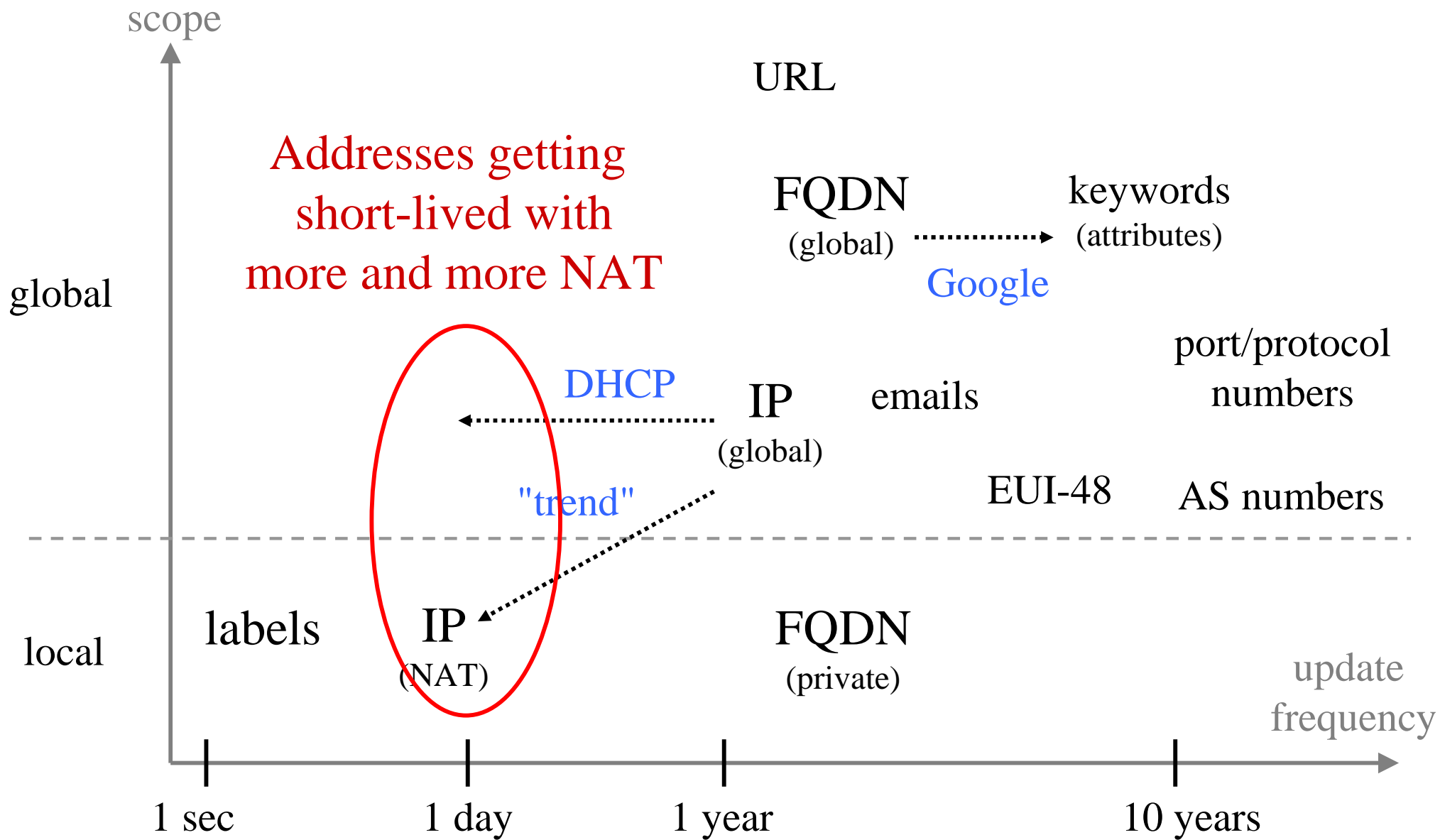
When addresses ruled the Net

- ◆ In the ARPANET, addresses were fixed and could actually be used as "long-lived names"
 - ◆ Address 1 **is** UCLA-NMC [RFC-597, 1973]
 - ◆ HOST.TXT file is mapping a static symbol into another static symbol
- ◆ Same with the early Internet
 - ◆ 1.0.0.0/8 **is** BBN-PR [RFC-820, 1982]
- ◆ After the introduction of DNS in 1984 addresses are still very long-lived: RFCs still contain the static list of assigned addresses
 - ◆ estimated number of hosts $\approx 1,000$
- ◆ RFC-990 (1986) is the last one to contain a list of assigned addresses
 - ◆ estimated number of hosts $< \approx 10,000$

And today? On the lifetime and scope of ...



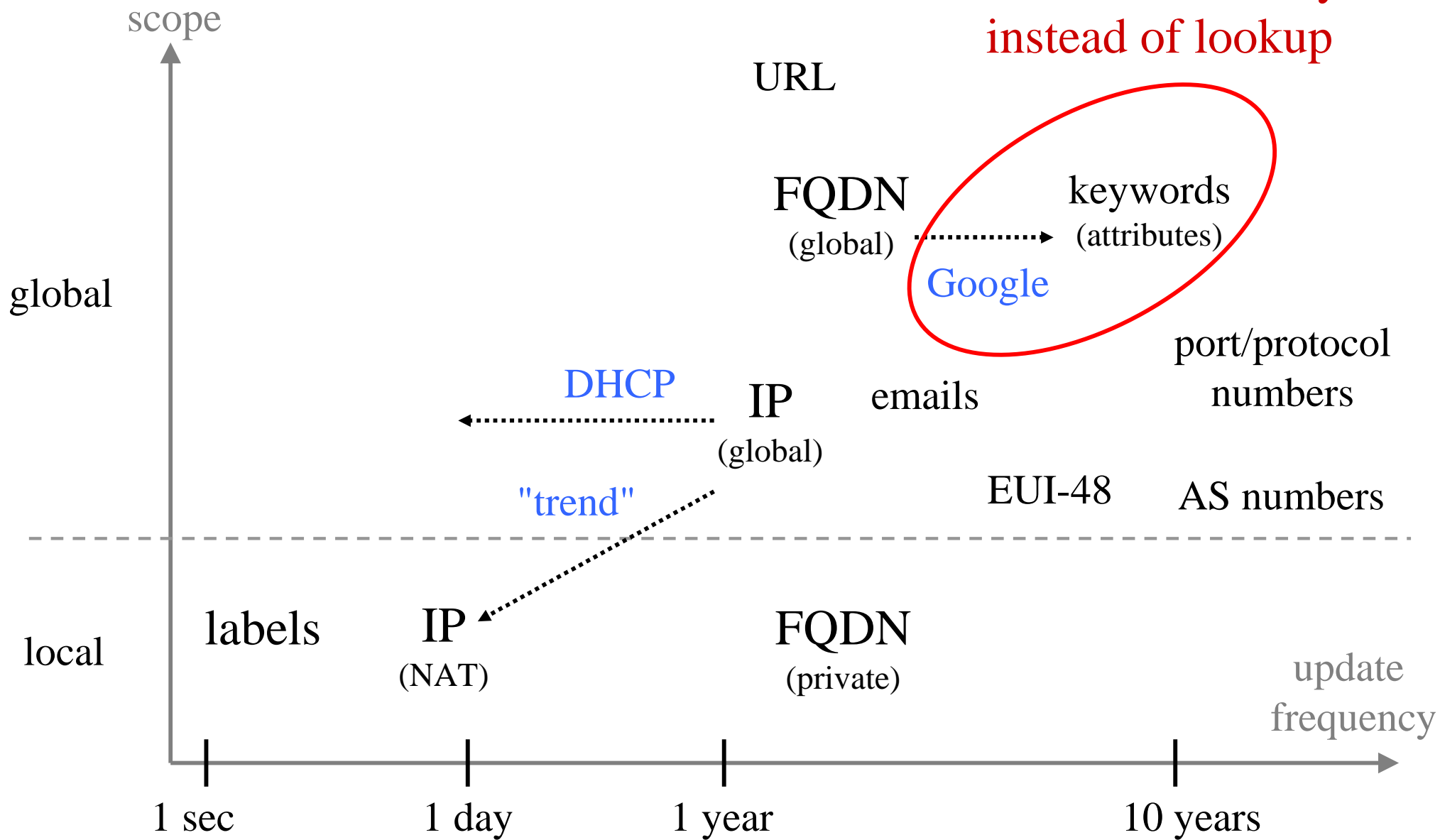
Two trends (1)



Two trends (1)

- ◆ Addresses getting short-lived
 - ◆ Less and less static address allocation, at least for hosts
 - ◆ DHCP lease time is by default 600 seconds (ISC server)
 - ◆ In practice the typical lease time is a few hours
 - ◆ Non static addresses for routers: IPv6 prefix delegation (RFC 3769)
- ◆ NAT is widely spread
 - ◆ Typical addressing setup: private – public Internet – private
 - ◆ But also: private – private – public Internet – private (PC behind wireless router at home then provider network with private addresses)
- ◆ Pushed to the extreme: @ not addresses any more and will disappear
 - ◆ Short lived addresses (just session duration [Handley04] or even shorter)
 - ◆ NAT in every hop = local labels !

Two trends (2)



Naming becomes a "search" activity instead of lookup

Two trends (2)

- ◆ DNS name space is becoming huge: how do you learn FQDNs, URLs, email addresses?
 - ◆ FQDN (www.): Advertisements on TV, radio, magazines, etc
 - ◆ Emails: Business cards
 - ◆ URLs: Hyperlinks ... but you just click, you don't really care where it goes
- ◆ And when you don't know the FQDN, URL, Email address?
 - ◆ Google! e.g. with keywords {Christophe Jelger Basel} Google takes you to **cn.cs.unibas.ch/people/cj**
 - ◆ But it also finds **clarinet.u-strasbg.fr/~jelger**, i.e. my previous home page, so it even has some "memory of the past"

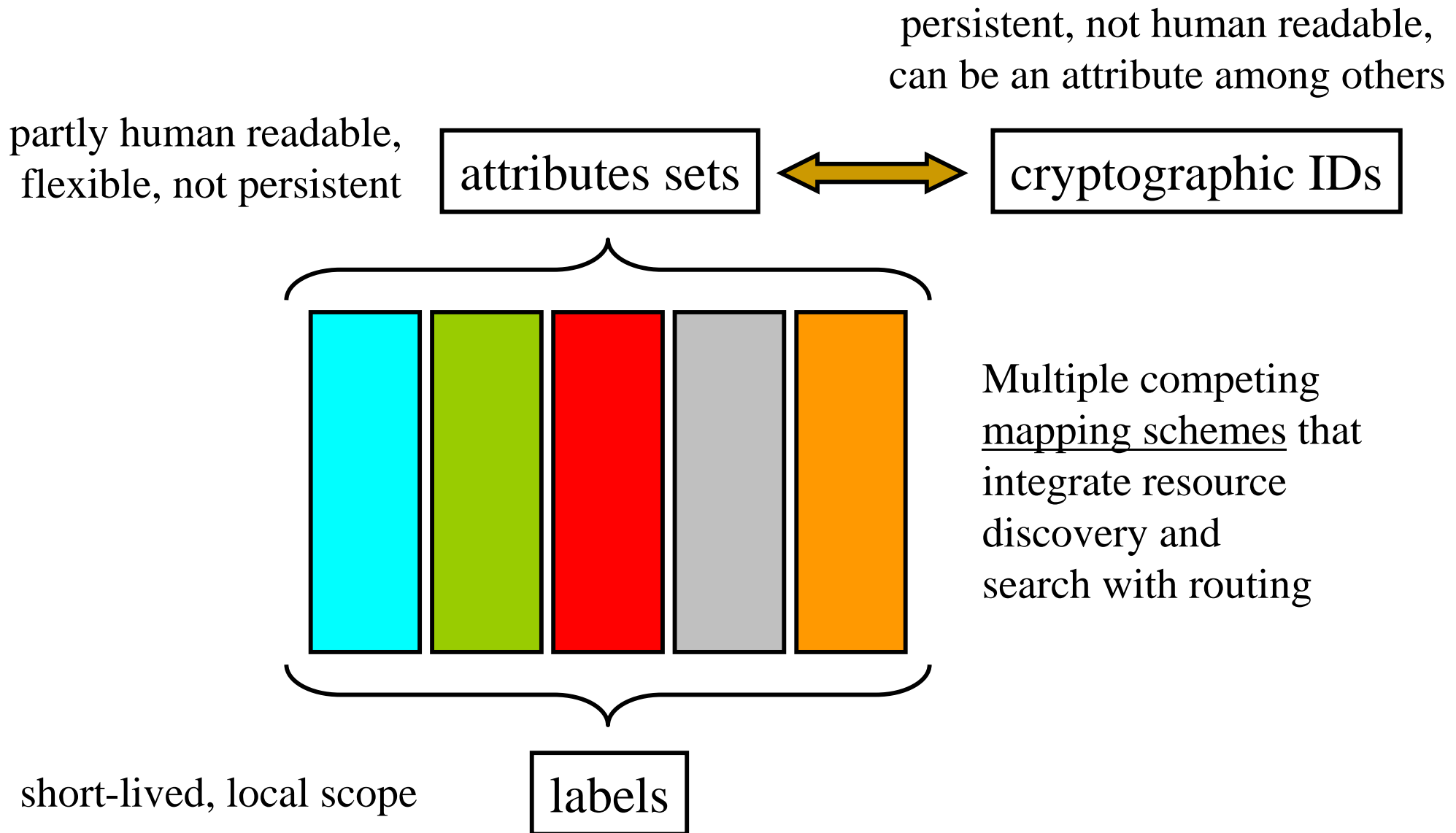
Hence (a bit of controversy) ...

- ◆ "Addresses" dissolve, both static and dynamic → variable labels
 - ◆ Addresses replaced with short-lived local labels
 - ◆ Paths no longer globally labeled ("NAT by default")
 - ◆ What about routing scalability? Label aggregation?
- ◆ Static "names" also dissolve → variable names
 - ◆ Use a google-like search system based on keywords or attributes
 - ◆ e.g. "search" {informatik, university of basel, web server}
 - ◆ A network-layer next-generation DNS-Google ? (mapping attributes into labels)
- ◆ What about security/authentication?
 - ◆ How can you prove you are "who you say you are"?, that these are the right labels?
 - ◆ Do we need cryptographic IDs "behind the scene"?

Others working on making (IP) addresses obsolete

- ◆ Routing with flat labels is a hot topic
 - ◆ Ceasar et al's Routing on Flat Labels, Sigcomm'06
 - ◆ UIP, TRIAD
 - ◆ DHT over Link-Layer?
- ◆ Label-switched forwarding
 - ◆ in MANETs with very short-lived local labels: LUNAR, Lilith
 - ◆ in the Internet, with long-lived local labels: MPLS
 - ◆ to prevent DoS [Handley04]
 - ◆ 0% vs. 100% NAT discussion on end-to-end mailing list
- ◆ Lookup with attributes
 - ◆ Google !
 - ◆ Intentional naming system (SOSP'99)

The future?



The future? (2)

- ◆ As we can already download ...
 - ◆ MP3 Beattles Imagine
 - ◆ Movie Amelie Poulain
- ◆ We could browse ...
 - ◆ Dagstuhl seminar
 - ◆ Dagstuhl seminar naming addressing
- ◆ And email the medium found to ...
 - ◆ Christophe Jelger Basel
 - ◆ James Sterbenz (he has 10 different email addresses!) 🤖
- ◆ Conclusion: **addresses disappear and are not an issue any more**
 - ◆ for users
 - ◆ for network (meta) architectures
although network instances might use addresses for routing

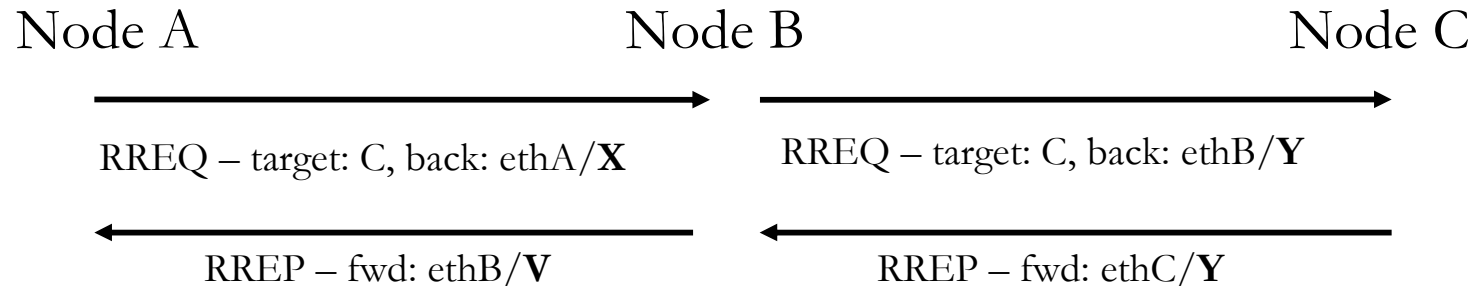
A small-scale example for MANETs

- ◆ LUNARng [see CoNEXT'06, Dec. 2006]
 - ◆ Forwarding is done with short-lived local labels: no MANET-global addresses (actually no addresses at all!).
 - ◆ Node discovery and path setup (i.e. reactive routing "à la AODV") via dynamic shortest discriminating names, created from a list of ordered attributes.
 - ◆ "Strict" node identification done via Host Identity Tag (HIT, see [HIP]).
 - ◆ Fully self-configuring: no addresses, names dynamically generated + name collision detection and repair, long-lived IDs (HITs)

A small-scale example for MANETs

- ◆ Path setup with local-label switching

Labels shown in bold



- ◆ Name creation with set of ordered attributes

attributes {John, Doe, UniBasel, CSDept, Switzerland}

user-level "name" → john-doe OR john-doe-unibasel OR john-doe-csdept OR ...

LUNAR ID → 398a-61cb-7620-bc8e-f961-48da-18b2-90bc

Thank you

Questions?

More information about LUNARng?

→ Google {download lunarng}



→ Google {ANA project}