

G-Lab

HiiMap: Hierarchical Internet Mapping Architecture

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Outline

- ▶ Current issues
- ▶ Locator/Identifier split
- ▶ HiiMap: Hierarchical Internet Mapping Architecture
 - Architecture
 - Security
 - Load estimation
- ▶ Summary

Current issues

- ▶ Scalability
 - Shortage of addresses
 - Dramatically growing routing table entries
 - No support for content addressing
- ▶ Mobility
 - Almost no support for mobility in IP networks
 - No support for seamless roaming
- ▶ Security
 - IPSec: only an addon feature
 - Causes problems with other "innovations" (NAT)

The current Internet will not be able to handle the load we expect in 10 to 15 years!



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Locator/Identifier split

- ▶ Problem: IP-address is locator **and** identifier
 - Makes mobility difficult
 - BGP routing tables grow dramatically (relocation, multi-homing)
- ▶ Split of addresses:
 - Identifier (UID):
 - Globally unique
 - Assigned to nodes (persons or content also possible)
 - Locator:
 - Defines the position of entities in the Internet
 - Changes during lifetime
- ▶ Mapping service:
 - Mapping between identifier and locator necessary
 - Needs to be highly scalable

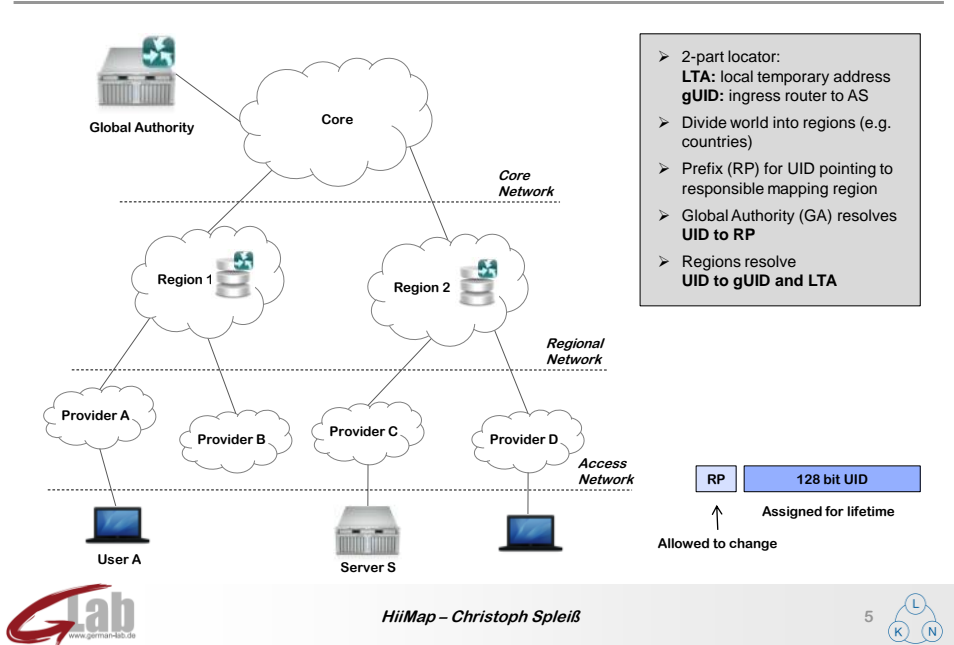


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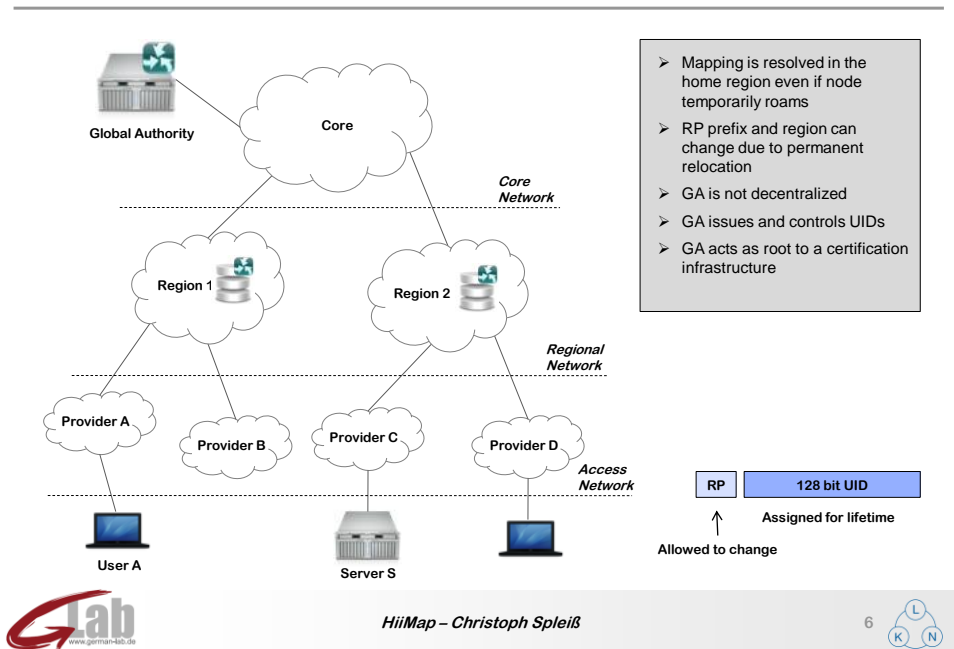
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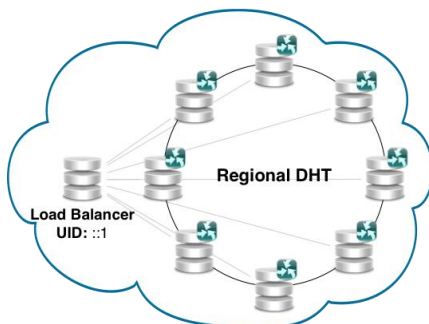
HiiMap Architecture



HiiMap Architecture



Regional based mapping



- ▶ Usage of DHTs suggested (depending on regions size)
- ▶ One Hop DHT protocol (e.g. D1HT)
- ▶ Load balancer as entry point
 - Only one default UID per region
 - Redundancy of load balancer ensures failsafe operation
- ▶ Mapping is done by an independent non-profit organisation (e.g. DeNIC)
- ▶ Disputes can be solved by contracts and a common law basis (country)



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Security concepts

- ▶ Loose coupling of UID and private key (RSA)
- ▶ Public Key is stored as an additional entry in the mapping system
- ▶ Public Key can be changed if necessary
- ▶ UID can be changed if necessary

UID
entries N
LTA₁
gUID₁
⋮
LTA_n
gUID_n
timestamp
RSA Public Key

Mapping entry of a node in a regional database



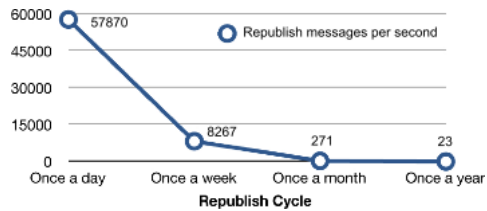
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Performance estimation

- ▶ Critical areas
 - Storage capacity
 - Network load
 - Database performance
- ▶ Assumptions (in 10-15 years)
 - 5 billion nodes
 - 100,000 autonomous systems (AS)



- ▶ Global authority
 - Storage: $256\text{bit} * 5\text{billion} = 150\text{GByte}$
 - Republish causes major part of the traffic
 - Republish every month: 271 messages per second
 - Data rate: $300 * 1000\text{byte} = 2,4\text{MBit/s}$
 - Database: 300 updates not a problem



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Performance estimation

- ▶ Regional level assumptions
 - Mapping request outnumbers updates due to roaming (several magnitudes)
 - Each node sends 0.025qps (LRZ statistic)
 - BIND on todays machines can handle more than 15,000 qps
- ▶ Regional level estimation
 - $0.025\text{ qps} * 5\text{ billion} = 125\text{ million qps}$
 - $125\text{ million qps} / 15,000\text{ qps} = 8,400\text{ server}$ (for the whole mapping system)
- Per 500,000 nodes one mapping server (in a DHT) must be provided
- Germany for example (80 million) would require 160 servers (without redundancy).



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Summary

- ▶ No trust problem like in other DHT-based mapping services for locator/identifier split
- ▶ Lifetime assigned, never changing identifiers (UIDs)
- ▶ Regional prefix to allow relocation without changing UID
- ▶ Global Authority allows for setting up a complete certification infrastructure
- ▶ Integrity, authenticity and cryptography can be provided through PKI
- ▶ Load caused by the mapping system is neglectible

