Global Lookup and Discovery of Services (GLADOS)

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Problem Statement
A Piece of the Puzzle – the Discovery Problem

Provider 1

Provider 2

+1 (732) 654-3210

Provider 3
Many Gatekeepers and Providers Use Phone Numbers

- Apple’s iMessage
- Android Messaging (RCS)
- WhatsApp
- SMS itself...
Address Books are Filled with Those Numbers Because of Phone and SMS Use Cases

6.9 Billion \times 100 = 690 Billion

Smartphone Users Globally  Contacts per User  Size of Phone Number Social Graph

1: https://www.bankmycell.com/blog/how-many-phones-are-in-the-world
MIMI Practical Applications Limited
without Solving the Discovery Problem
Requirements and Assumptions

• We need multiple mapping resolvers, to handle geopolitical and organizational boundaries
• The resolvers are trusted, and geopolitical and/or organizational processes would be put in place allowing that trust to be earned
• It is acceptable for the resolver to know the identifier (phone number or email) for a user and the service they are on, but it is not acceptable for it to know the social graph of interconnectedness between end users
• The resolver function should be invisible to end consumers – consumers should see the apps they are already using and not something new
• App providers will include gatekeepers and also small, potentially numerous, providers
• We want to protect against a malicious app provider that requests interop but uses it to send spam or scrape the system for a database of numbers
• Part of the role of the resolver is to validate the good behavior of the app provider – vetting them as a legitimate messaging app and rate limiting inquiries
GLADOS Architecture

1: Add Contact: +1 (732) 654-3210
2: Not within my app – check GP
3: Query: +1 (732) 654-3210
4: Lookup Mapping
5: Return Mapping
6: MIMI Protocols
Glados Identifier Concepts

Service Independent Identifier (SII)

+1 (732) 654-3210

joe@yahoo.com

Domain part is not their messaging provider!!

Service Specific Identifier (SSI)

{user2328371, whatsapp.com}

{user123663523, imessage.com}

User part is scoped to the provider
Glados Mapping Creation

GP is trusted in its accuracy of mapping

AP is (mostly) NOT trusted to provide valid mappings

GP performs the validation on its own

End user experience unchanged from today
GP to GP Routing: Bloom Filters

• Each GP periodically builds a bloom filter of size $2^N$, initialized to zero
• Each SII is canonicalized, hashed, modulus $2^N$ and corresponding bit in bloom filtered is OR’d with a 1
• GP exposes API to retrieve bloom filter
• GP exposes API for additions (not removals) from bloom filter to be streamed – allowing instant updates (key use case)
• Bloom filter protocol has many benefits
  • Privacy protecting
  • Compact
Alternative Architectures

• Global internet monolith doing the mapping (version -00)
  • Not likely to fly with GDPR and data residency concerns

• Blockchain
  • Trust worries on entities on the chain – there is disincentive to lie about mappings
  • ViPR went this direction though using DHT

• Telco centric (ala ENUM)
  • Telco owns the numbers but doesn’t know the mappings
  • Significant disincentive from telcos to do this