Intent-based Analysis of Network-wide Routing Policy Configuration

Kyriaki Levanti, Hyong S. Kim, Tina Wong
Carnegie Mellon University
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Electrical & Computer ENGINEERING

Introduction – Problem Definition

☹ Disconnect between low-level routing policy implementation and actual intent

➔ No efficient way to validate high-level network objectives

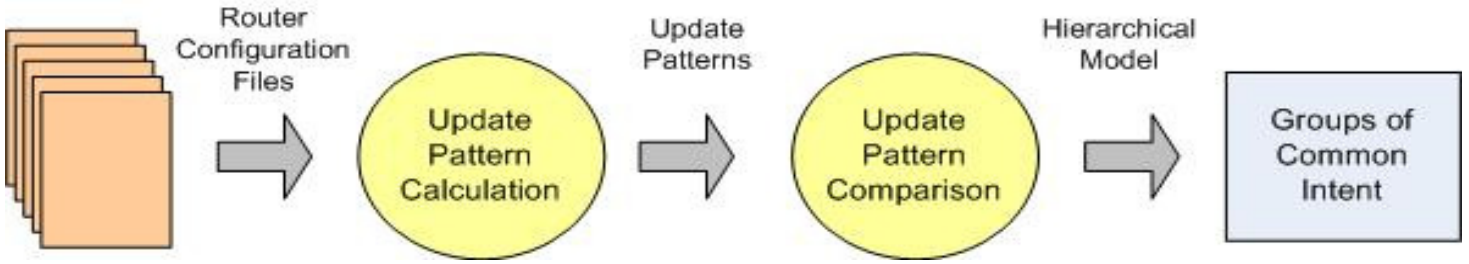
☹ Lack of network-wide view of the enforced routing policies

➔ Error-prone configuration changes

How is a network operator to manage the network's routing policy configuration?

Our Approach

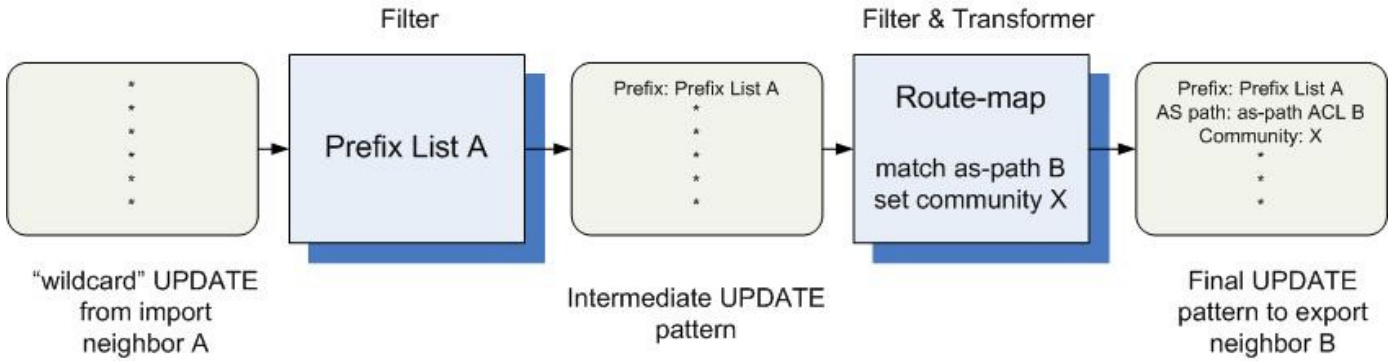
- Analyze the network's routing policies in a useful way for network operators
  - ✓ Routing policy abstraction
  - ✓ Focus on intent
  - ✓ Network-wide processing



High-level view of network's routing policies

Update Pattern Generation

- Generate the characteristics of the updates, update pattern, advertised
  - from each neighbor network (*import neighbor*)
  - to every other neighbor network (*export neighbor*)
- Update pattern attributes:
  - Lists: Advertised prefix, AS path, communities
  - Values: Local preference, MED, prepending

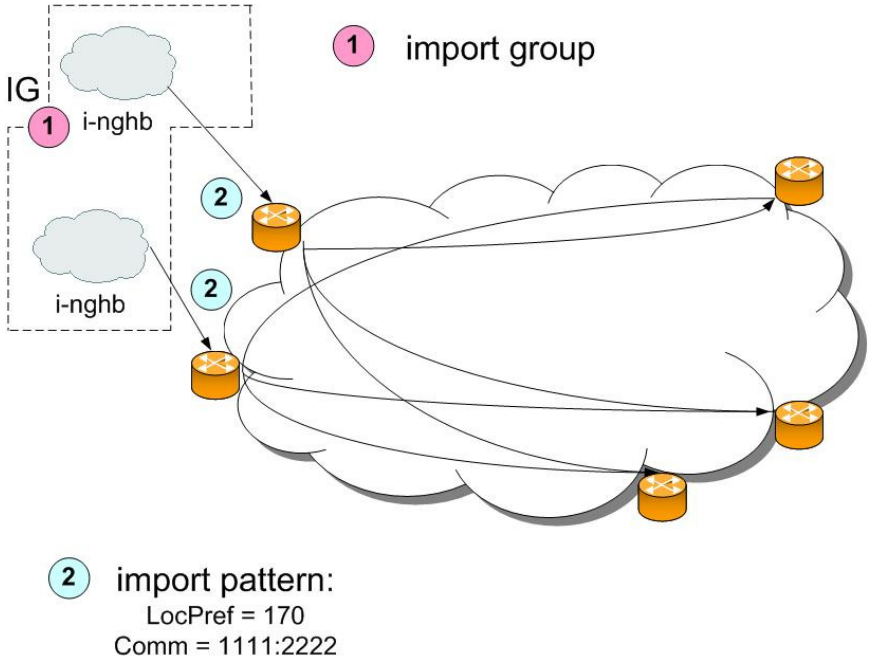


Update Pattern Comparison

- Multi-level Model
  - Hierarchical (Generic ➔ Import)
  - Compact
  - Expressive
- Levels
  - Generic Grouping
    - Groups of import neighbors whose updates are exported in a similar manner
    - Network treats members of group in the same way
  - Viewpoints
    - Import Grouping
    - Export Grouping

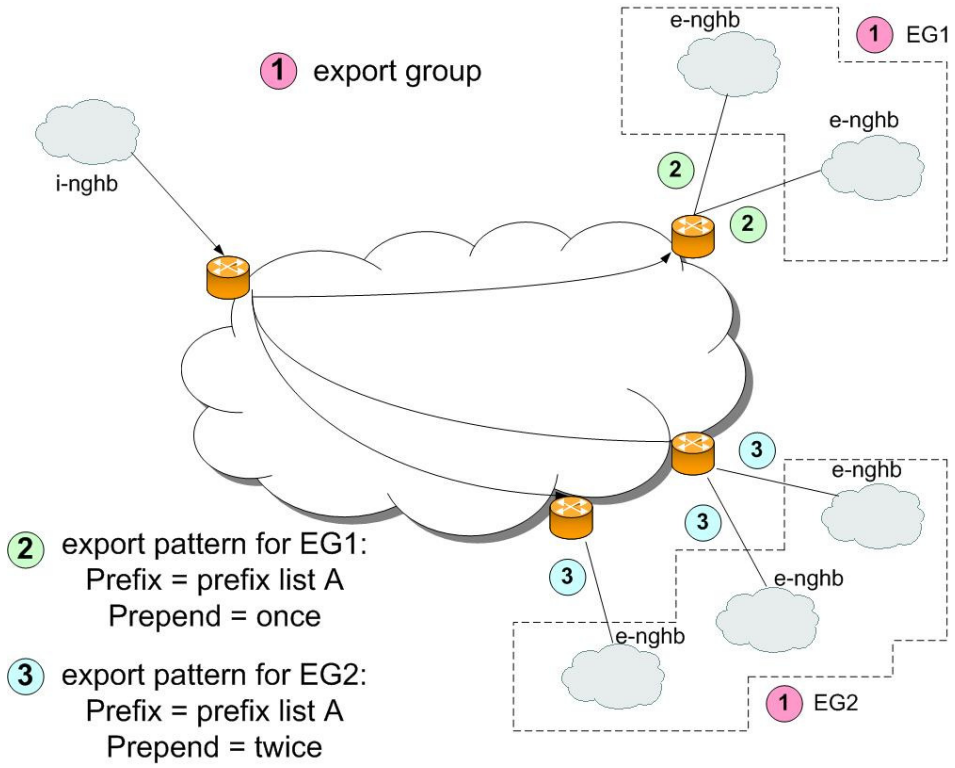
Import Groups

- **Import Group (IG):** group of import neighbors with similar initial update patterns
  - Similarity Criteria: advertised prefix/AS path, communities, local preference



Export Groups

- **Export Group (EG)** of an import neighbor: group of export neighbors with similar final update patterns
  - Similarity Criteria: advertised prefix, AS path, communities, prepending



Evaluation

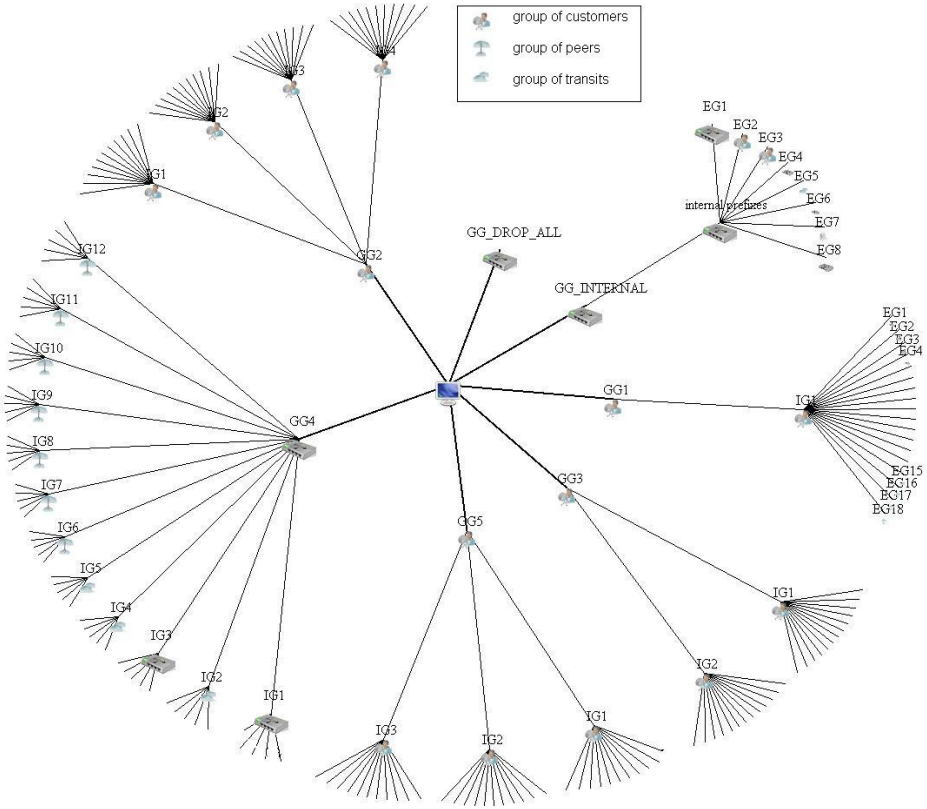
- 13 router configuration files from Tier-1 ISP
- 64 neighbor networks

GG description	#members	#EG	#IG
transits + peers	31	5	12
majority of customers	10	10	4
customers connected to router X	4	10	3
customer A (multiple sessions)	5	12	2
customer B (multiple sessions)	4	17	1
imported updates all dropped	10	-	-

Common practices, deviations, misconfigurations

Model View

- 64 neighbor networks ➔ 6 generic groups
- group size
- group type
  - customer
  - peer
  - transit
  - mixed



Conclusions

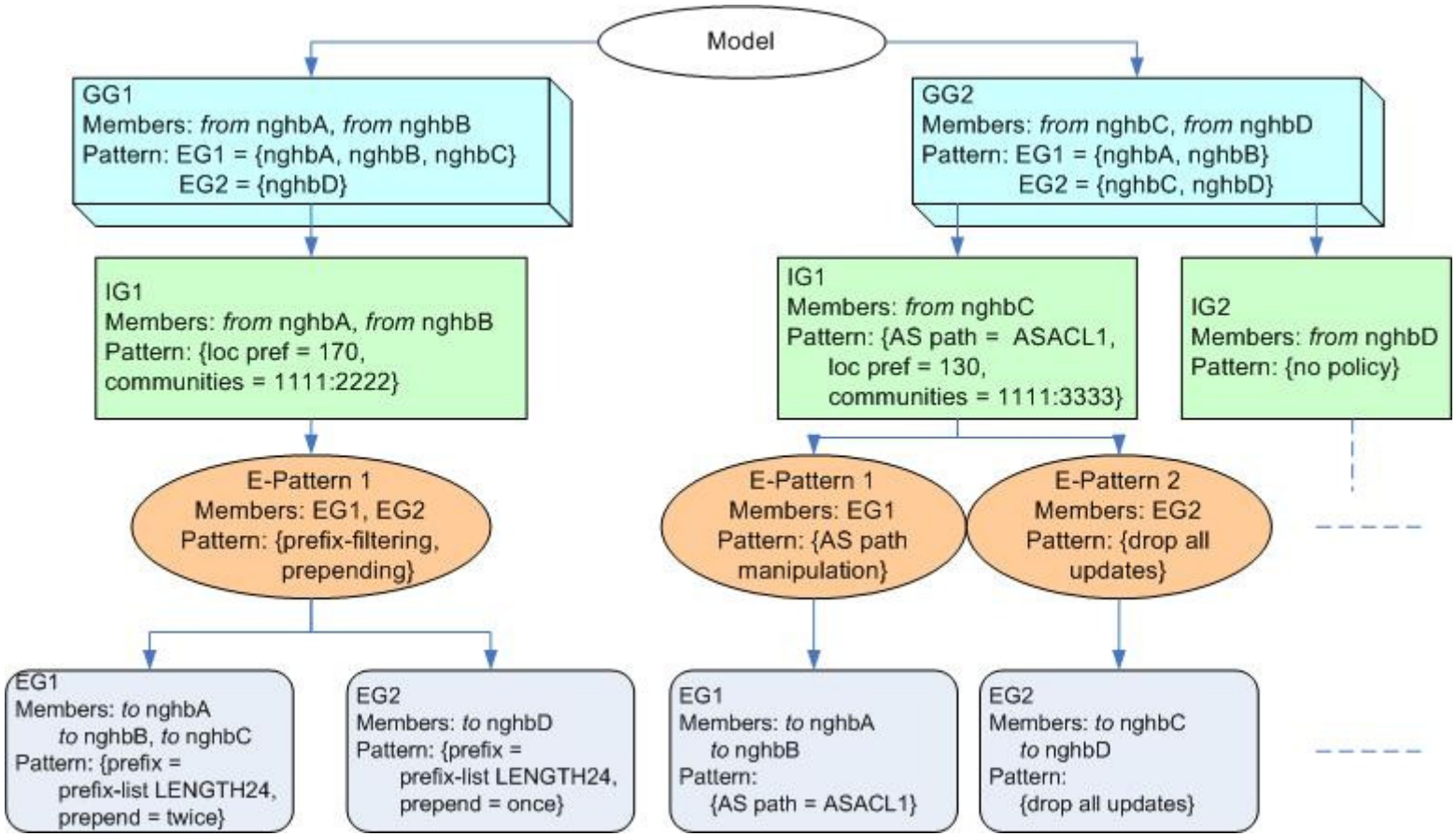
- Multi-level model for representation of network-wide routing policies based on similarity of update patterns
- Compact view of common network practices and deviant cases
- Some misconfigurations revealed
- Positive feedback from network operator

Thank you!!

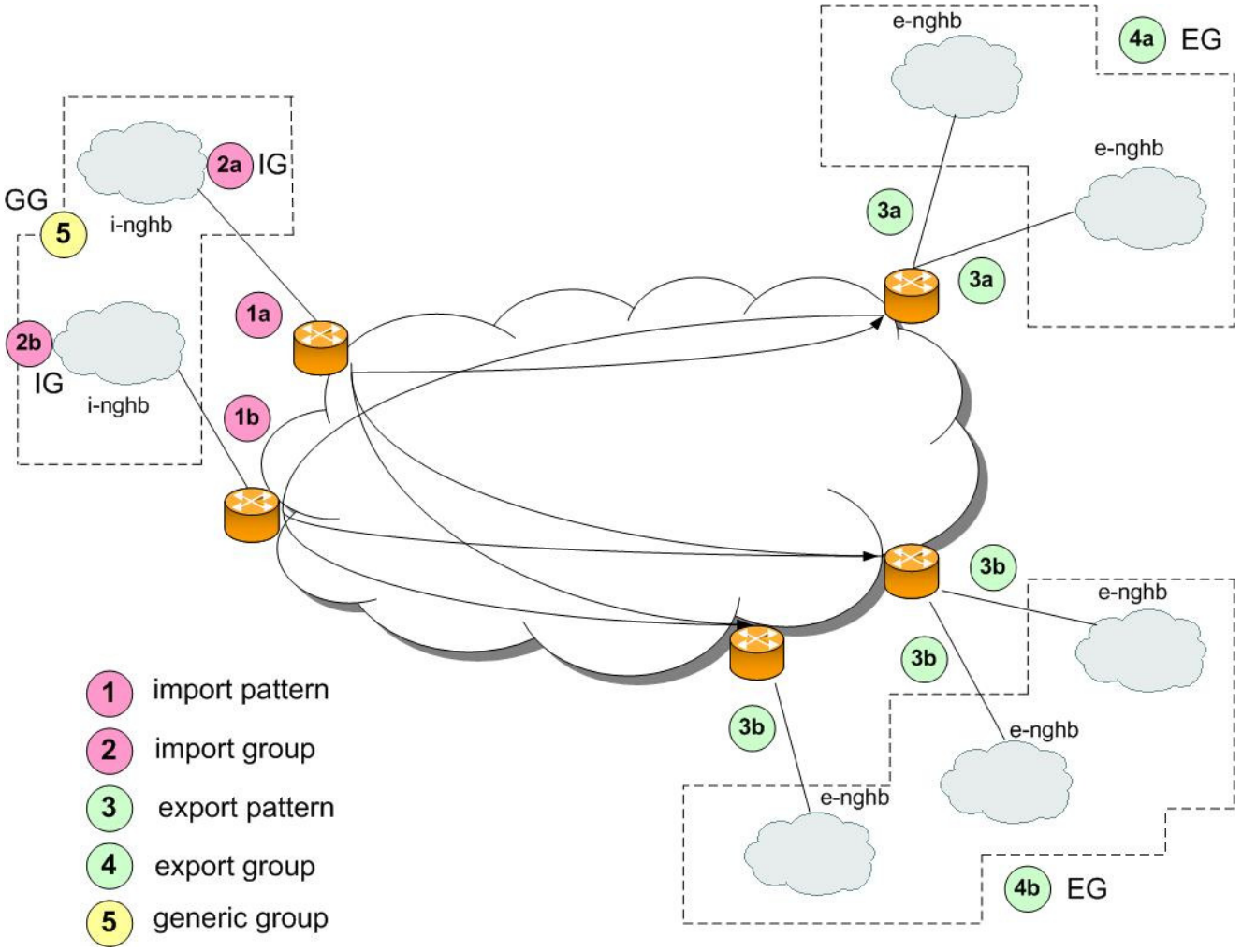
- For more information:

  klevanti@ece.cmu.edu

Backup: tree


Model
GG1
Members: from nghbA, from nghbB
Pattern: EG1 = {nghbA, nghbB, nghbC}
EG2 = {nghbD}
GG2
Members: from nghbC, from nghbD
Pattern: EG1 = {nghbA, nghbB}
EG2 = {nghbC, nghbD}
IG1
Members: from nghbA, from nghbB
Pattern: {loc pref = 170,
communities = 1111:2222}
IG1
Members: from nghbC
Pattern: {AS path = ASACL1,
loc pref = 130,
communities = 1111:3333}
IG2
Members: from nghbD
Pattern: {no policy}
E-Pattern 1
Members: EG1, EG2
Pattern: {prefix-filtering,
prepending}
E-Pattern 1
Members: EG1
Pattern: {AS path
manipulation}
E-Pattern 2
Members: EG2
Pattern: {drop all
updates}
EG1
Members: to nghbA
to nghbB, to nghbC
Pattern: {prefix =
prefix-list LENGTH24,
prepend = twice}
EG2
Members: to nghbD
Pattern: {prefix =
prefix-list LENGTH24,
prepend = once}
EG1
Members: to nghbA
to nghbB
Pattern:
{AS path = ASACL1}
EG2
Members: to nghbC
to nghbD
Pattern:
{drop all updates}

Backup: network map



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