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The Internet Intelligence Authority

Using Security Metrics to Motivate a Response to a Critical Vulnerability

aka: The Importance of Context

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Metricon 4.0

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Why Do We Pursue Security Metrics?

- Because metrics simplify and make concrete things that are complex and abstract.
- Because metrics allow us to **rank** different groups or approaches and **identify outliers** (the very bad)
- Because metrics make people take action, in ways that more complex arguments or threats do not
- **Because we want people to change their behavior**

How do we make people change their behavior?

- **Easy.**
- When there's a critical **operational** issue with **security** implications, we're justified in deploying metrics that cut straight to base emotions: **Fear and Shame.**

Smell something burning?
...Yeah, that's the context.

- Every organization owes its Internet connectivity to one protocol: BGP4. **There are no alternatives**.
- BGP4 has longstanding problems that **cannot be fixed,** and can only be monitored carefully.

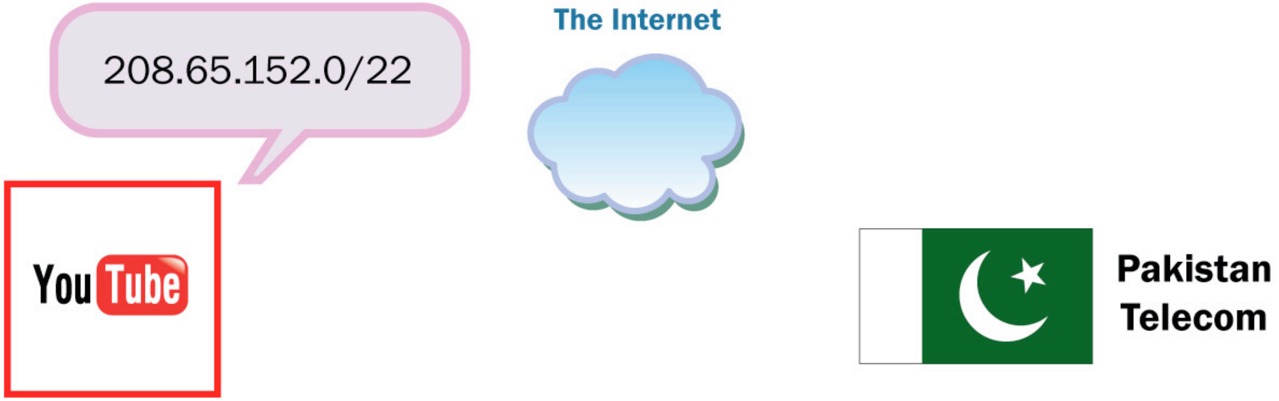
1) Everyone is exposed to various Internet routing vulnerabilities:
   - **downtime & instability, hijacking,wholesale traffic interception**.
   - **Risks: how much does leaving the Internet cost your enterprise per hour? Having your customers' traffic silently intercepted?**
2) Very few people understand these risks, so they are not being **measured** or **managed** appropriately. No one is covering your back!

Key to routing vulnerabilities

- No single authoritative source of who should be doing what.
- All routing is based on *trust* and *cooperation*.
  - Neighboring routers typically trust each other.
  - Traffic is assumed to flow unimpeded. Global connectivity!
- No requirements around physical redundancy.
- No mechanism in place to handle those who go ***rogue***. There are no Internet police!

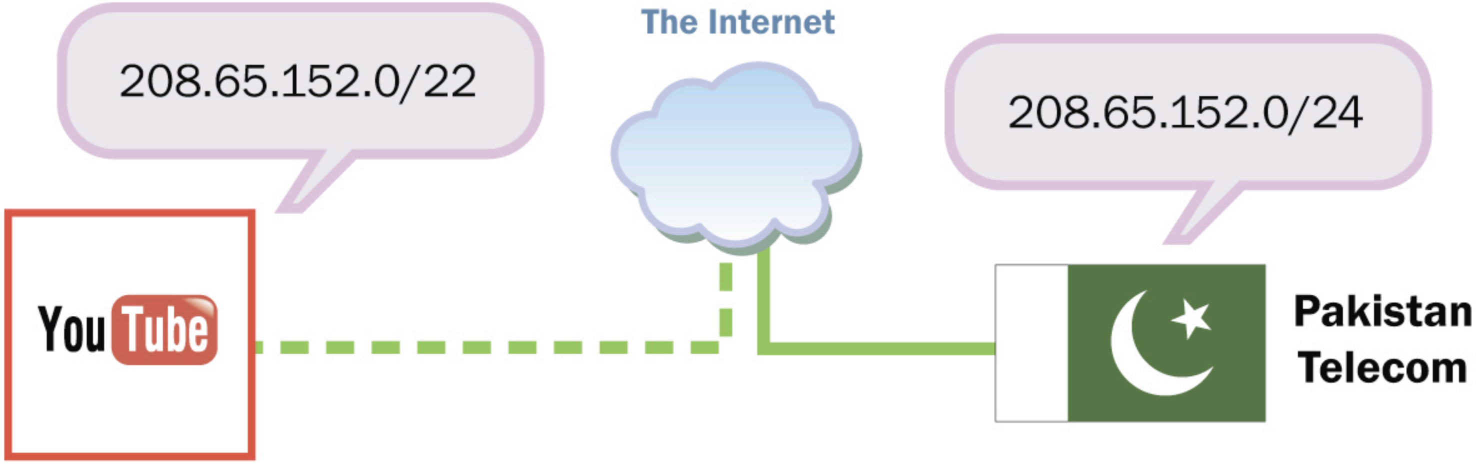
Hijacking Used Space – YouTube: Feb ’08

- YouTube owns 208.65.152.0/22
  - This contains the more-specific 208.65.153.0/24
  - The above /24 *used* to contain all of YouTube’s
    - DNS Servers (have since moved)
    - Web Servers (have since added additional IP space)
  - YouTube announced only the /22



Hijacking Used Space – YouTube: Feb '08

– Pakistan Telecom announces the /24
  - In BGP, most specific route to an IP address wins!
  - Pakistan Telecom gets all traffic intended for YouTube
  - YouTube is globally unreachable for 2 hours



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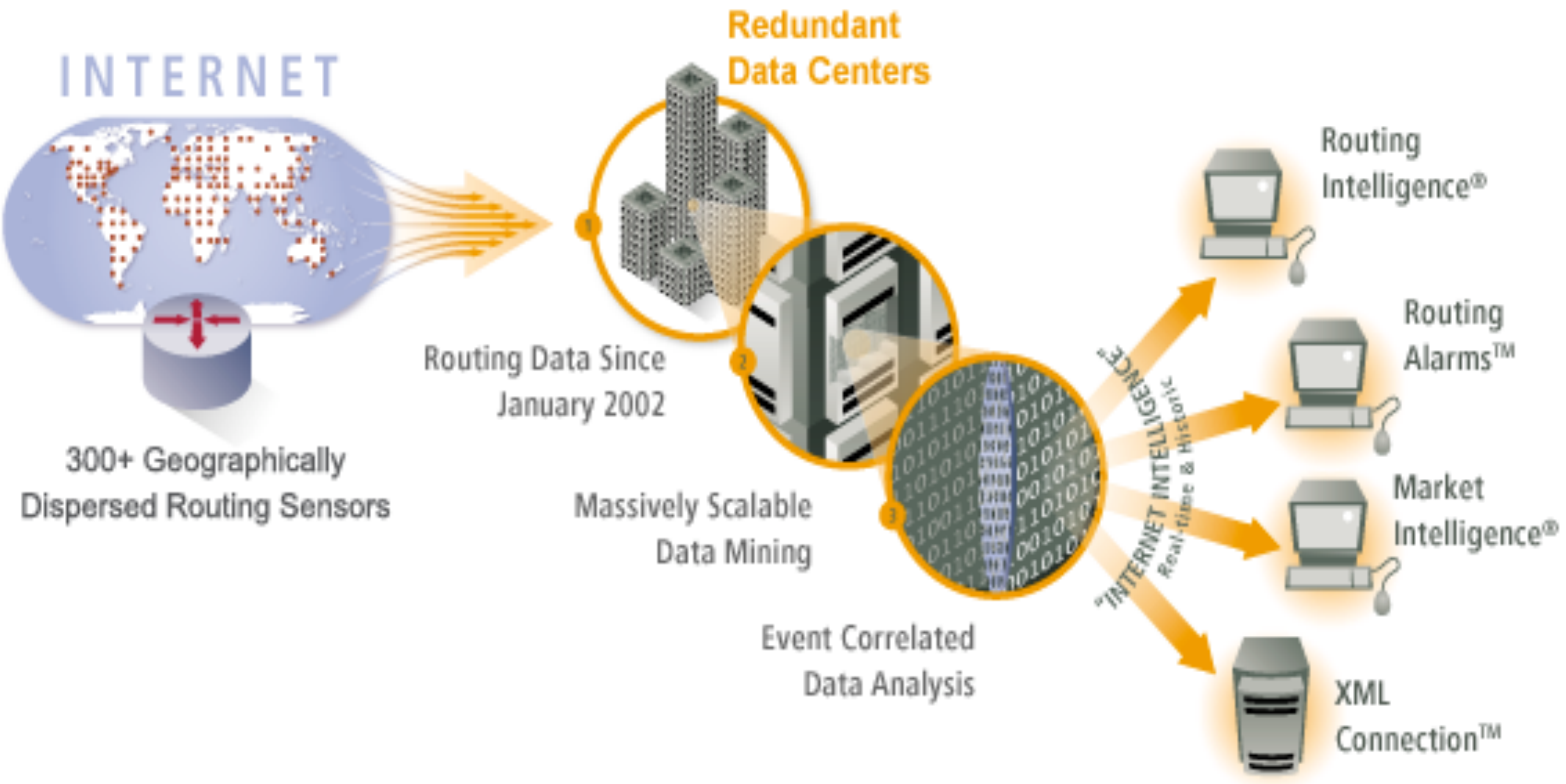
Renesys Studies Routing Relationships



Three Security Metrics for Routing

- **Compliance, Availability, Diversity**

- Organizations that measure these and change their behavior in response to them are dramatically less likely to be the target of successful routing attacks.
- You can't secure what you don't understand.
- “Living clean” and being consistent is the key to detecting and mitigating routing attacks

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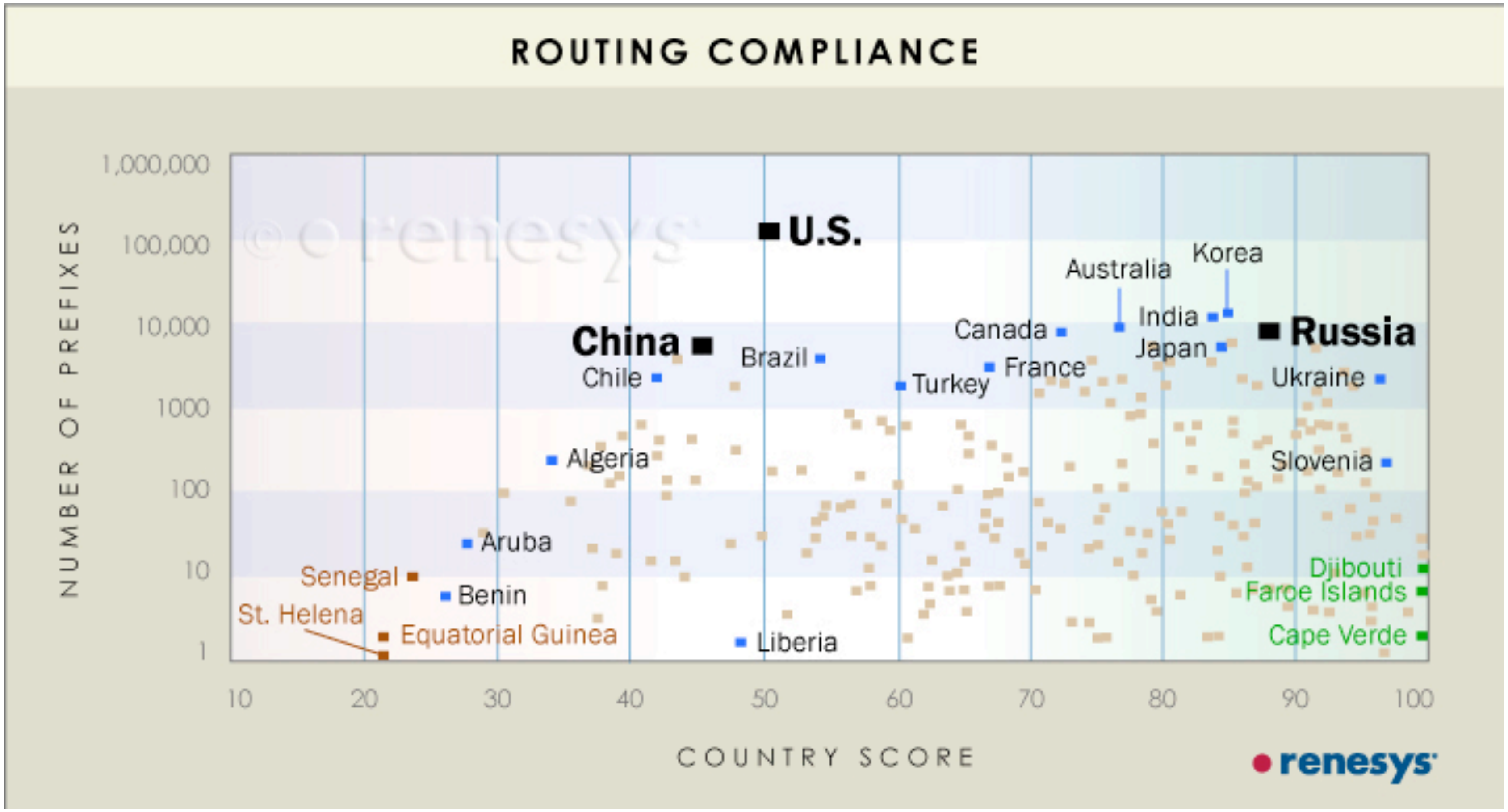
Compliance – Required for accountability

- Third-party routing registries give an organization a centralized place to declare their routing policies.

- We compare *routing registries* to *observed routing*
    - Do registered origins match observed origins? (majority of score)
    - Do registered providers match observed providers?
    - Possible scores range from 0 – 100.
        - Completely correct origins and providers yields a score of 100.
        - Registering *nothing* yields score of ~ 25.
        - Numerous mismatches, score approaches zero.

- Without knowing the correct origin for your prefixes, you have *no hope of detecting hijacks or ensuring the integrity of your Internet communications.*

Compliance Scoring by Country



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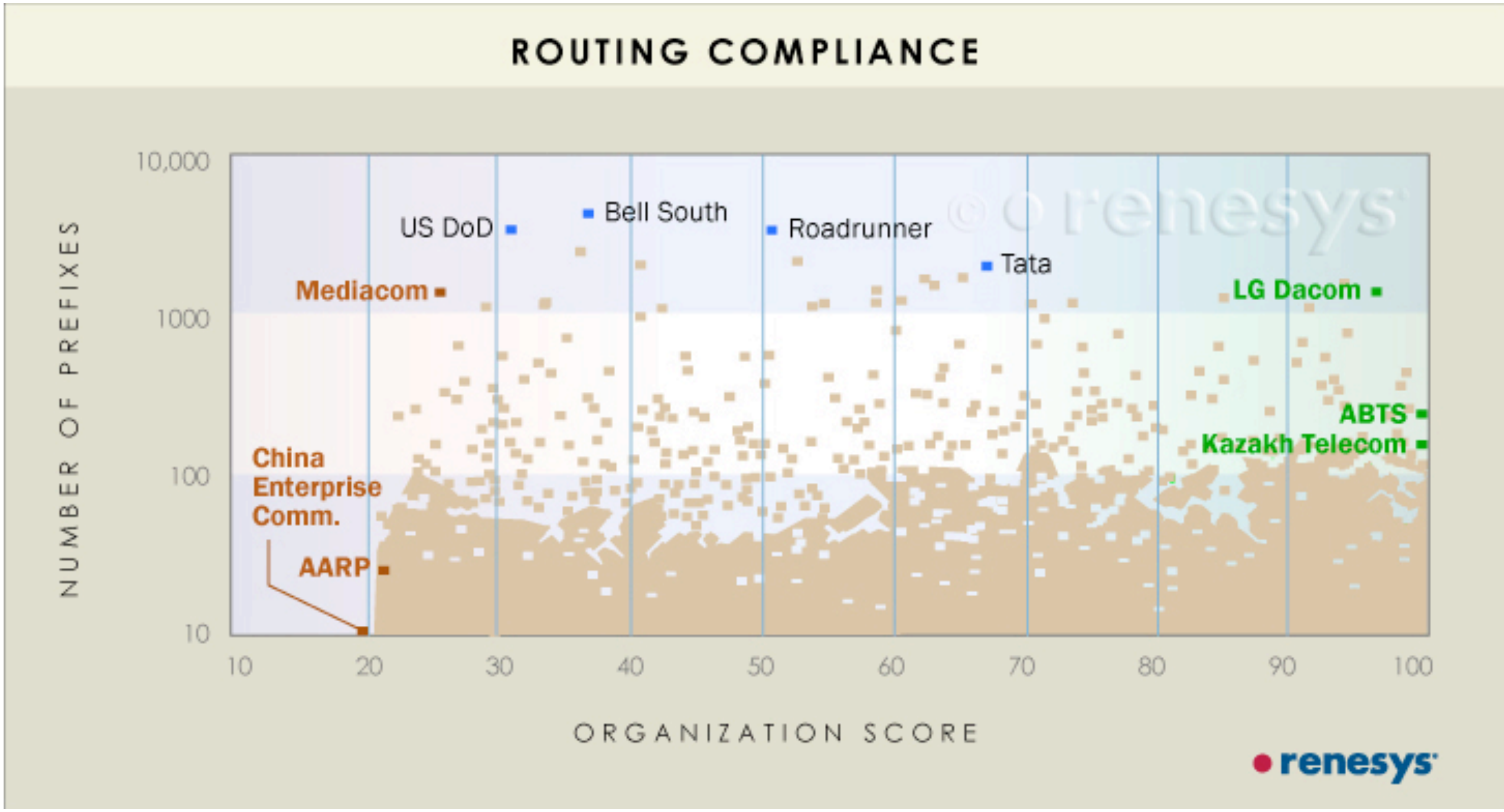
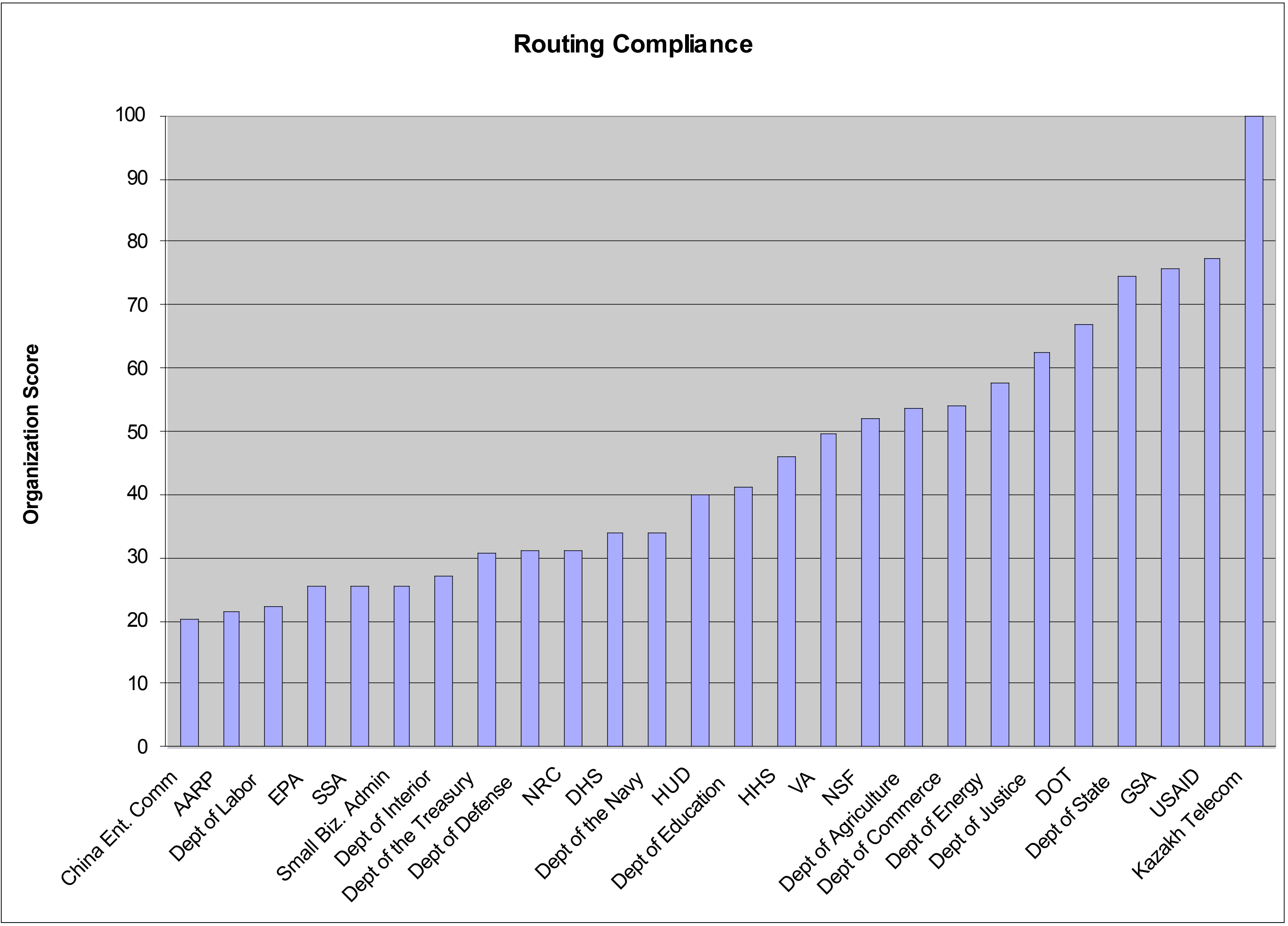
Compliance Scoring by Organization



Compliance Scoring by Agency

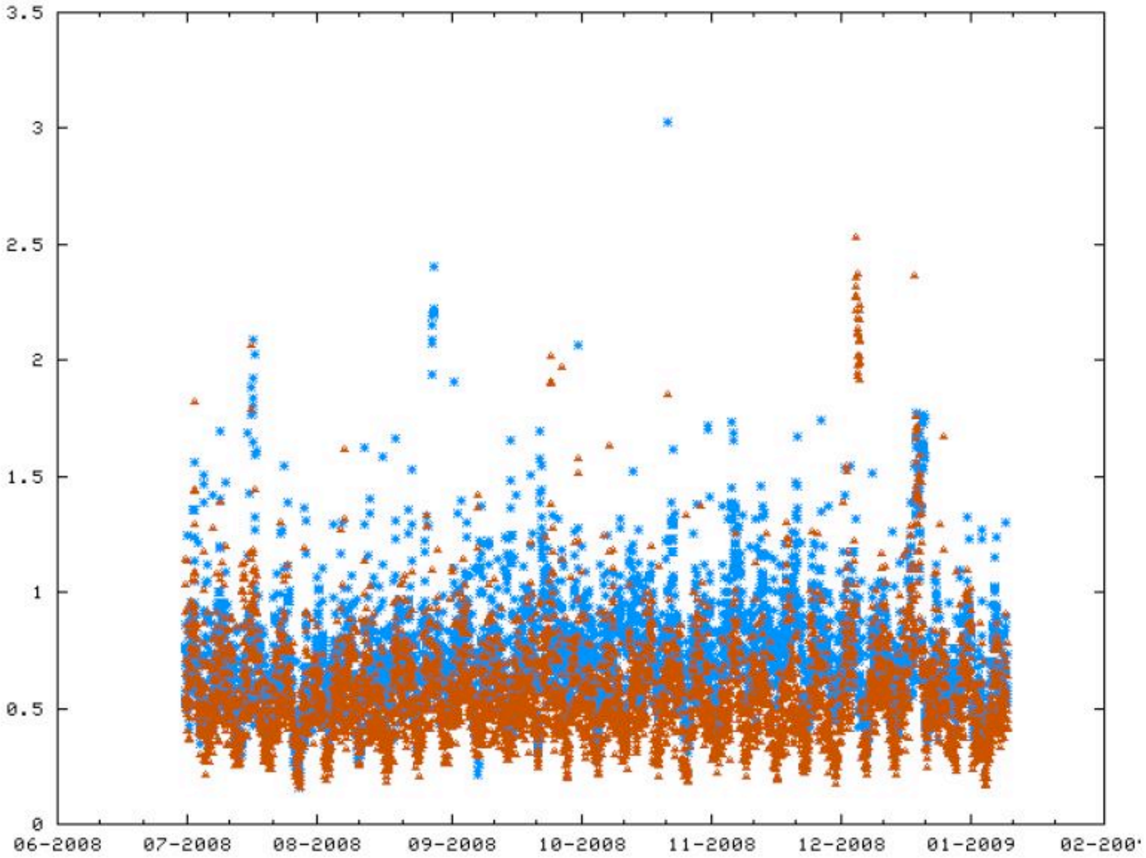


Availability – Required for Internet Access

- *Outaged* prefixes cannot be reached.
- *Unstable* prefixes show frequent routing changes.
  - Implies very poor connectivity, considerable packet loss
- We score organizations based on prefix availability, i.e., the absence of outages and instabilities.
  - Score range: 0 (never available) – 100 (always available)

Availability – Comparisons?

- How do customers of different providers compare?



% Unstable Prefixes:

Verizon customers

Level(3) customers

Level(3) customers' prefixes are more stable and less bursty overall.

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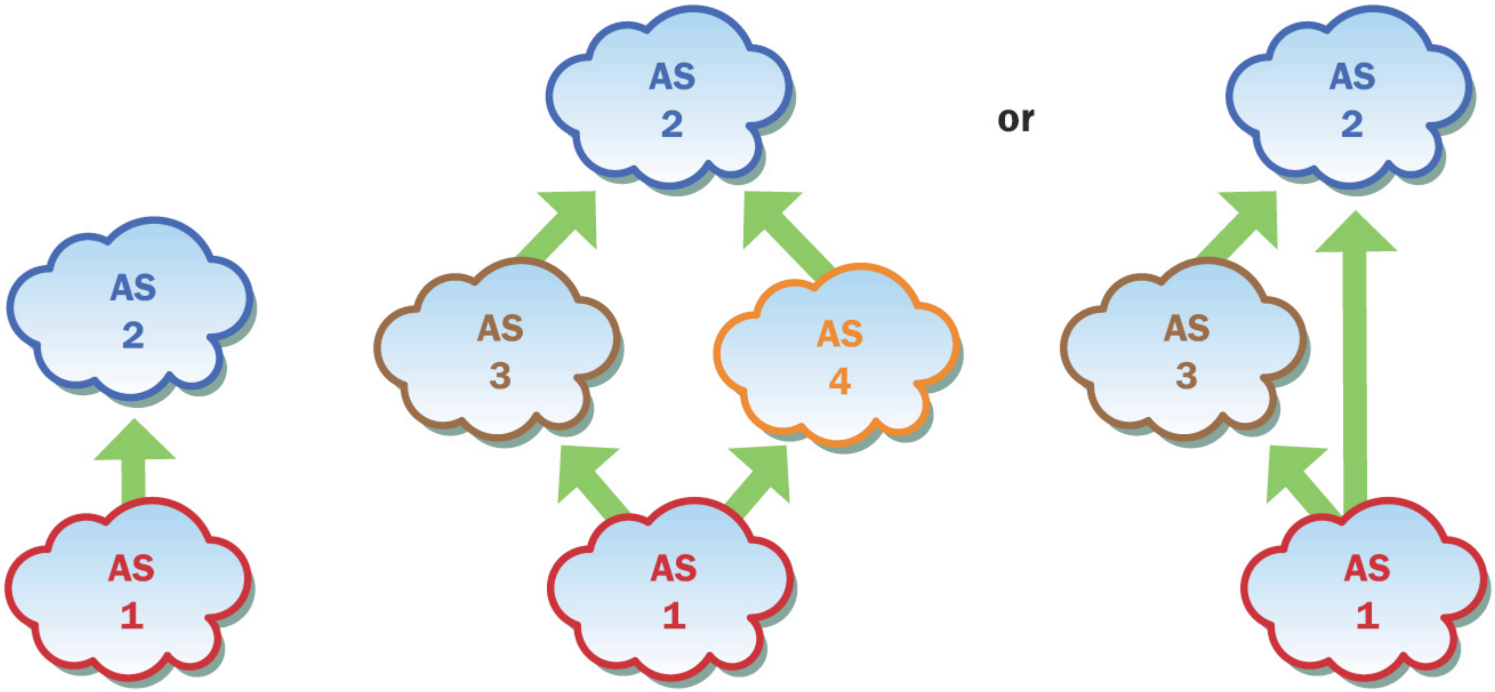
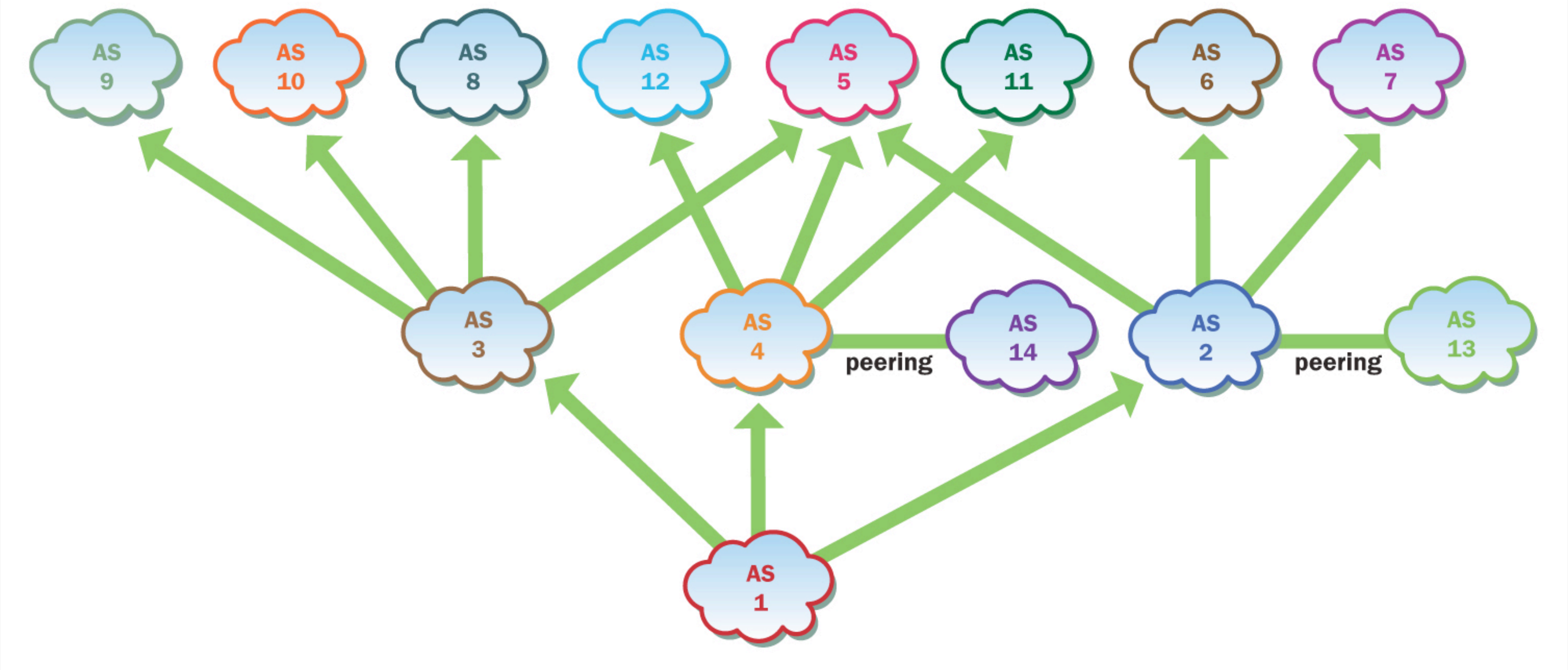
Diversity – Finding single points of failure



AS1 has only one provider **(very bad diversity)**

AS1 has two providers, but is ultimately solely dependent on **AS2 (less bad)**

Diversity – Eliminating single points of failure



AS1 has three providers, each of which is richly interconnected to the rest of the Internet.

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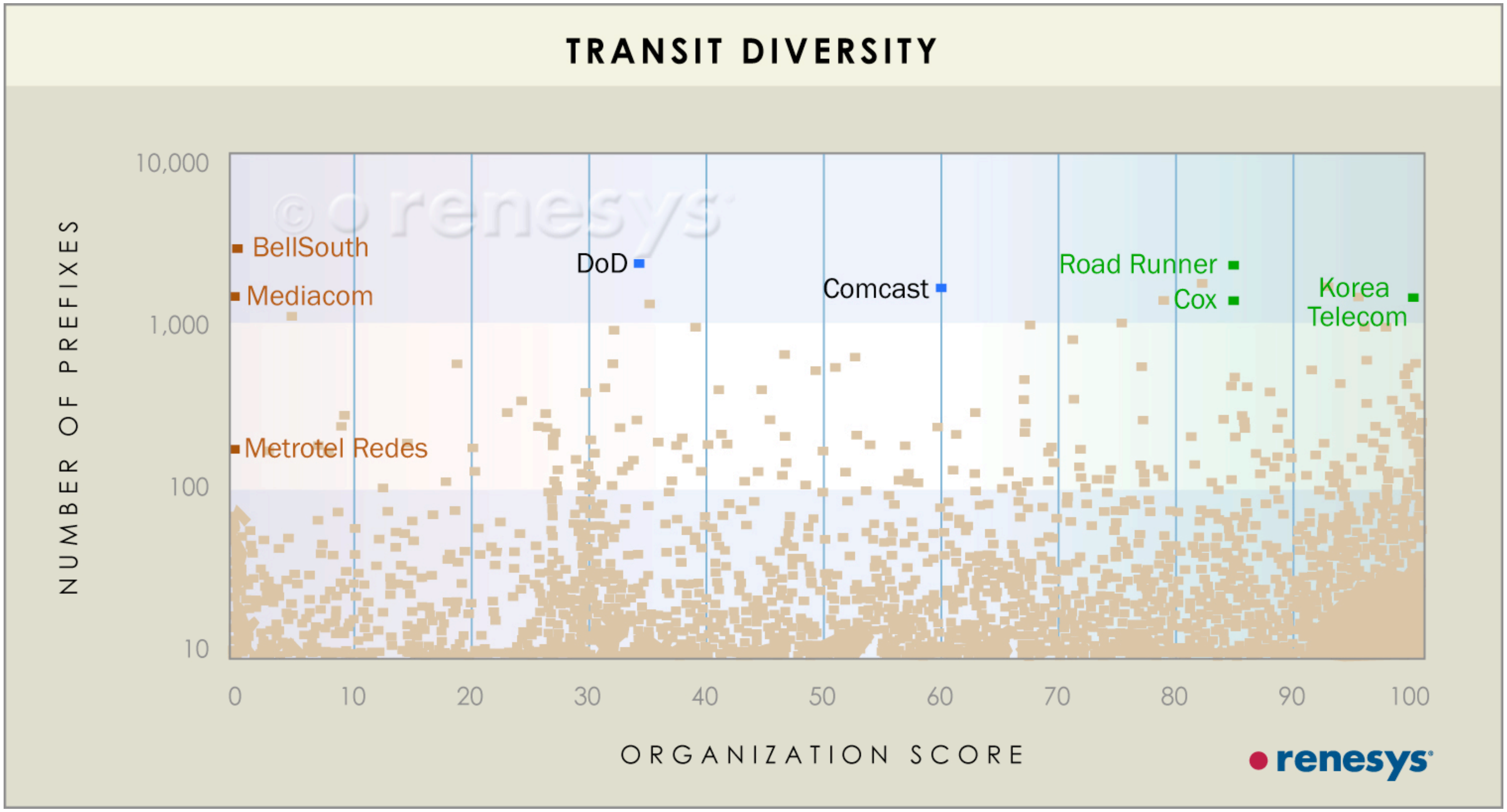
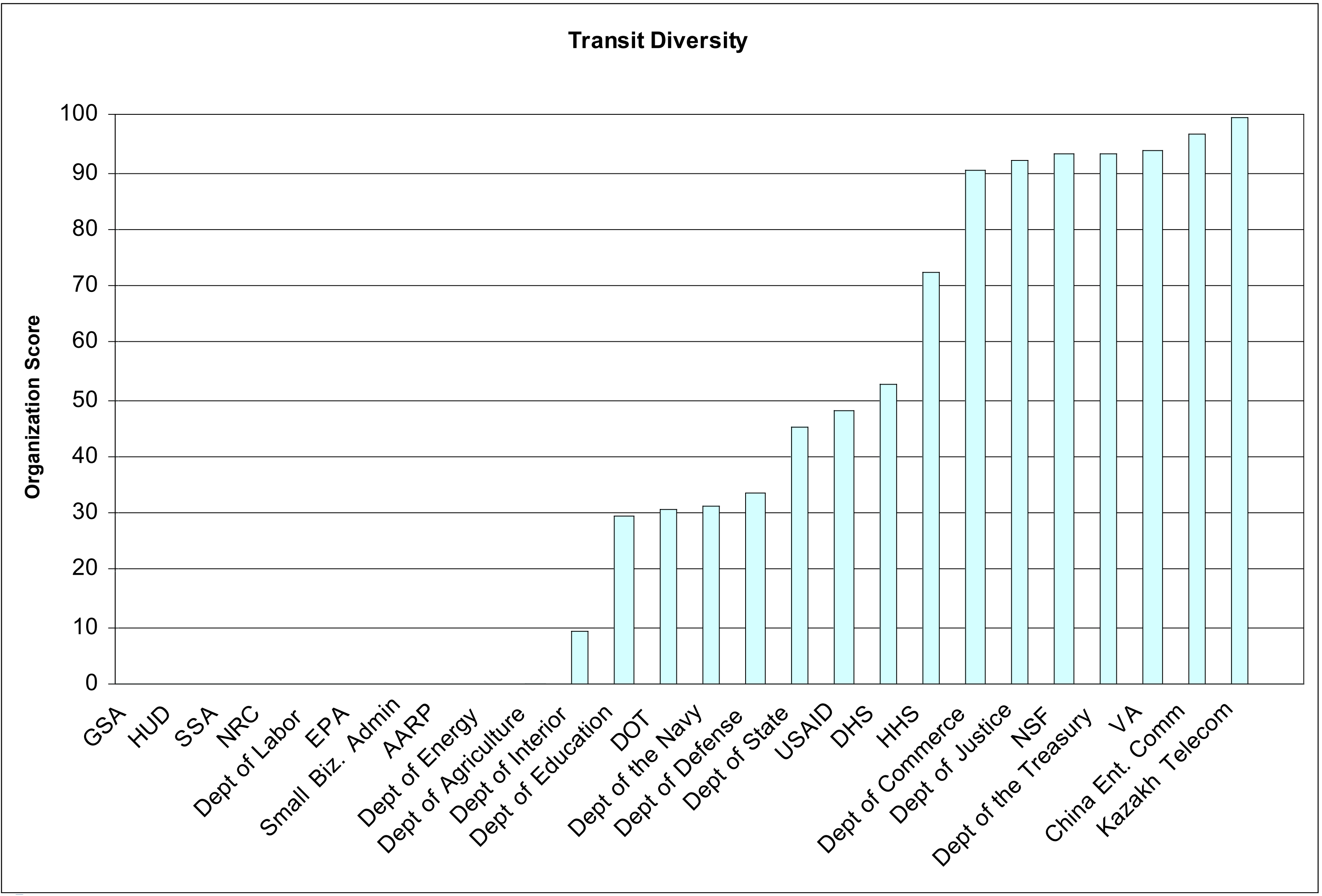
Measuring Diversity

- For each prefix …
  - How many direct providers are seen? (majority of score)
  - How many different Tier-1's ultimately provide transit?
- For each organization …
  - Average their prefix diversity scores in some way
    - Here we weight each prefix by its size
  - Composite score measures total *Internet transit diversity*
    - Score range: 0 (no diversity) – 100 (3 or more providers & Tier-1s)
  - Higher score → More diversity → Less risk

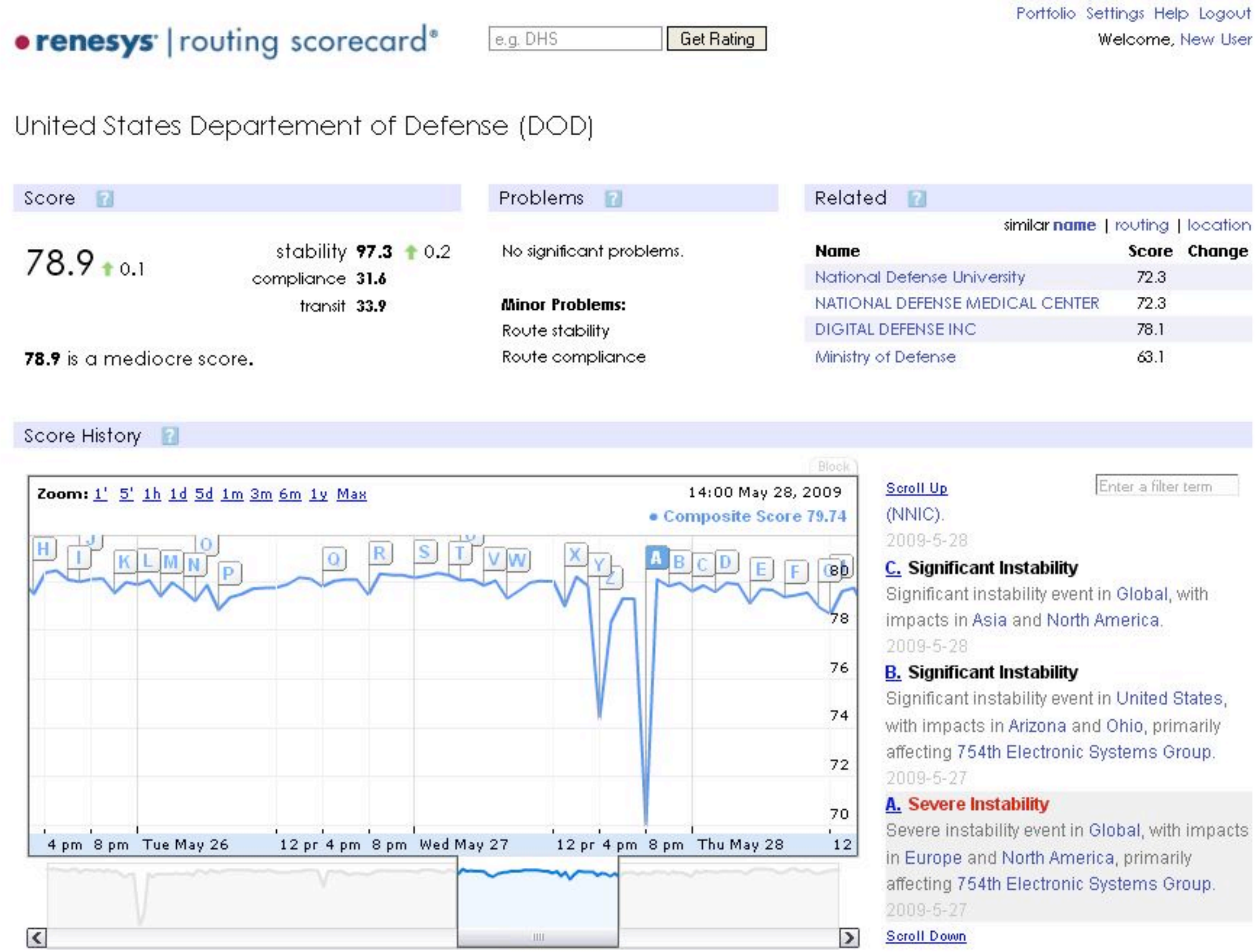
Diversity Scoring by Organization



Diversity Scoring by Agency



A Sample Scoring Application



renesys | routing scorecard®

e.g. DHS   Get Rating

Portfolio Settings Help Logout

Welcome, New User

United States Departement of Defense (DOD)

Score

78.9 ↑ 0.1

stability **97.3** ↑ 0.2
compliance **31.6**
transit **33.9**

78.9 is a mediocre score.

Problems

No significant problems.

Minor Problems:
Route stability
Route compliance

Related

similar **name** | routing | location

Name	Score	Change
National Defense University	72.3	
NATIONAL DEFENSE MEDICAL CENTER	72.3	
DIGITAL DEFENSE INC	78.1	
Ministry of Defense	63.1	

Score History

Scroll Up   Enter a filter term

(NNIC).
2009-5-28

C. Significant Instability
Significant instability event in Global, with impacts in Asia and North America.
2009-5-28

B. Significant Instability
Significant instability event in United States, with impacts in Arizona and Ohio, primarily affecting 754th Electronic Systems Group.
2009-5-27

A. Severe Instability
Severe instability event in Global, with impacts in Europe and North America, primarily affecting 754th Electronic Systems Group.
2009-5-27

Scroll Down

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So *that's* why we should care.

- Routing is based on trust. BGP in the real world lacks a secure infrastructure for establishing trust.
- It falls to the participants in the routing system to watch their backs and think critically when constructing filters and policies.
- Having just **a few key metrics** that expose organizational clue levels, gives you leverage that can make key people change their behavior in ways that radically improve an organization's routing security posture.

Thanks for listening.

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