IPv4: Mining Strategic Reserves

BGP Routing Table Complexity and the Transfer Market

APNIC, Jakarta

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10 September 2015

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IPv4 transfer is heating up

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Address Transfers in APNIC

7 Aug 2015 in **IP Addresses**, **Policy** by Geoff Huston

In 2010 the Asia Pacific Regional Address Policy community adopted a policy that permitted address holders in the region to transfer address registration records, enabling an aftermarket in IPv4 addresses to operate with the support of the APNIC registry function. While APNIC was still able to allocate addresses to meet demands there was very little in the way of activity in this market, but once APNIC was down to its last /8 of addresses in April 2011 the level of transfer activity has picked up. In this article I'd like to take a more detailed look at APNIC's transfer log and see what it can tell us about the level of activity in the address market in the Asia Pacific region.

Transfers of IPv4 addresses between entities are logged by APNIC in a transfer registry. This registry is updated daily, and can be found at ftp://ftp.apnic.net/public/transfers/apnic/, together with an archive of the state of the registry since its inception in 2010. At the end of July 2015 this registry contained 1,086 entries. Some 914 of these entries were related to the movement of address blocks between entities located in the Asia Pacific region, and 172 entries referred to IP address movement from another region into the Asia Pacific area. All of these 172 inter-RIR transfers refer to transfers of IPv4 addresses from the ARIN registry to the APNIC registry. These transfers list a total of 14,210,816 addresses, of which 9,674,496 transferred addresses were within the Asia Pacific region and 4,536,320 addresses have been transferred from ARIN to APNIC.

The average number of transfers per month has been steadily rising over the period since the commencement of transfers in late 2010. As shown in Figure 1, the number of transfers has risen from 2 – 3 transfers per month to the 2015 average rate of 44 transfers per month. The volume of addresses being transferred has also risen from some 2,500 addresses per month to some an average of 700,000 addresses per month. In 2015 The average size of entries in the transfer log for 2015 is a /18, or 16,336 addresses, while the overall average for the entire period is slightly lower at 13,085 addresses per transfer.

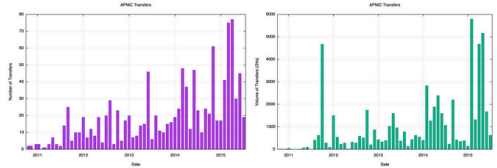


Figure 1 – Per Month view of APNIC transfers, showing the number of transfers per month (left) and the volume of transferred addresses (right)

https://labs.apnic.net/?p=689

- The basic story has been well-told
  - ~1000 intra-registry transfers
  - ~175 inter-registry transfers
  - Exhaustion is upon us
  - Markets have begin to function

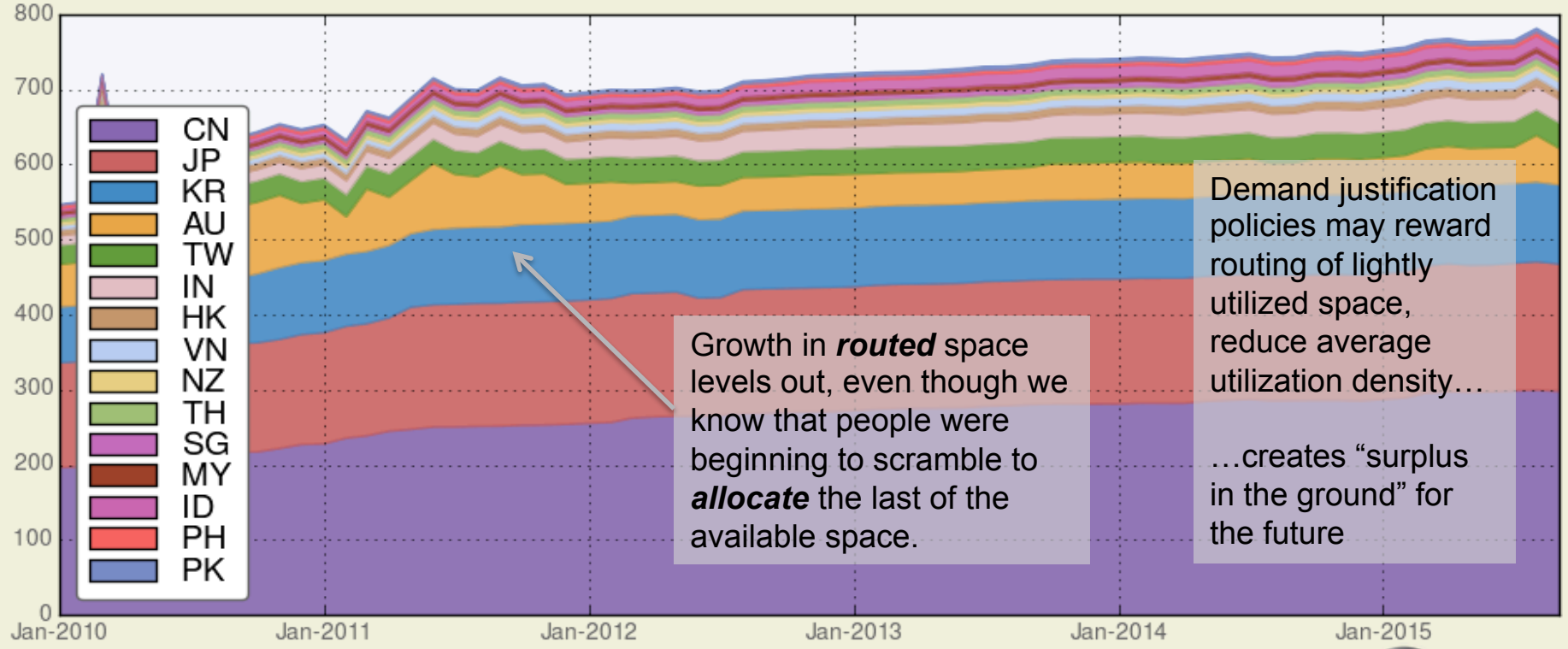
Transfers create special opportunities for chaos in the BGP Routing System….

Framing the problem

- Initial address allocation is nearly complete, but **allocated != routed** and **routed != used**.
- We have much more demand than supply. Some is visible (public routing table), but not all.
- Let's predict the forward pricing….

IPv4 Routed Addresses, country-level, millions of covered /32s

Source: Dyn IP Transit Intelligence



Growth in ***routed*** space levels out, even though we know that people were beginning to scramble to ***allocate*** the last of the available space.

Demand justification policies may reward routing of lightly utilized space, reduce average utilization density…

…creates "surplus in the ground" for the future

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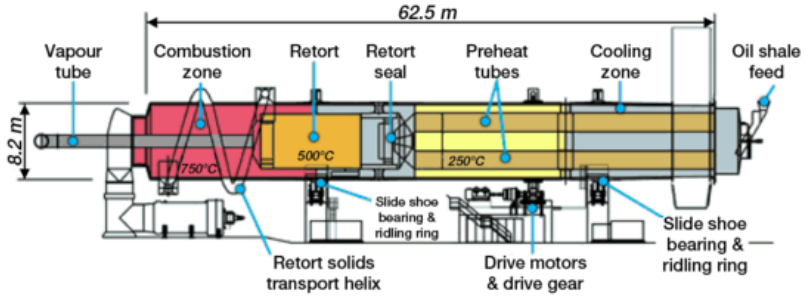
Perhaps we need a good analogy.

- **Petroleum** is a finite resource with huge demand, no easy substitutes, and efficient global markets.
- We all know oil will run out some day.
- **Why, in practice, does the price of oil not increase monotonically over time?**

Scarcity breeds creativity.

- When prices rise, technology brings previously invisible reserves of oil (and other forms of energy) into the market.



- That causes oil prices to fall, disrupting economies that depend on steady revenue from oil extraction.

- Eventually, however, it will all be gone.

Drilling the Strategic Reserves….

- We have different proven reserves of IPv4 “in the ground”

- Some of them are cheaper to deliver to market than others
- Inter-regional transfer policy will play a huge role in determining global prices, by making North America’s strategic reserves more easily available around the world

Anecdotes from the RIPE experience

As markets heat up, problems are inevitable

Dacia 1300 in Morocco. Credit: Andrew Szabo

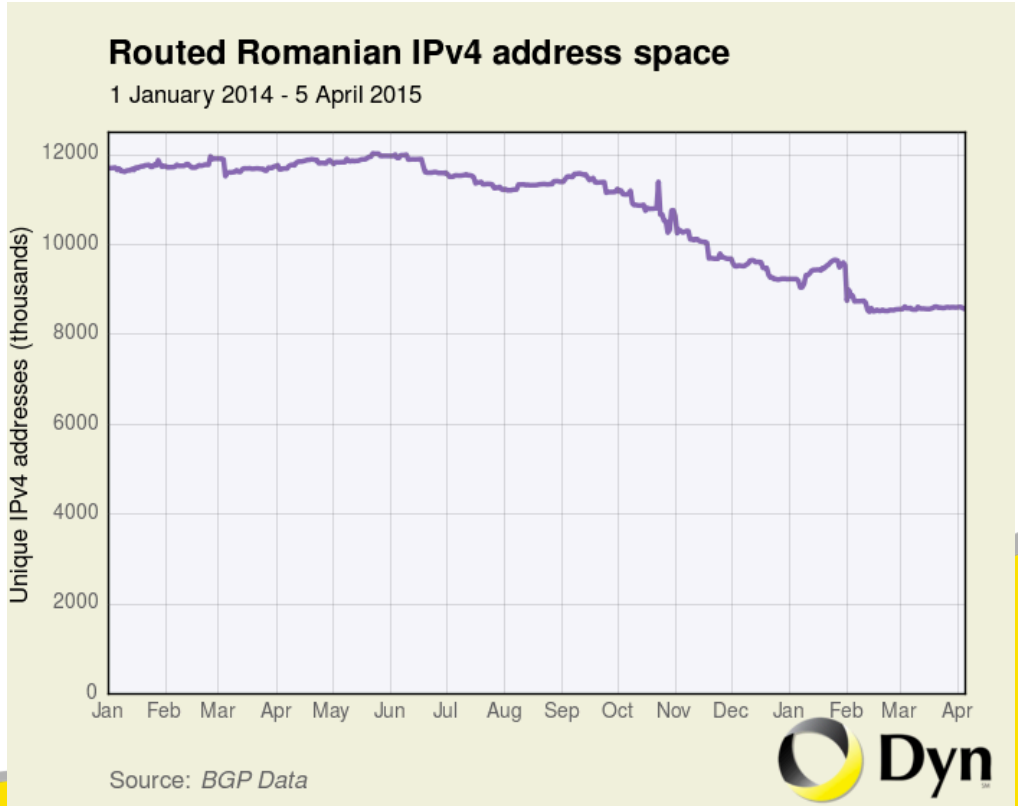
Selling a block of addresses is not like selling a car.

Transfer of “title” and handing over the keys typically stops the seller from continuing to drive the car, get traffic tickets, etc.!

Romania is *visibly shrinking*

Much IPv4 address space has been transferred (i.e. “sold”) from Romania

- 930 out of 1856 (50%) blocks transferred through early 2015 were from Romania
- 817 (44%) were from Jump Mgt (AS2541, jump.ro)



Analyzing the movement of IPv4

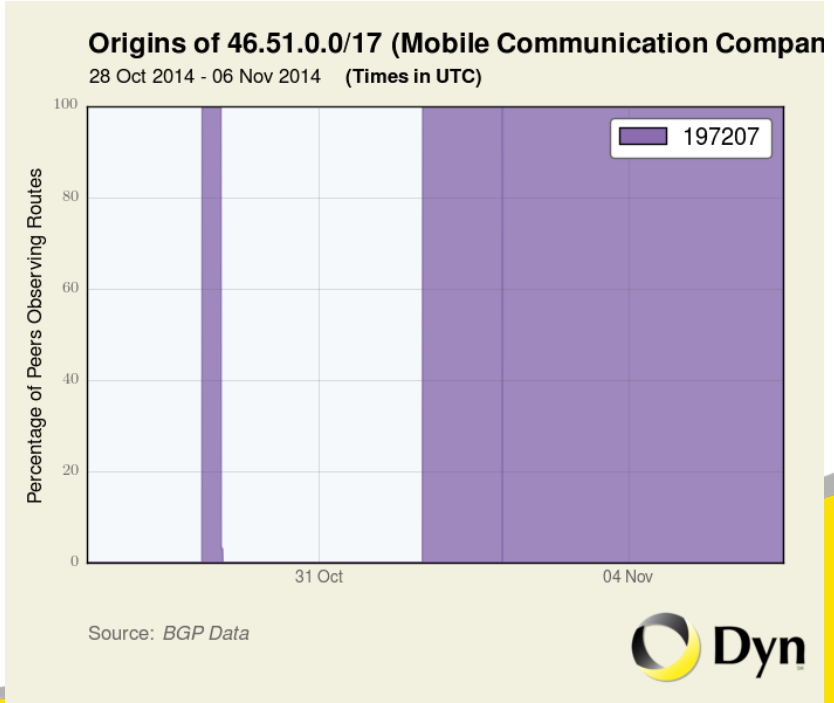
Much of the Romanian address space has shown up in the Middle East

- **33%** of the ~4500 prefixes originated in Saudi Arabia were Romanian a couple of months ago
- Iran, Syria, UAE are some other ME nations now using former Romanian IPv4 space

Example of the complexity of handover

- 27-Oct-2014: 46.51.0.0/17 was transferred from Netserv Consult SRL (RO) to Mobile Communication Company of Iran
- Mobile Communication Company of Iran (**AS197207**) began announcing the prefix immediately

- **Looks good, the keys have been handed over, the Iranian mobile provider is ready to drive!**



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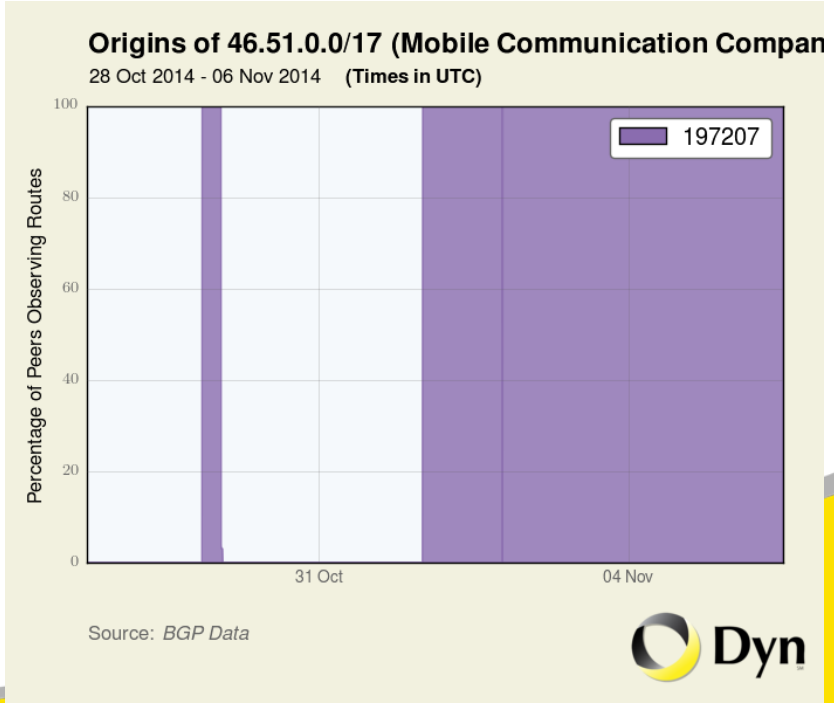
- ~~Looks good, the keys have been handed over, the Iranian mobile provider is ready to drive!~~

Not so fast…

- **Level 3 (AS3356) has announced more-specific prefixes within this range since early 2012:**
  - **46.51.16.0/21, 46.51.24.0/21, 46.51.32.0/21 …**



Time passes, impairment mysterious

From October transfer through early December, anyone trying to go to the more-specific /21s within the transferred /17 will end up blackholed (presumably in Romania)

Iranian mobile users trying to use data services to reach content in the USA probably encounter real frustration

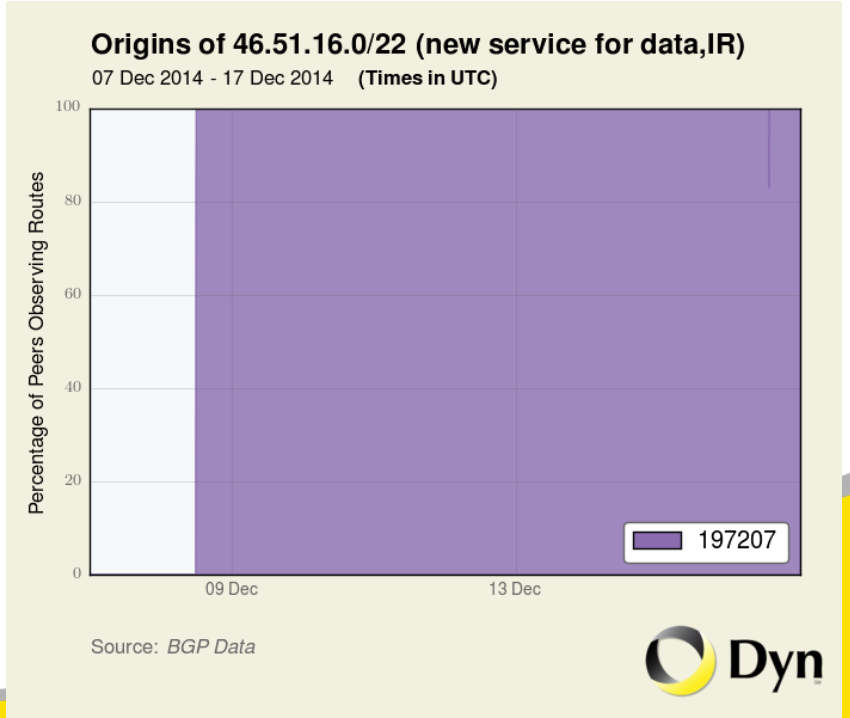
The embargo against Iranian users doesn't help clarify the situation – who's blocking them?!

Darwinian Competition: The New Normal?

So starting in early December, AS197207 started announcing all the even-more-specifics of AS3356's more-specifics to regain control over the space!

Had nothing to do with sanctions ..

Just a side effect of a market in which buyers close escrow without establishing clean routability (the seller's responsibility in future standard T&Cs?)

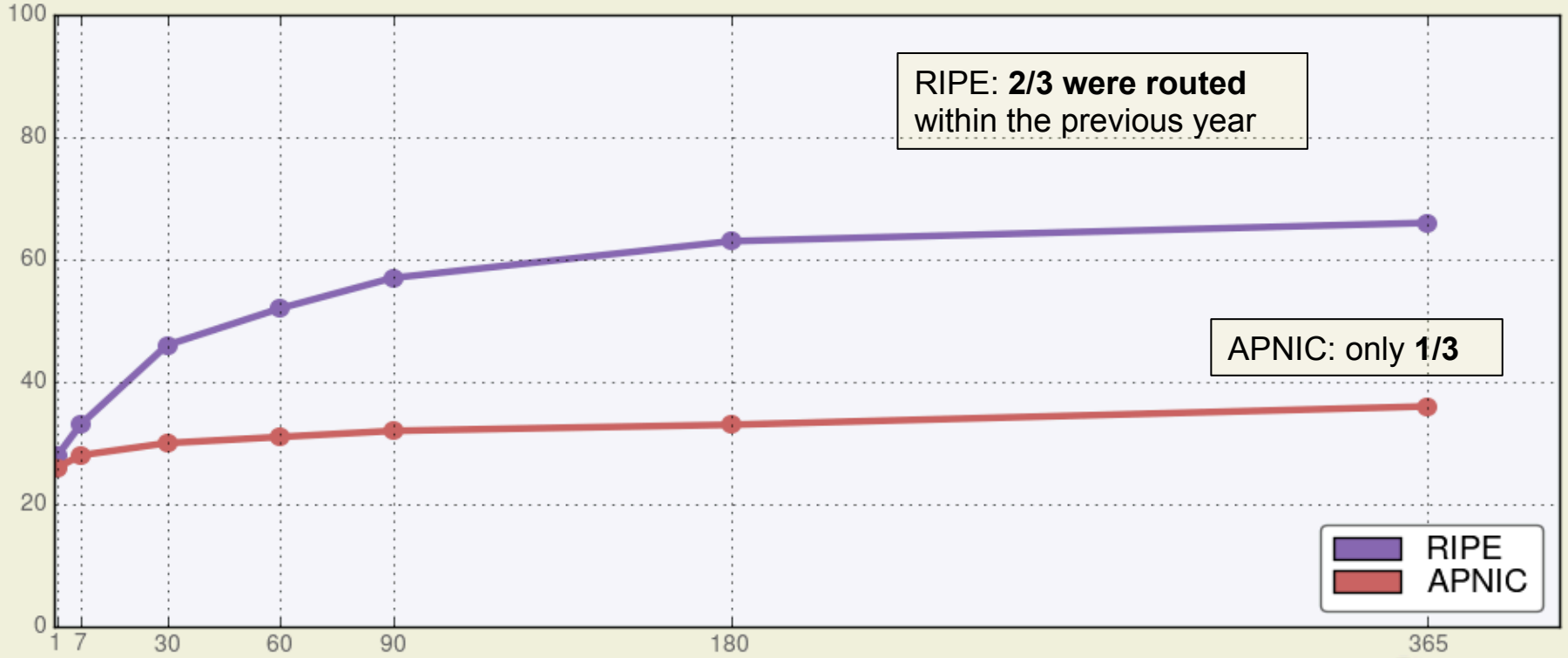


The Good News

- We **haven't seen** the same kind of transfer-related BGP struggle in the APNIC region .. and we've looked fairly carefully.
  - What's different here? Something structural?
  - RIPE and APNIC are **different places**.
  - APNIC has had access to ARIN transfer space for years as exhaustion grew closer
  - Transfers more likely to be **unused space**

Percentage of transferred prefixes routed within X days preceding transfer

Source: Dyn IP Transit Intelligence



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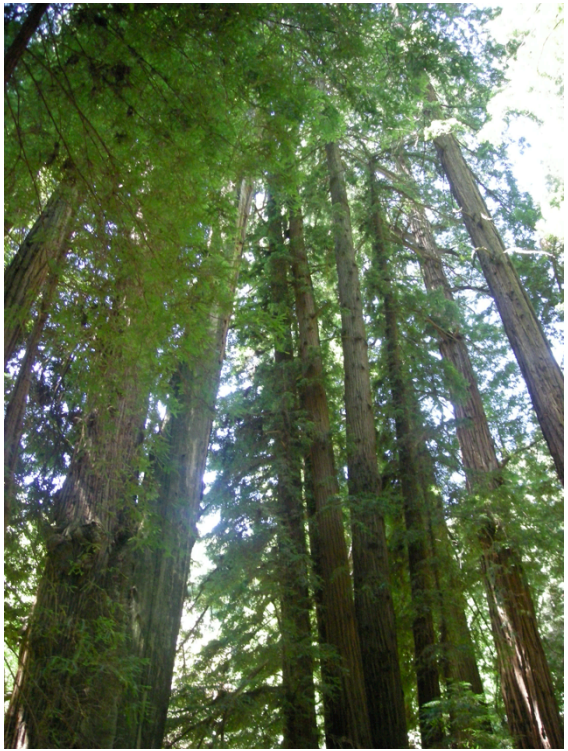
The Benefits of Cutting Old Growth Forest

Photo: Snežana Trifunović

Accidental transfer-related BGP route hijacking takes place because of **conflicting sequential use.**

Consider the history of 207.189.184.0/22



- An “old growth” prefix
- Allocated 25 Feb 1999
- Goes completely unrouted for 16 years

```
207.189.184.0/22|American Registry
for Internet Numbers/PACIN|AP|ARIN|
19990225
```

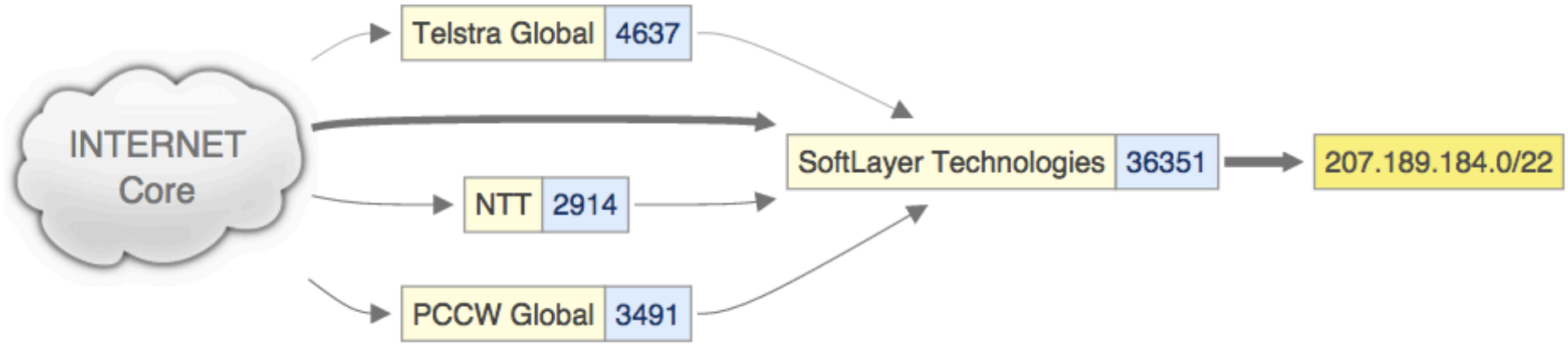
16 March 2015: Transferred ARIN-APNIC

```
ipv4|207.189.184.0/22|American Registry for Internet
Numbers/PACIN|AP|ARIN|19990225|Octane Marketing (P)
Ltd.|IN|APNIC|20150316
```

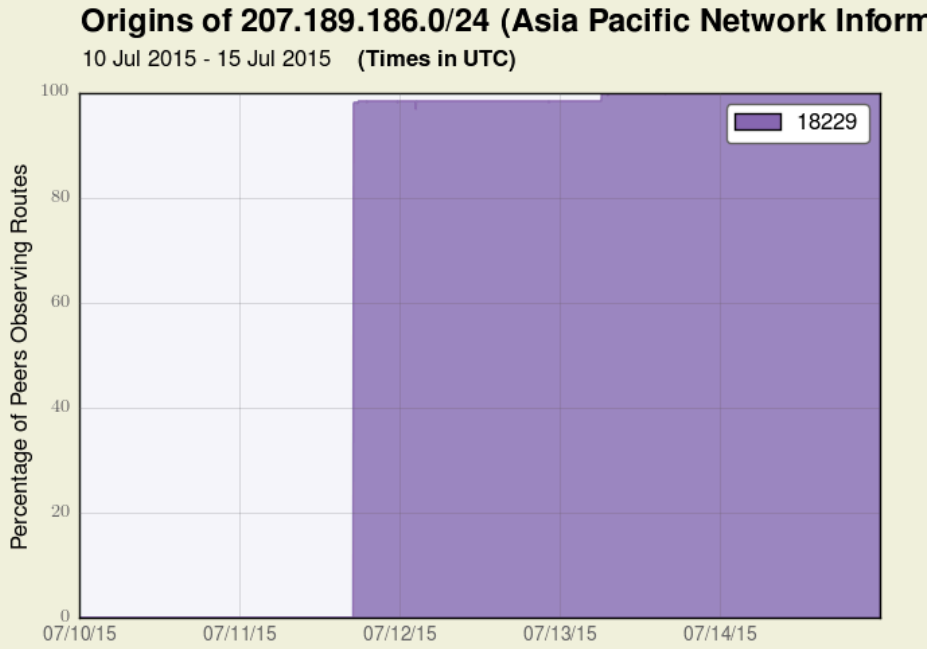
Note: This was always “in India” within ARIN space, from the ancient days, so the transfer isn’t going far.

What happened next?

22 May 2015: Softlayer starts routing in India



12 July 2015: Alternate-origin more-specific appears



AS18229 (a non-Softlayer datacenter) begins to sink traffic to the 3rd /24 in the /22 – **potentially alarming**!

50 days have passed since first origination by Softlayer

Is this a hijacking?

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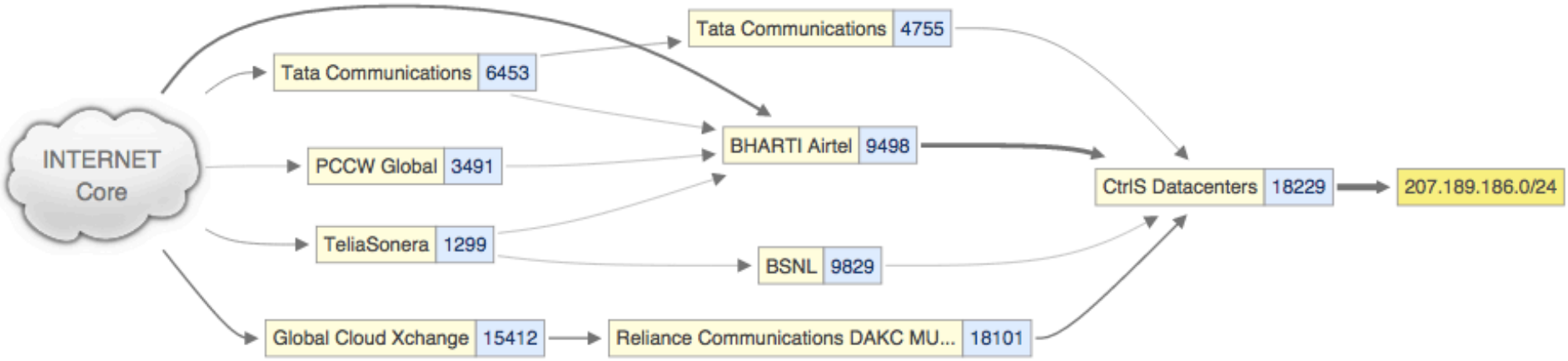
12 July 2015: Alternate-origin more-specific appears



Routing similarity to the Softlayer covering /22 is close to zero – worrisome - these are clearly distinct applications

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DOMAIN REPORT

trackcampaigns.com

trackcampaigns.com

September 6, 2015

In my portfolio

Add to my portfolio

Network details

- Map of IPv4 hosts
- IPv4 hosts for top domains

See network connectivity at each location:

Filter by:

Location	Organizations
Ashburn, VA, US	Octane Marketing (P) Ltd.
Saket, India	Octane Marketing Private Limited

Showing 1 to 2 of 2 entries

Map of IPv4 hosts for **trackcampaigns.com**

Feedback

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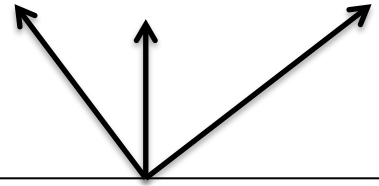
Saket, India	Octane Marketing Private Limited

Showing 1 to 2 of 2 entries

IPv4 Hosts for trackcampaigns.com

Filter by:

IP Address	Prefix	Organization	AS	City	Country	Domains
119.81.142.26	119.81.128.0/18	Octane Marketing Private Limited	SoftLayer Technologies AS 36351	Saket	India	images.trackcampaigns.com
199.166.35.9	199.166.34.0/23	Octane Marketing (P) Ltd.	SoftLayer Technologies AS 36351	Ashburn, VA	United States	www.trackcampaigns.com trackcampaigns.com



The relationship among Octane, Softlayer, and local content hosting in India seems plausible.

Showing 1 to 2 of 2 entries

Feedback

Why this set off all our alarm bells:

- Recent transfer (inter-regional at that)
- Multiple origin ASNs
- Sequential expression of more-specific routes (“taking control” of part of the routed space)
- Origins have no clear preexisting transit or peering relationship in the history of the BGP routing table
- This is what **leasing** will look like.

Summary: Markets Require Measurement

- Carefully research the **historical routing** of networks for sale and any more specifics. Appropriate settling time?
- Don't forget DNS: Legacy FQDNs that point to transfer space can bring the buyer unwanted (nasty) traffic.
- Configure **aggressive routing alarms** on any purchased prefix via a 3rd party service, **especially** if the network has been previously routed (less common in APNIC)
- Brokers may want to explore ‘clean routing’ assertions at close of escrow (maybe even clawbacks) as a part of standard T&Cs

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Recent historical trends in IPv4 address consumption

APNIC, Jakarta

Jim Cowie, Doug Madory

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