

2005 – BGP Updates

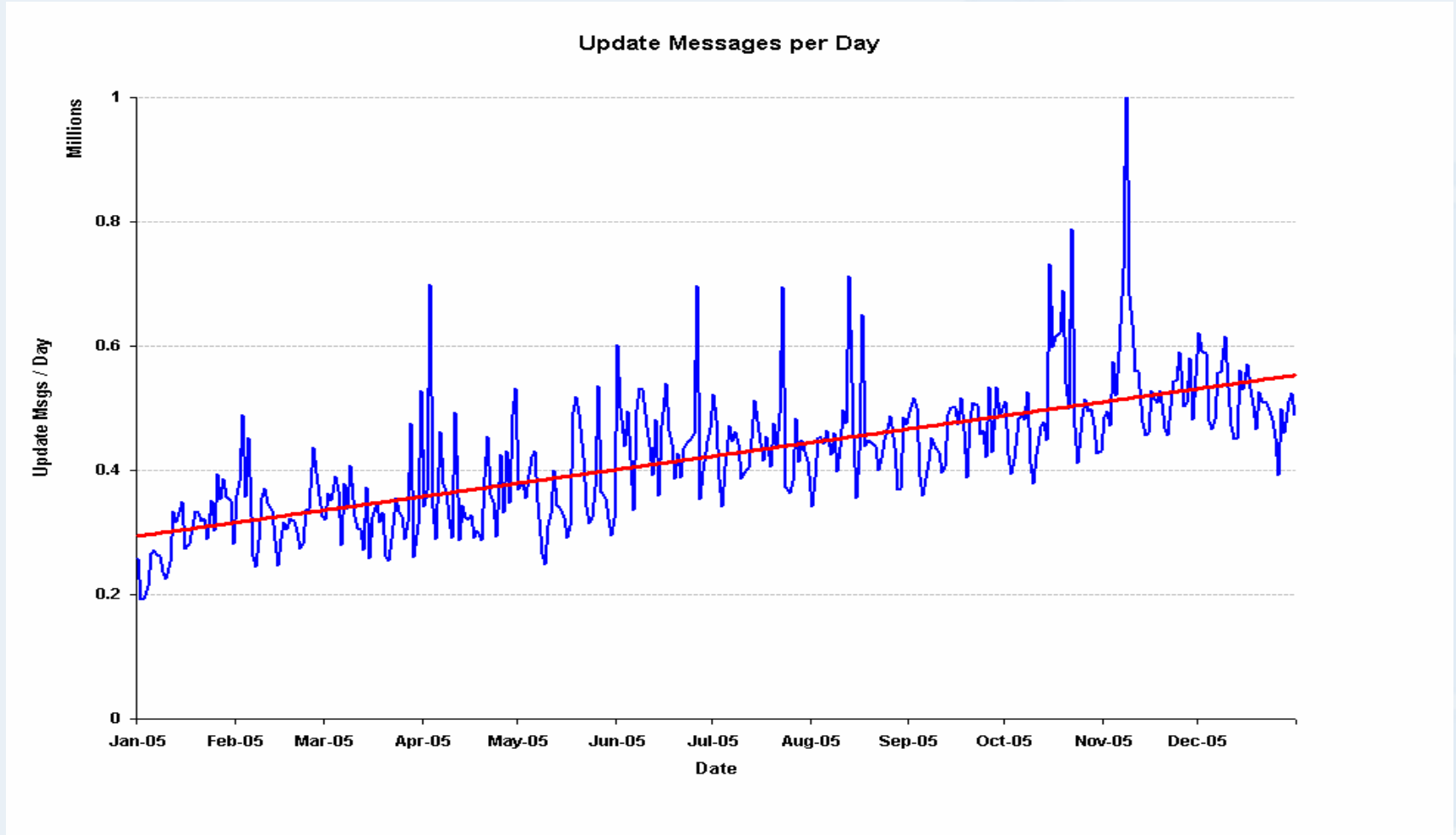
March 2006

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APNIC

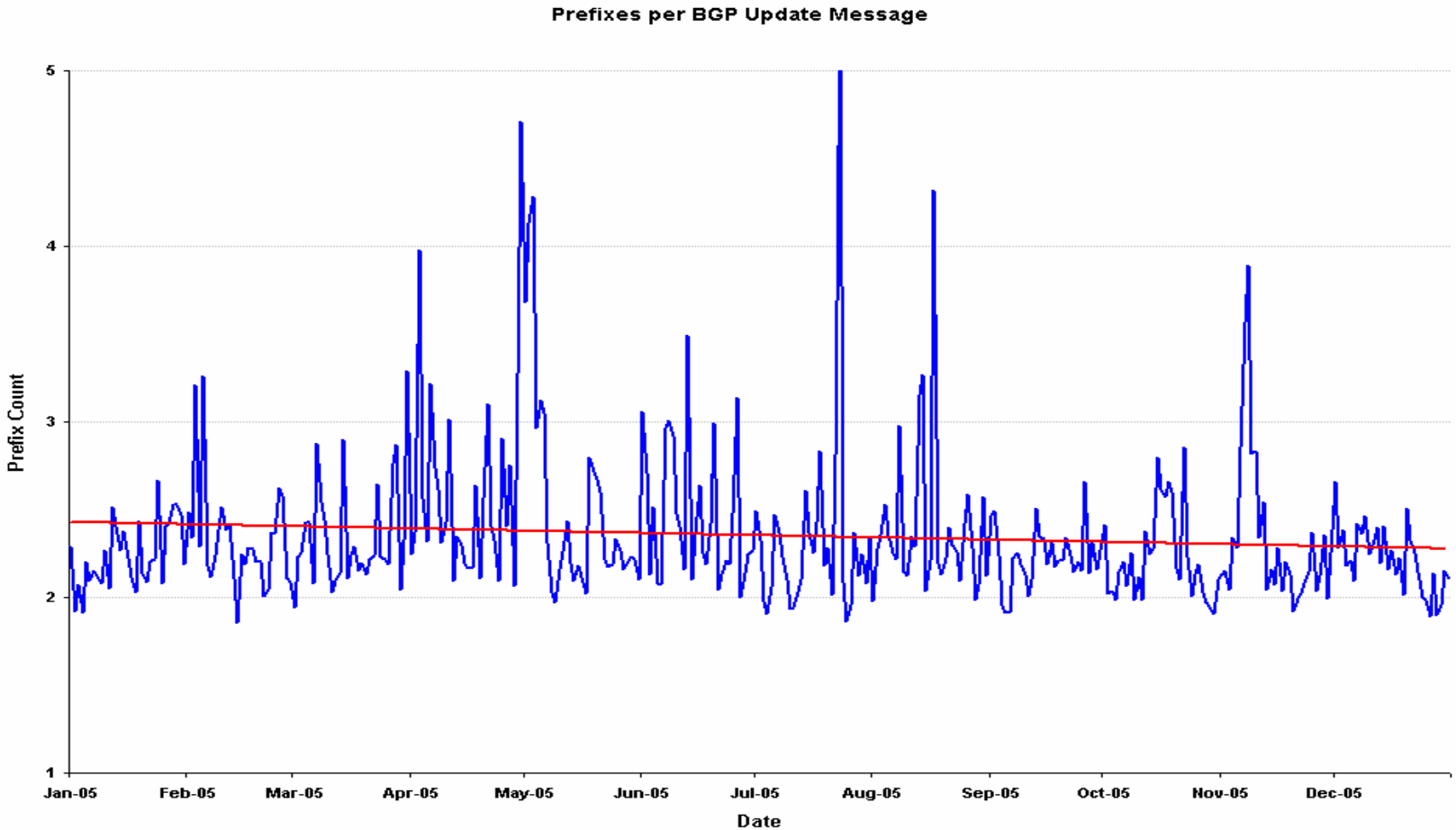
BGP Update Study - Methodology

- Examine update and withdrawal rates from BGP log records for 2005 from a viewpoint within AS1221
 - Eliminate local effects to filter out non-DFZ BGP updates
 - Look at the relative rate of updates and withdrawals against the table size
- Generate a BGP table size predictive model and use this to generate update rate and processing rate predictions

Update Message Rate



Prefixes per Update Message



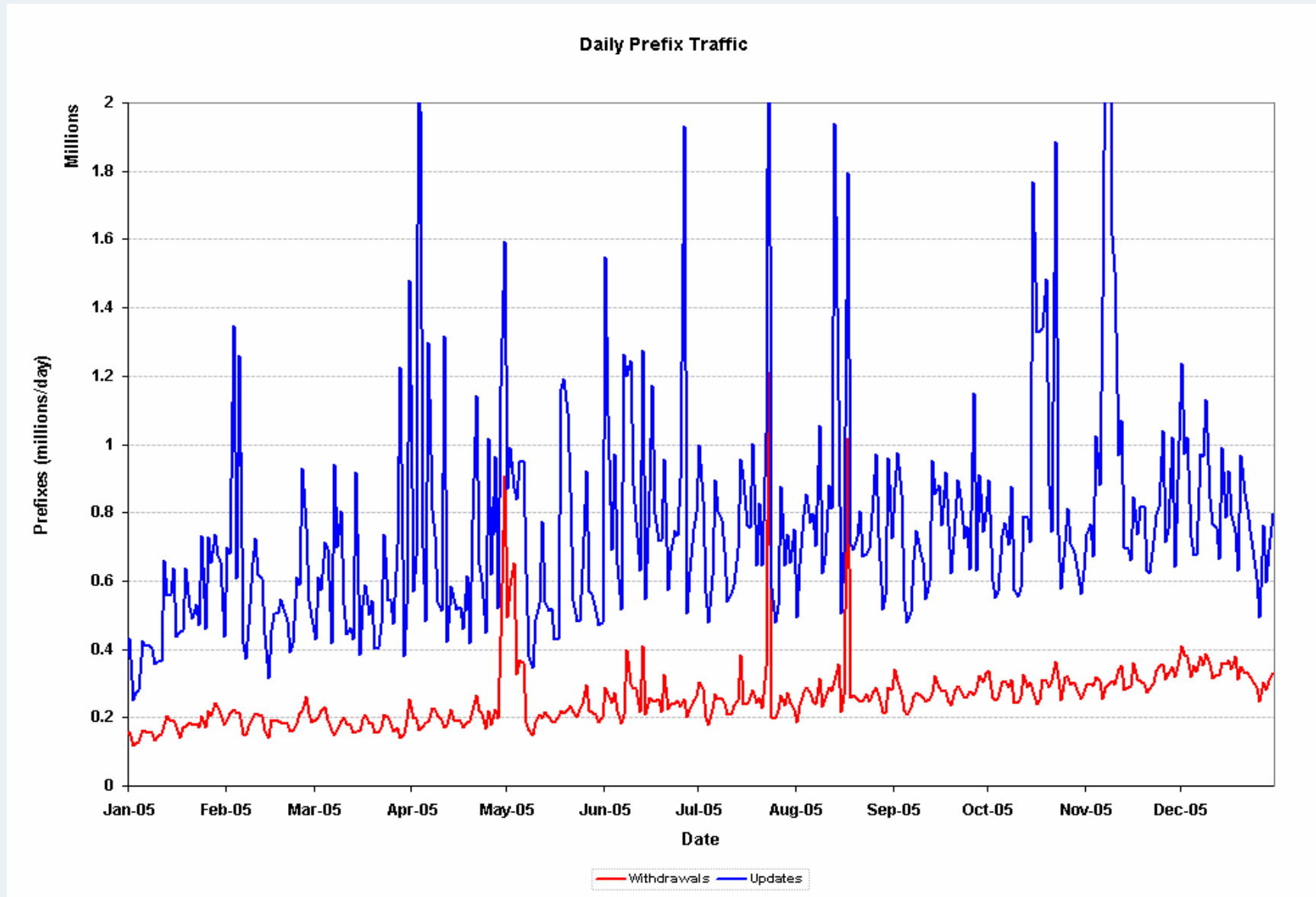
Update Trends across 2005

- Number of update messages per day has doubled across 2005 (Dec 2005 saw approx 550,000 update messages per day)
 - Considering the population size the daily rate is highly variable – why?
- Number of prefixes per update message is falling from an average of 2.4 to 2.3 prefixes per update
 - Is this attributable to increased use of public ASs and eBGP at the edge of the network? (Multi-homing?)
- Is the prefix update rate increasing at a greater rate than the number of prefixes in the routing table?
 - Is there some multiplicative factor at play here?
 - Why is instability increasing faster than the network size?

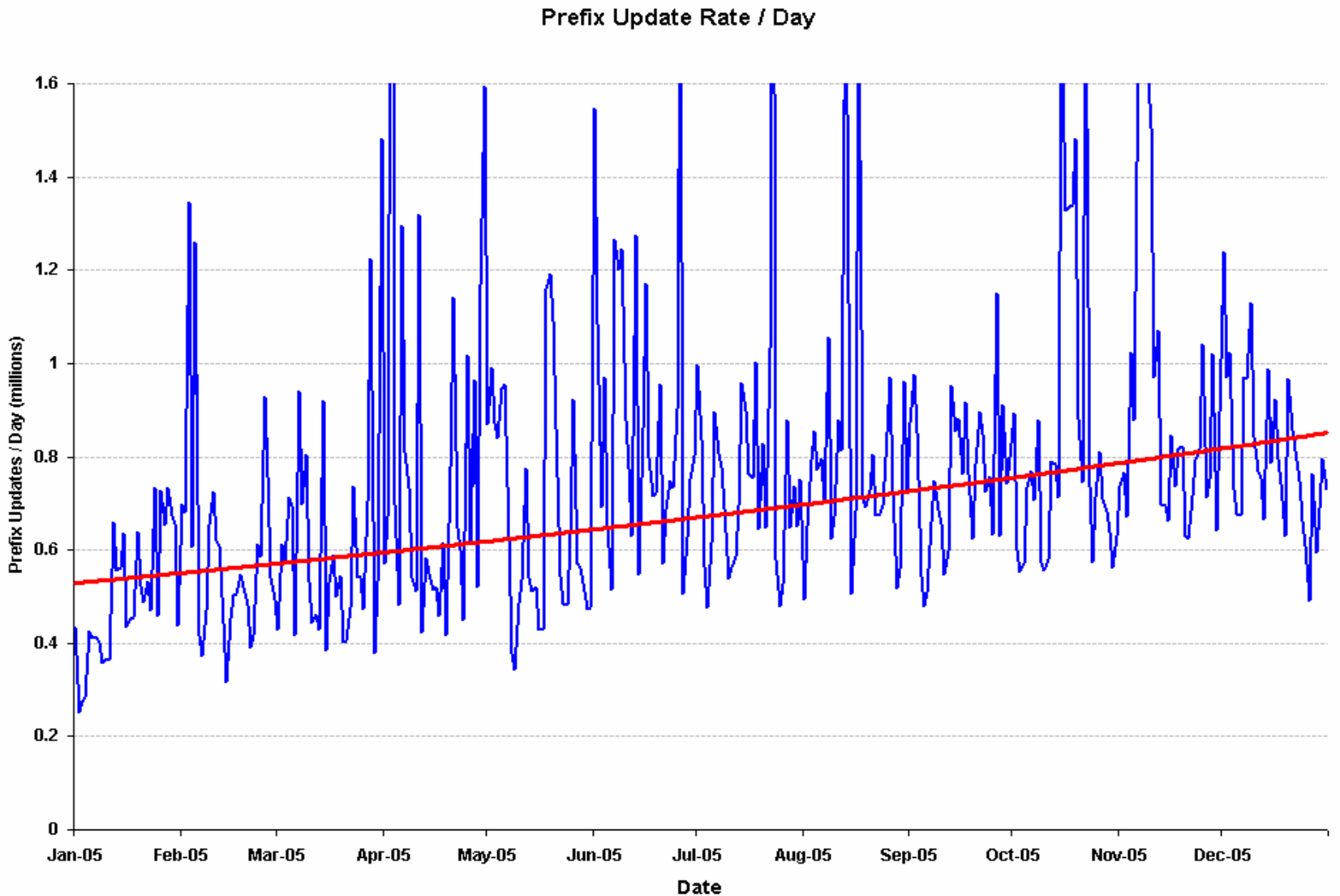
Prefixes vs Updates

- Look at the number of prefixes that are the subject of update messages
- What are the trends of prefix update behaviour?

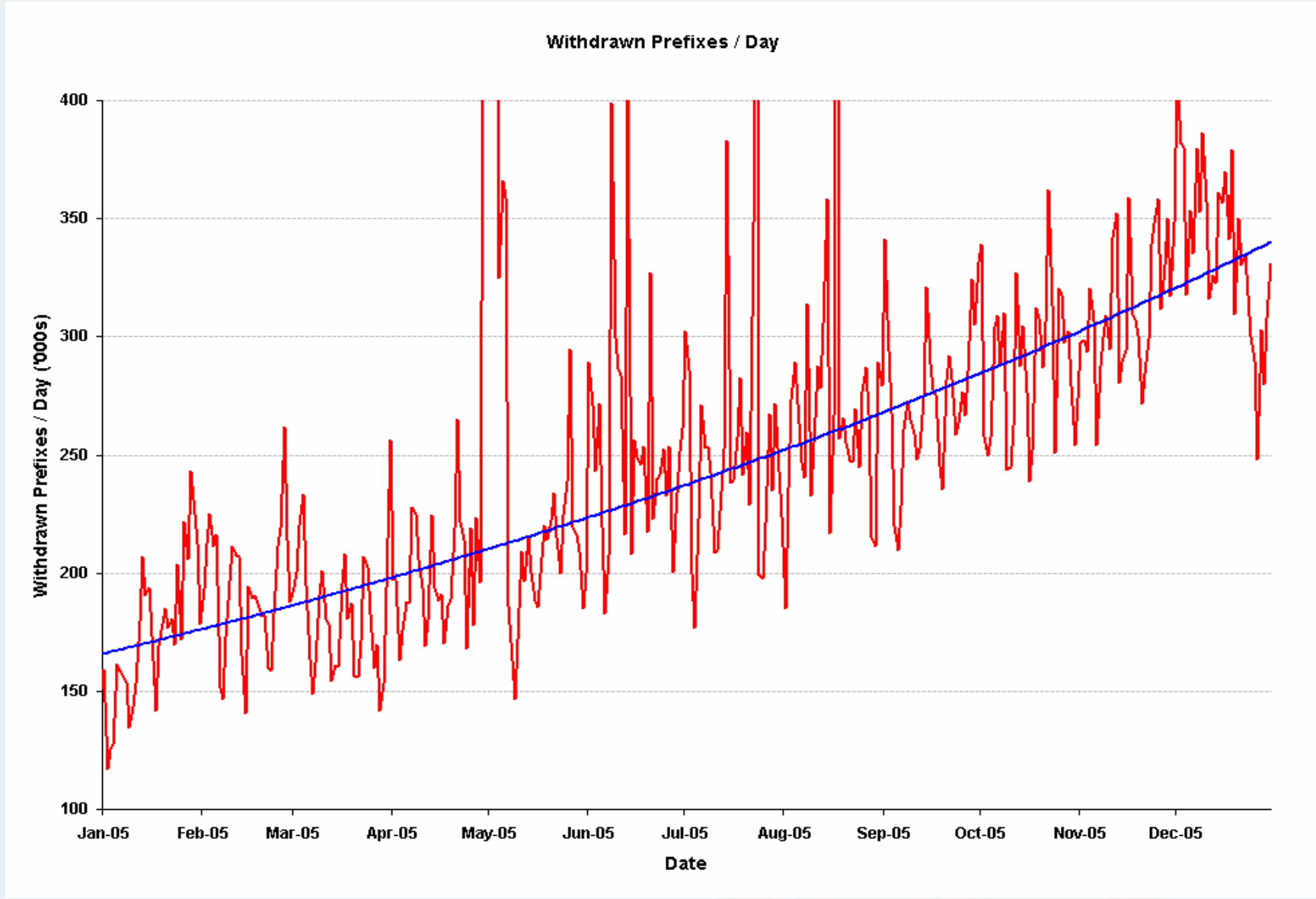
Prefix Update and Withdrawal Rates



Prefix Update Rates



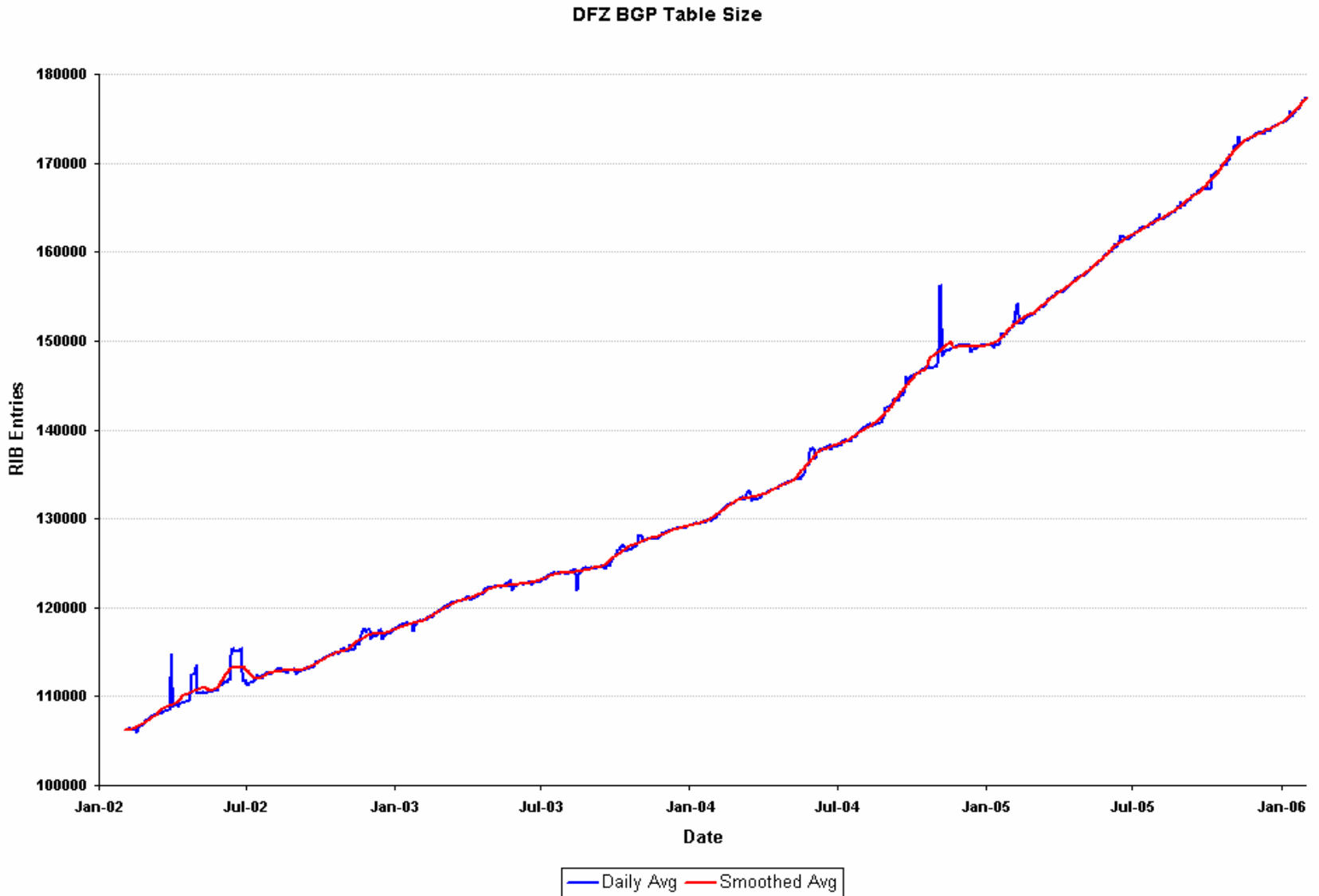
Withdrawal Rates



Prefix Rate Trends

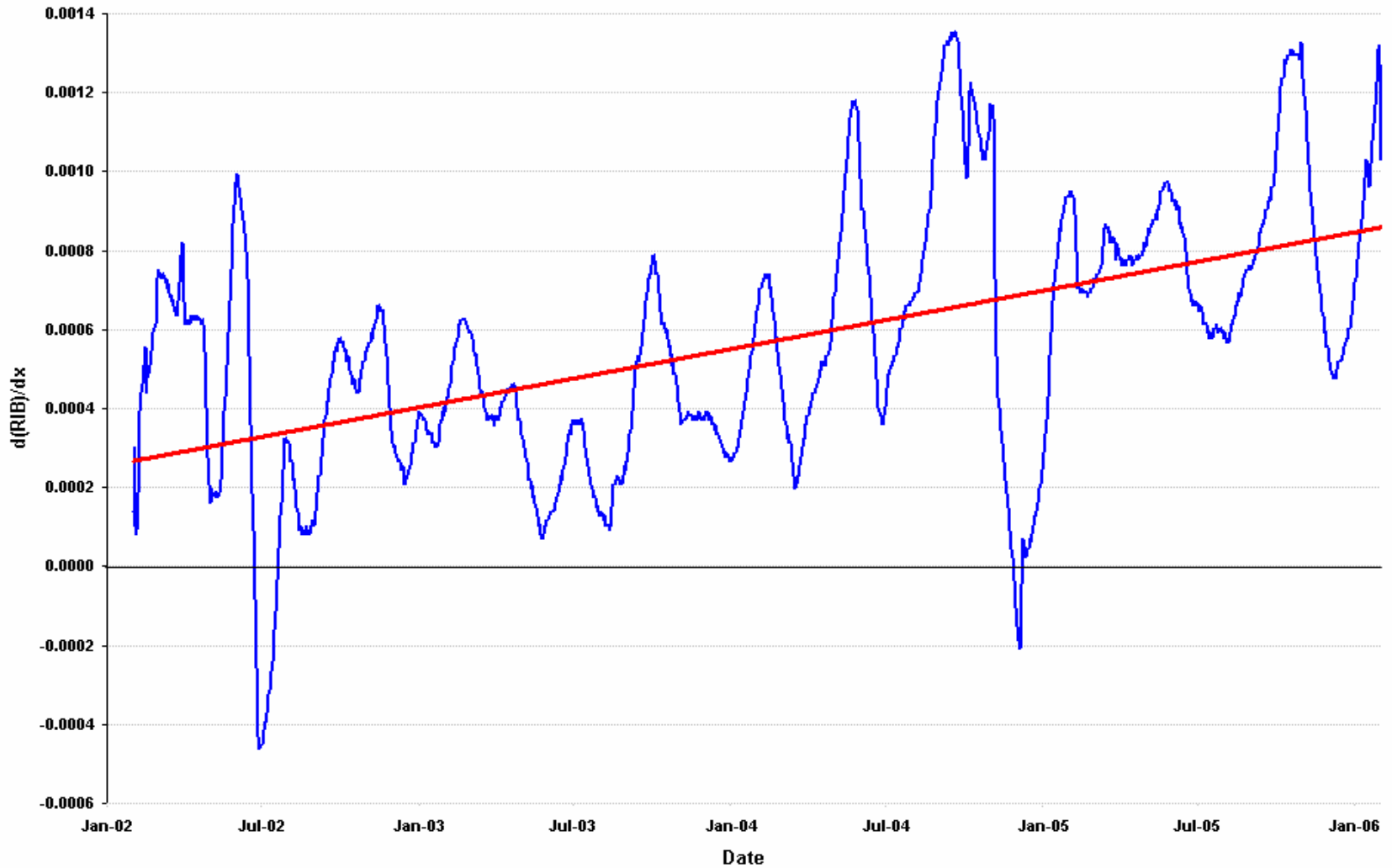
- High variability in day-to-day prefix change rates
- Best fit model appears to be exponential – although update and withdrawal rates show different growth rates

DFZ Prefix Table Size

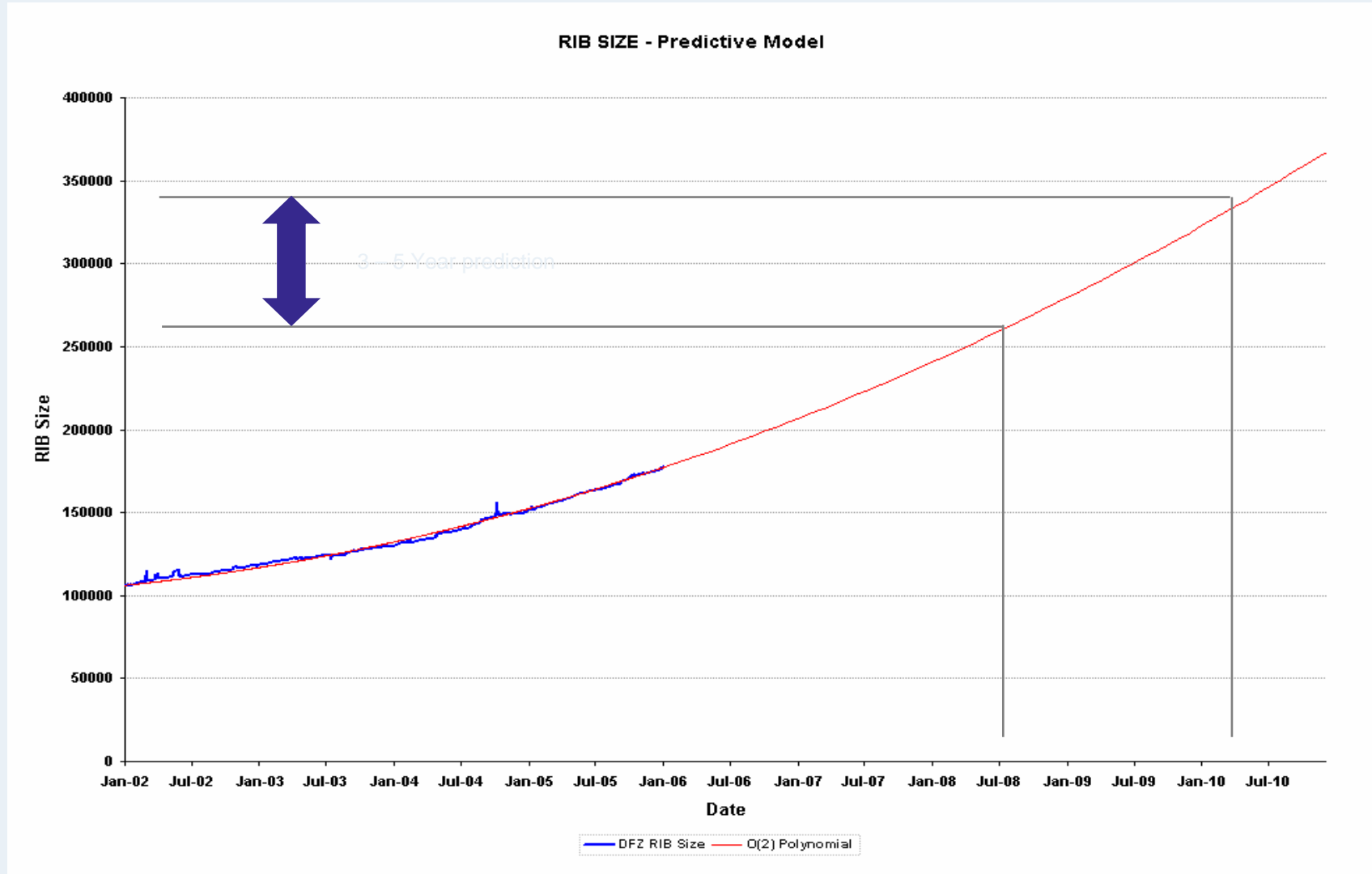


1st Order Differential

DFZ BGP Table Size - 1st Order Differential



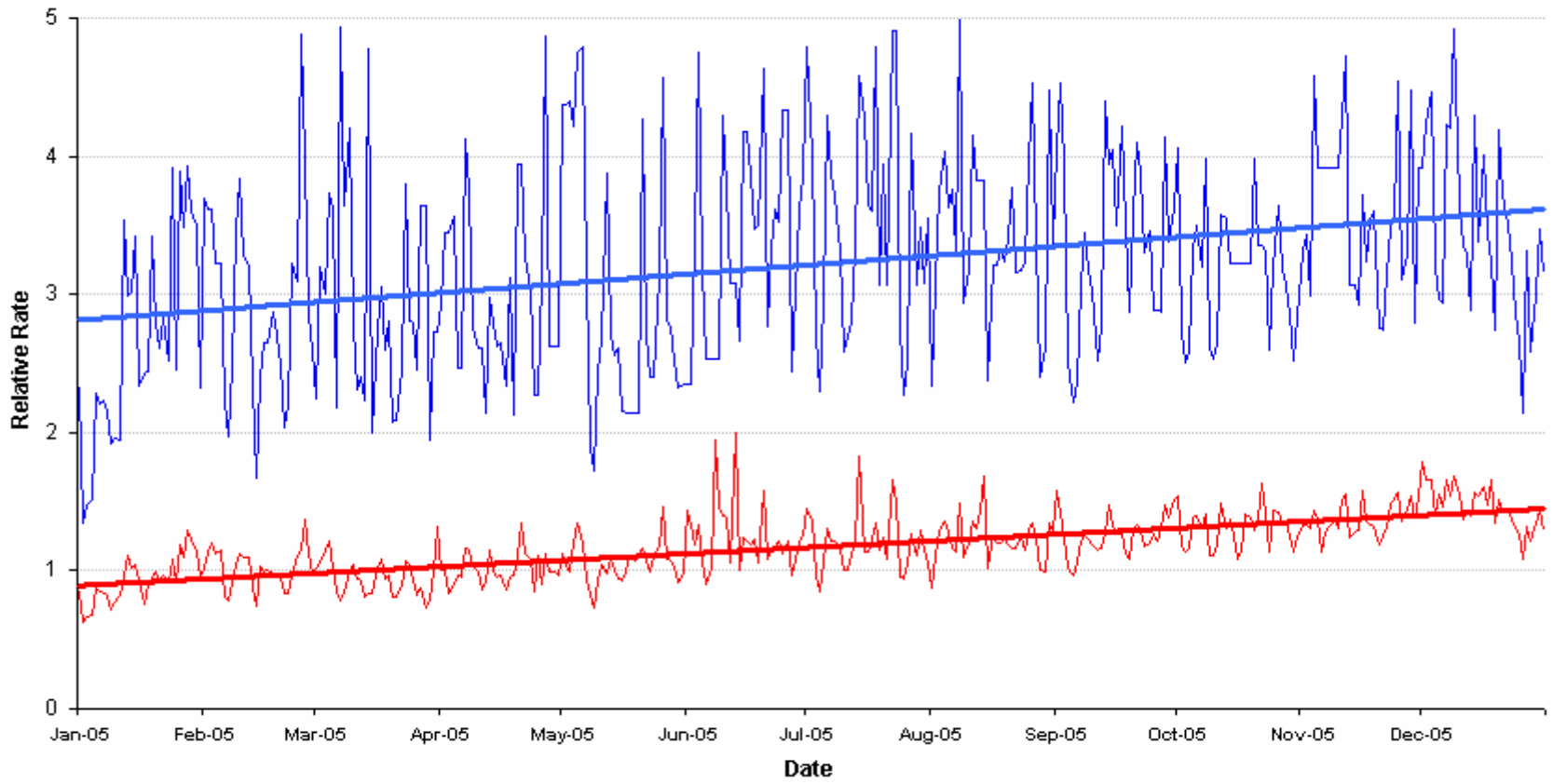
DFZ Model as an O(2) Polynomial





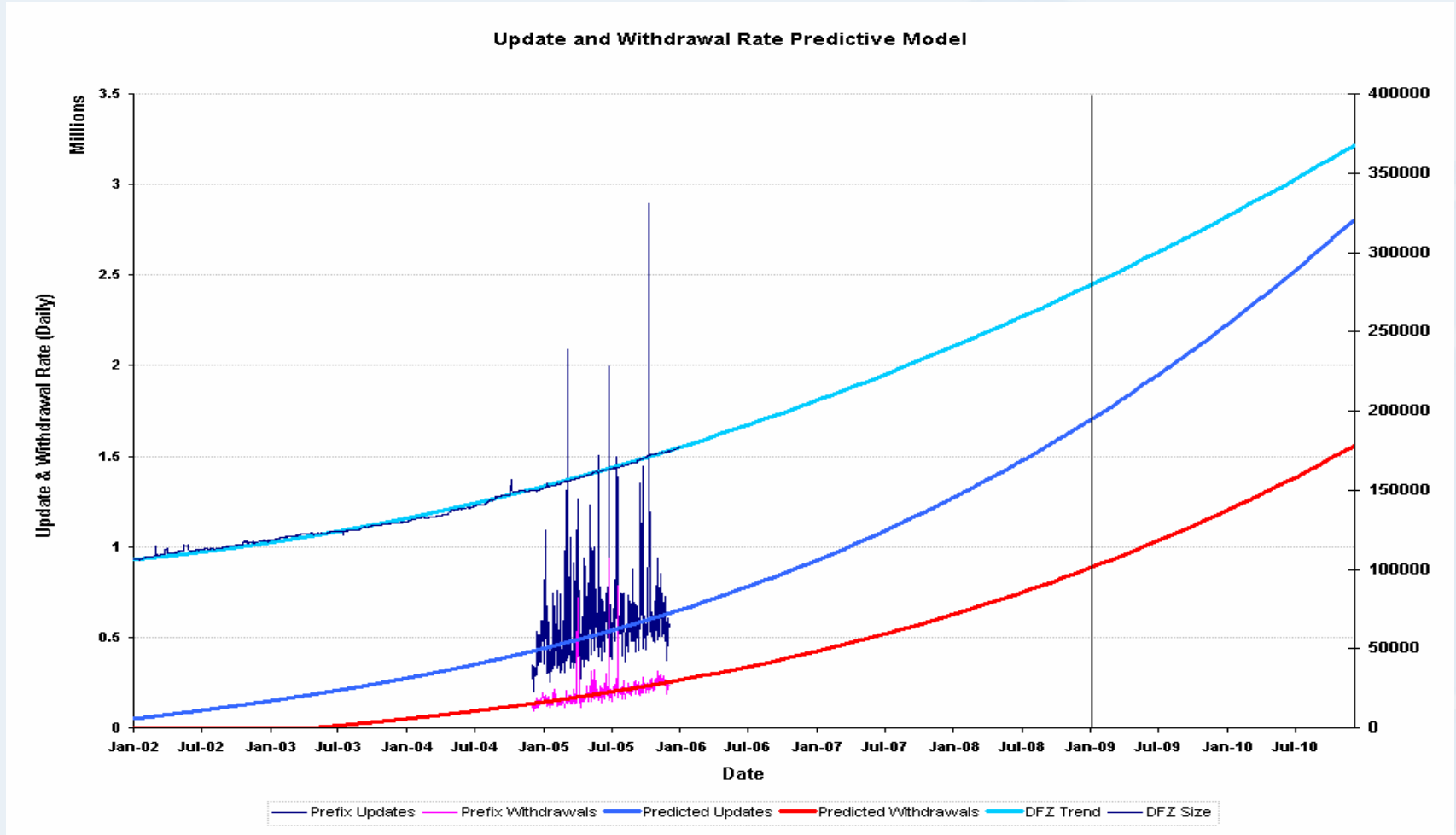
Relative Update / Withdrawal Rates

Update and Withdrawal Rate / RIB Entry



— Rel_Upds — Linear_Trend_Upds — Rel_Wdl — Linear_trend_Wdls

Update Rate Prediction



3-5 Year Predictions for the IPv4 DFZ

- Today (1/1/2006)
 - Table Size **176,000** prefixes
 - Update Rate 0.7M prefix updates / day
 - Withdrawal Rate 0.4M prefix withdrawals per day
- 3 Years (1/1/2009)
 - Table Size **275,000** prefixes
 - Update Rate 1.7M prefix updates / day
 - Withdrawal Rate 0.9M withdrawals per day
- 5 Years (1/1/2011)
 - Table Size **370,000** prefixes
 - Update Rate 2.8M prefix updates / day
 - Withdrawal Rate 1.6M withdrawals per day

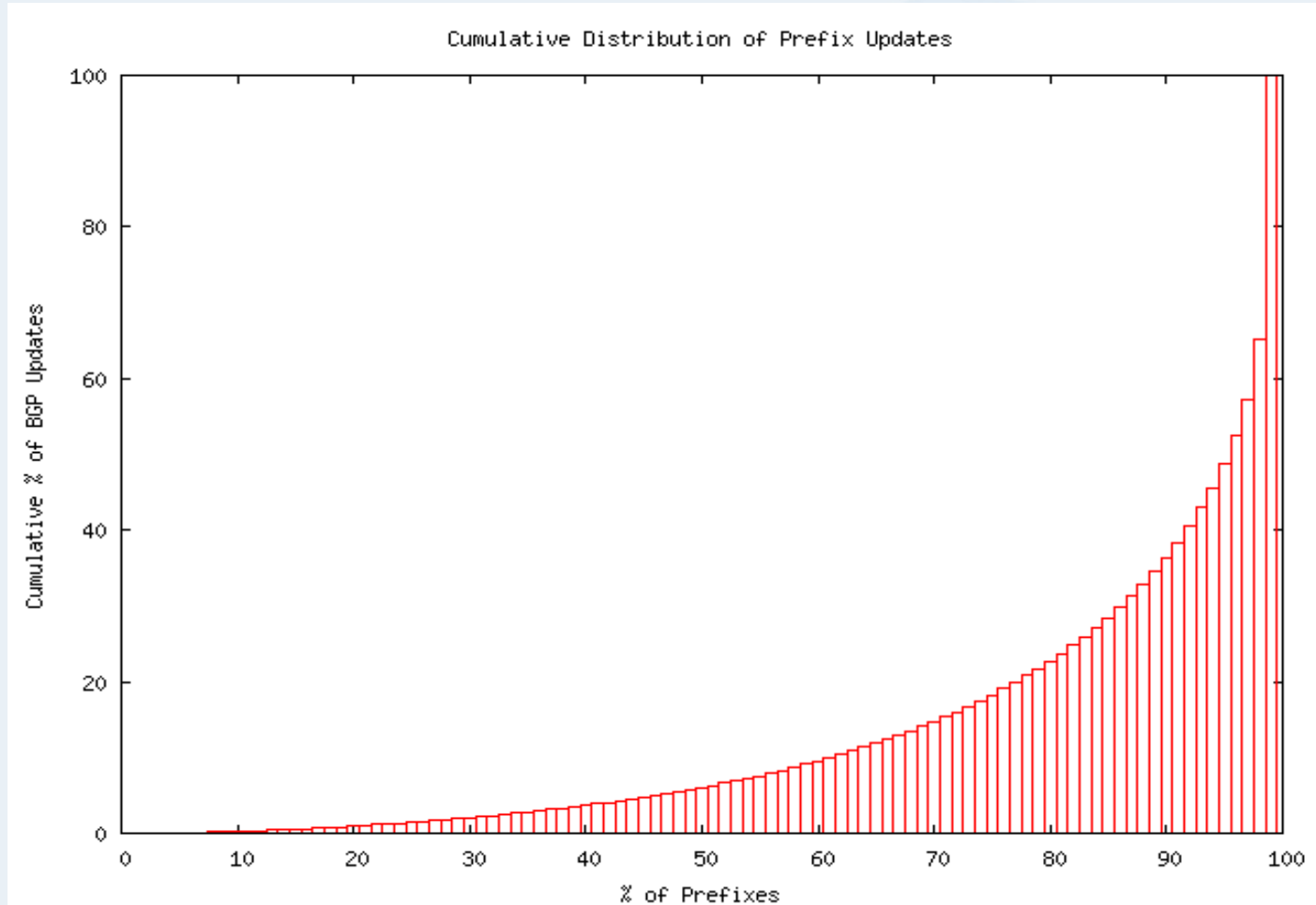
What's the uncertainty factor?

- Are we seeing a uniform distribution of updates across all ASs and all Prefixes?
- Or is this a skewed heavy tail distribution where a small number of prefixes contribute to most of the BGP updates?

Prefix Stats

- Number of unique prefixes announced: 289,558
- Prefix Updates: 70,761,786
- Stable prefixes: 12,640
- Updated prefixes (year end): 162,039
- Withdrawn prefixes: 127,519

Cumulative Distribution of Prefix Updates

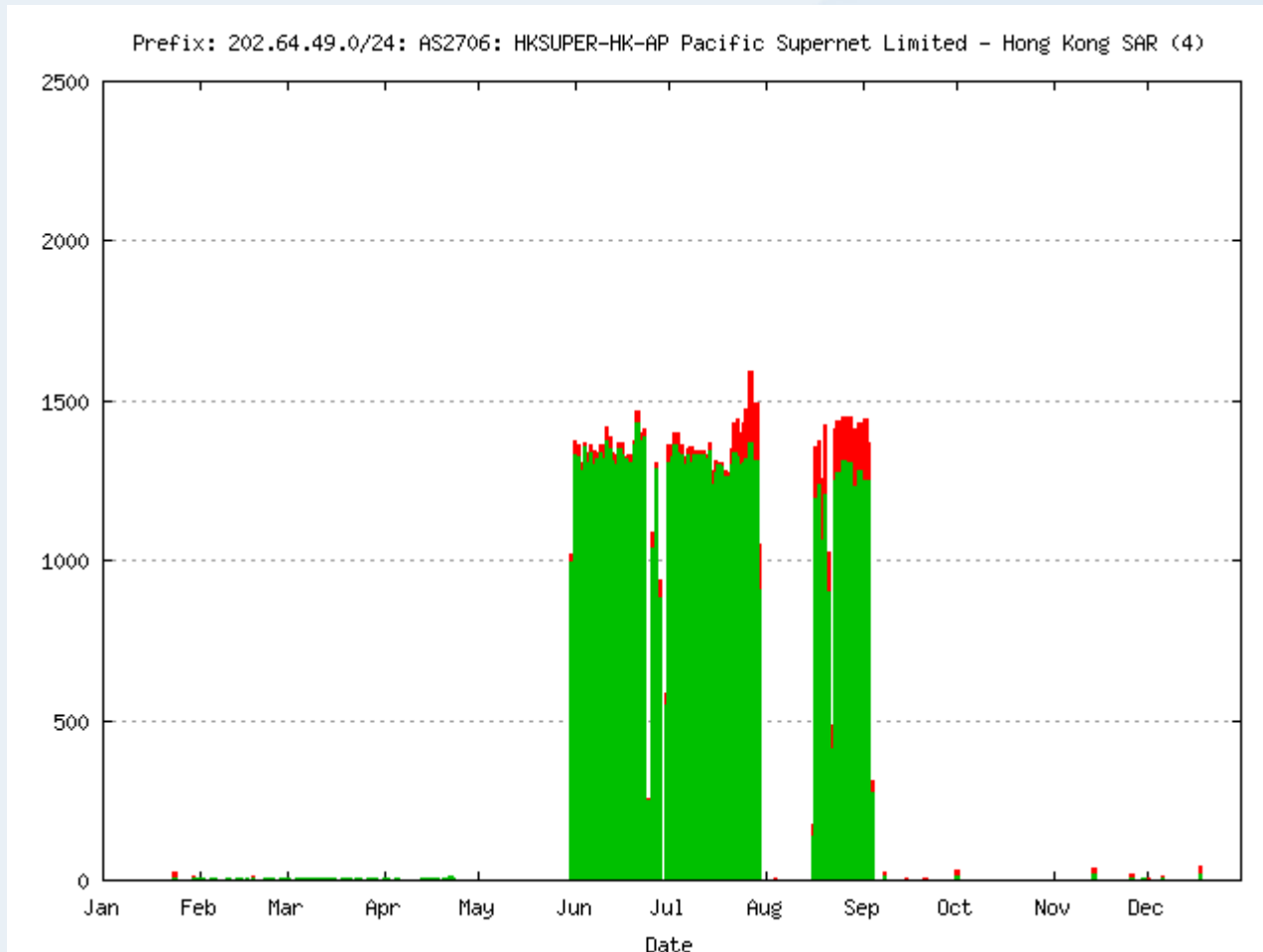


Active Prefixes

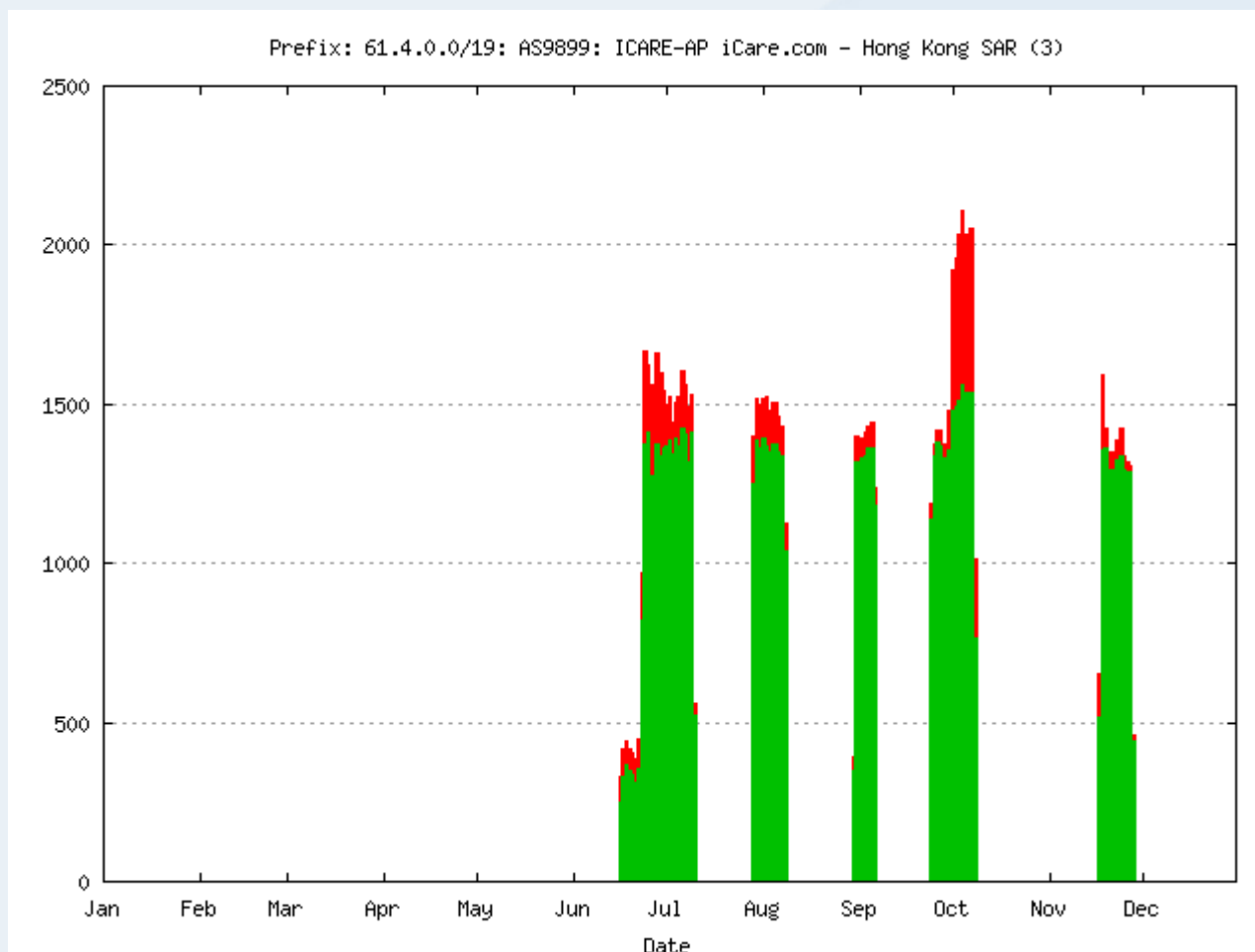
Top 10 Prefixes

	<u>Prefix</u>	<u>Updates</u>	<u>Flaps</u>	<u>Re-Homes</u>
1.	202.64.49.0/24	198,370	96,330	918
2.	61.4.0.0/19	177,132	83,277	55
3.	202.64.40.0/24	160,127	78,494	1,321
4.	81.212.149.0/24	158,205	61,455	20,031
5.	81.213.47.0/24	138,526	60,885	12,059
6.	209.140.24.0/24	132,676	42,200	0
7.	207.27.155.0/24	103,709	42,292	0
8.	81.212.197.0/24	99,077	37,441	15,248
9.	66.150.140.0/23	84,956	11,109	5,963
10.	207.168.184.0/24	74,679	34,519	0

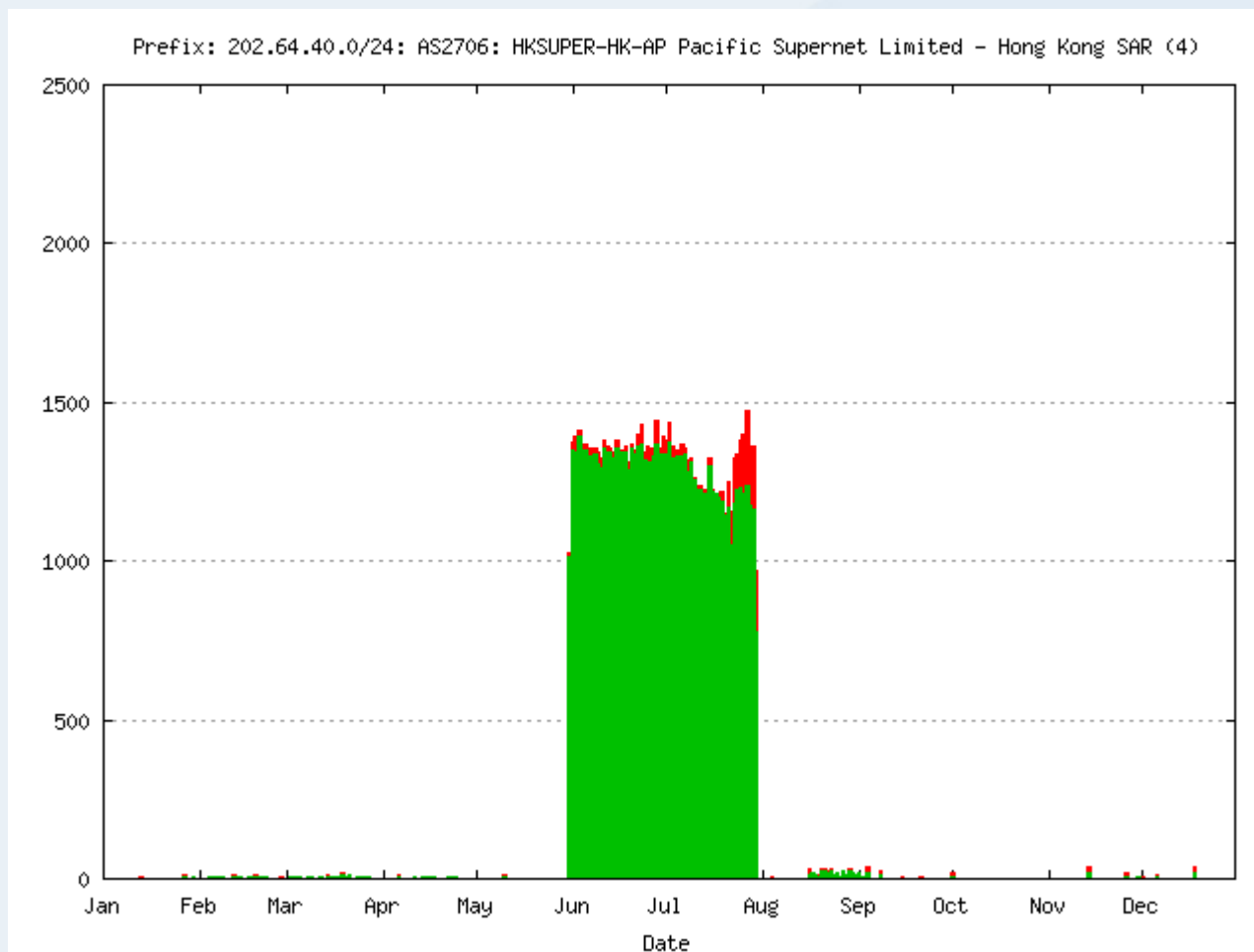
1 - 202.64.49.0/24



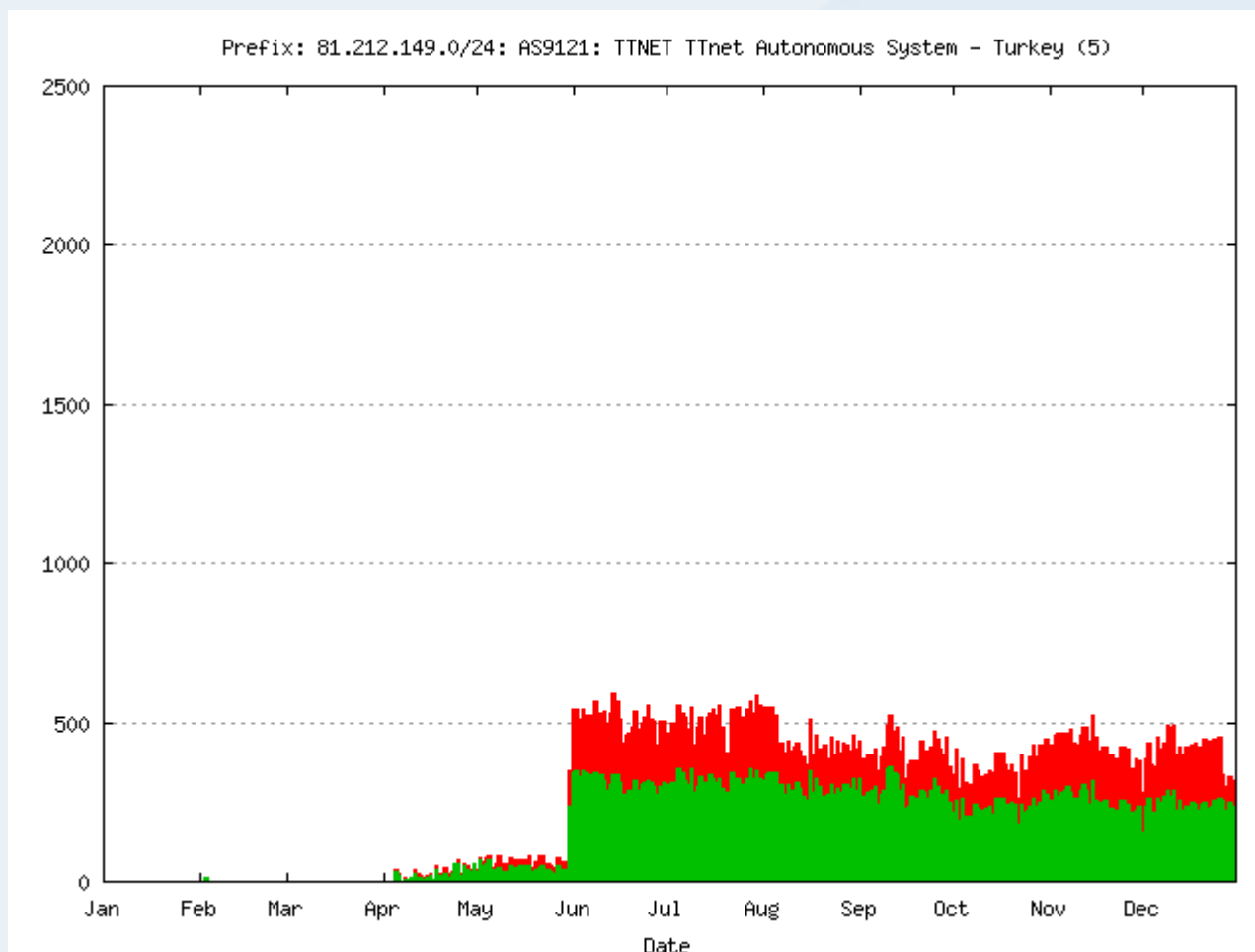
2 - 61.4.0.0/19



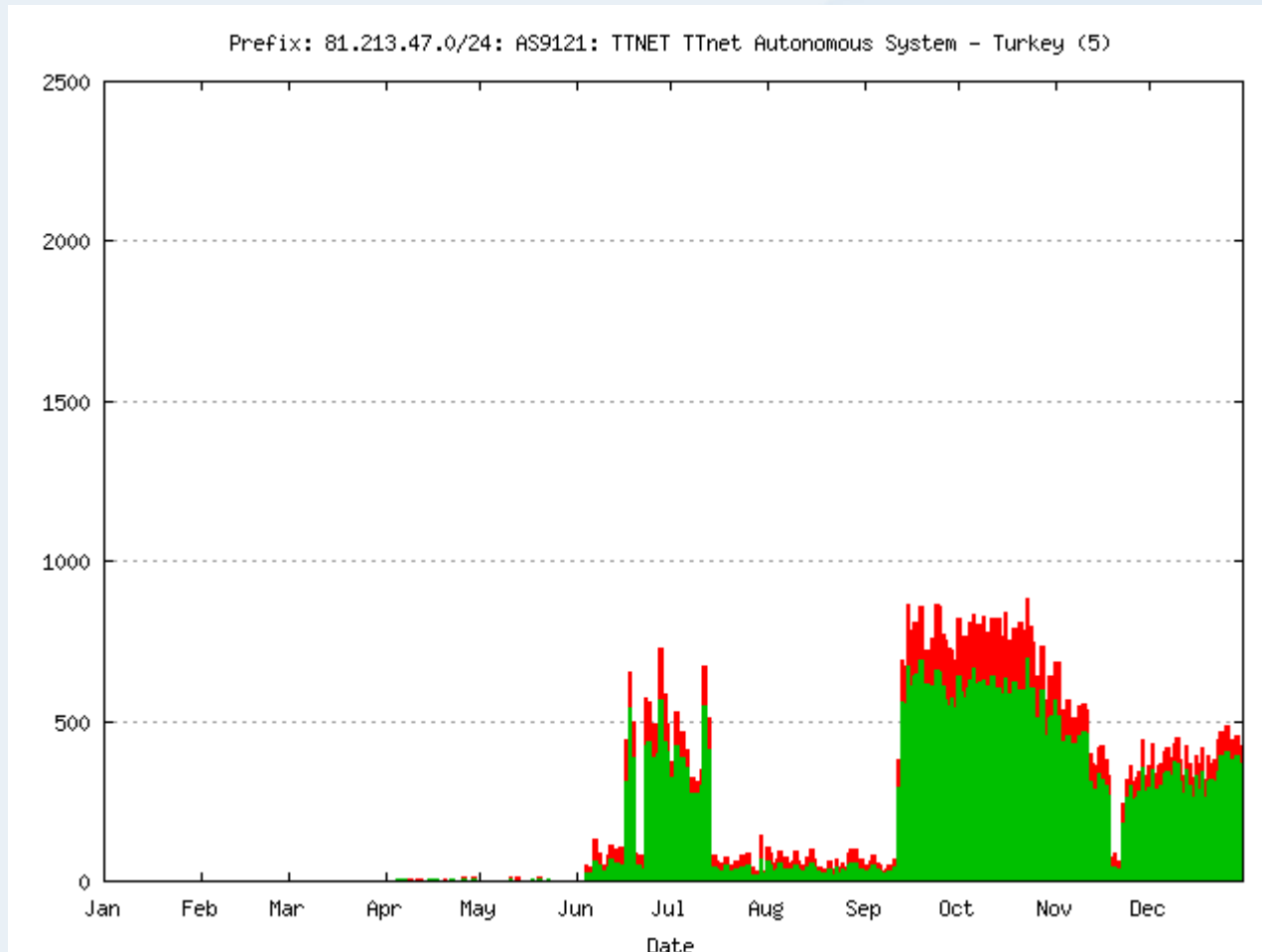
3 - 202.64.40.0/24



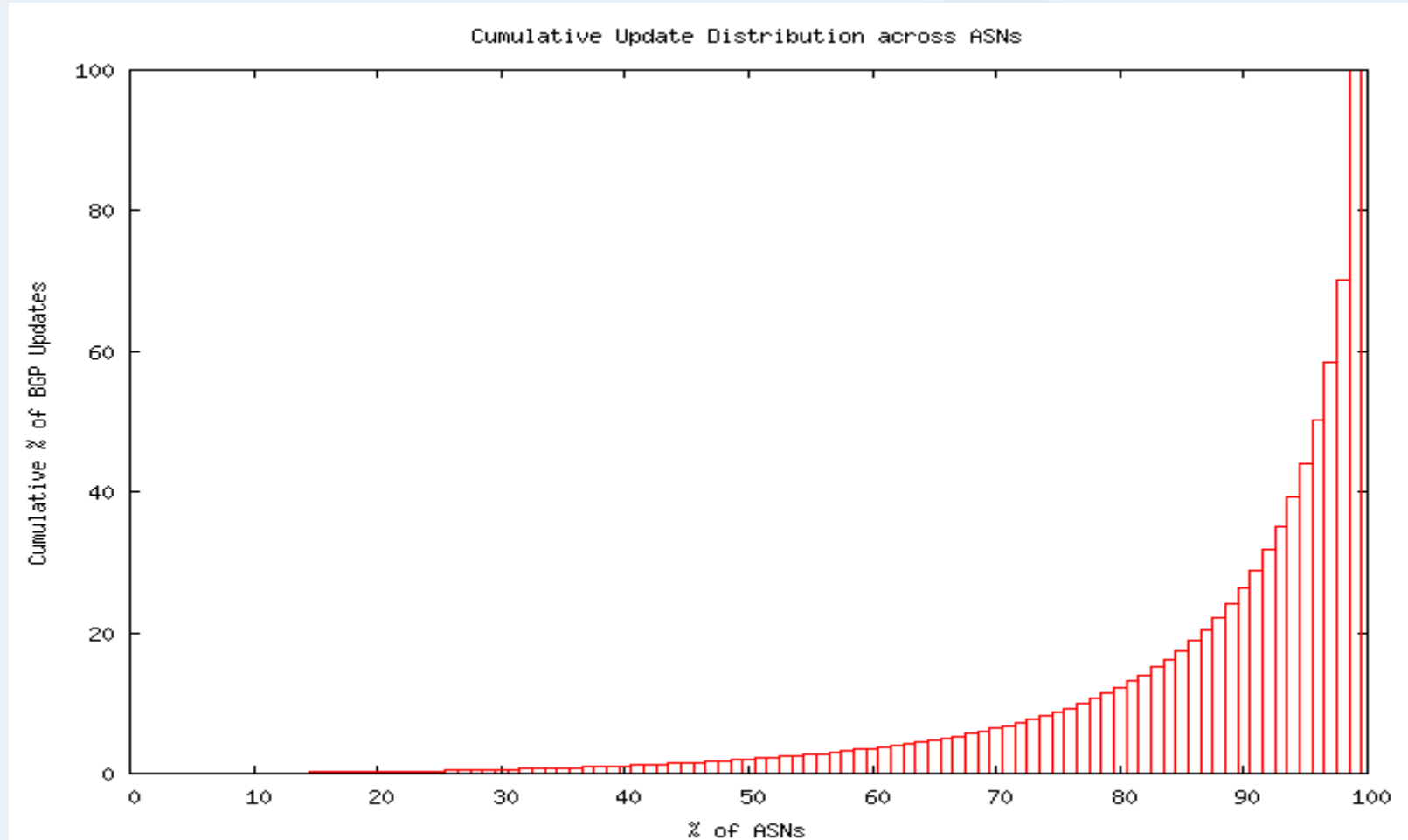
4 - 81.212.149.0/24



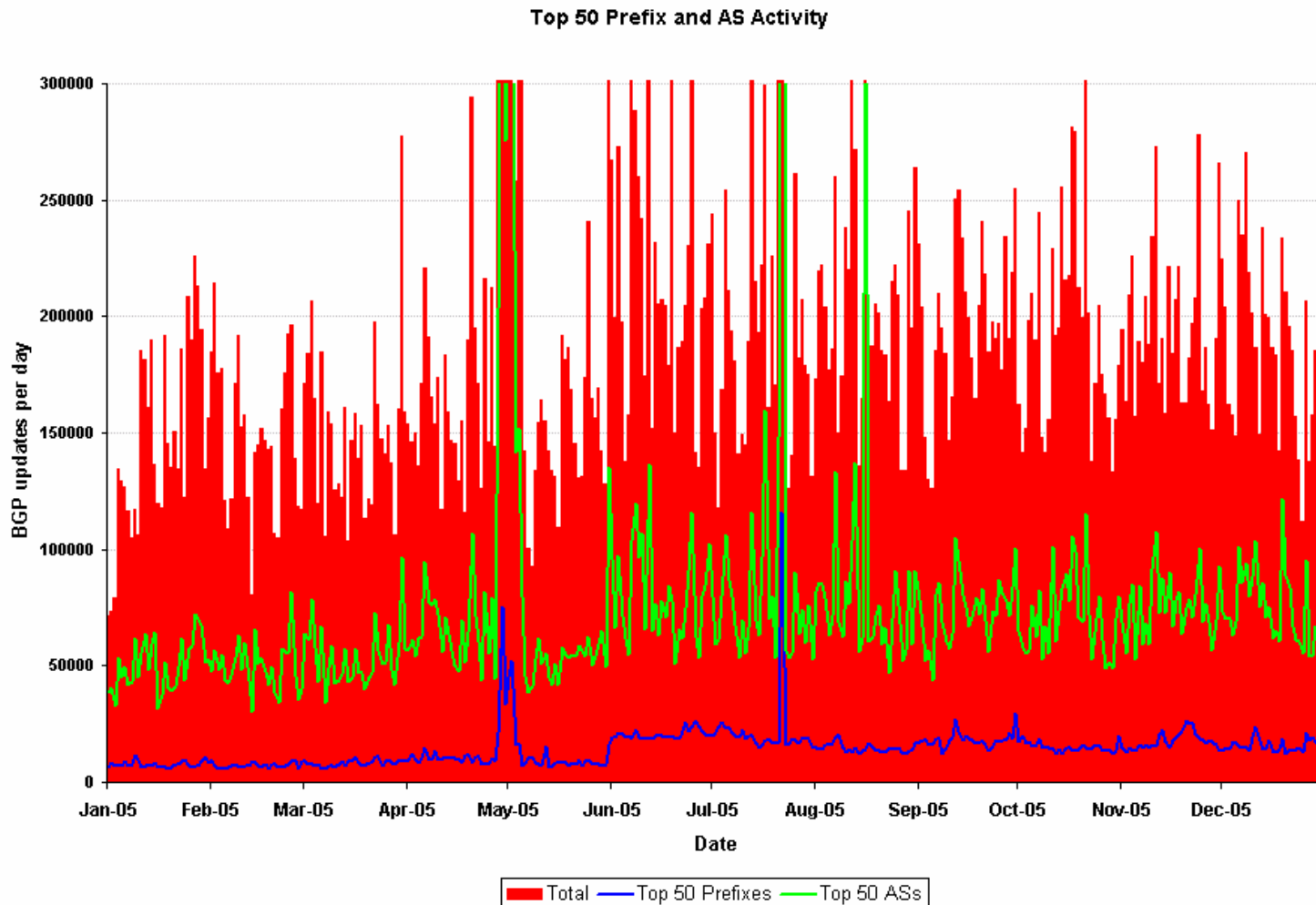
5 - 81.213.47.0/24



Distribution of Updates by AS



Distribution of Updates

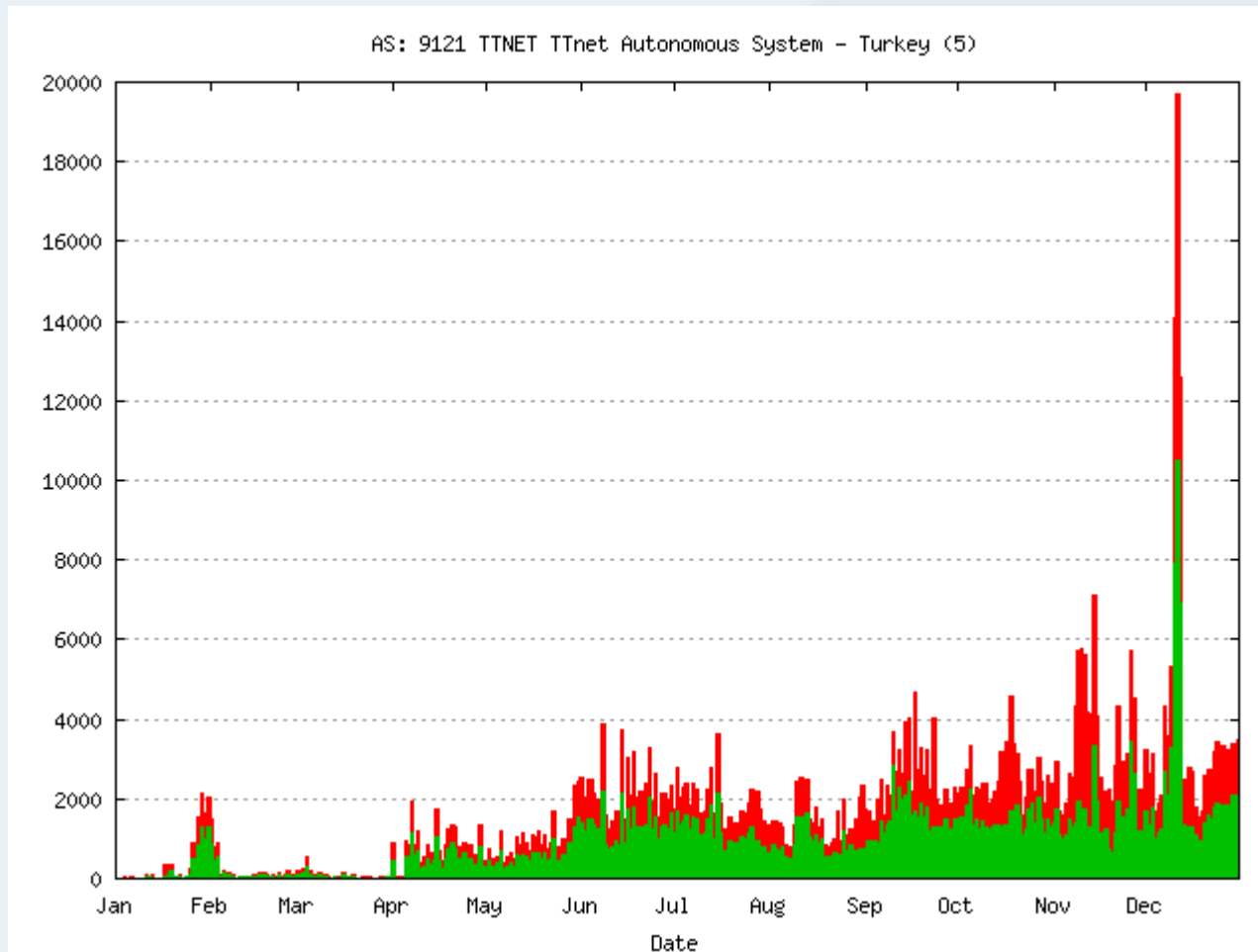


Active ASNs

Top 10 ASNs

	<u>AS</u>	<u>Updates</u>	<u>Flaps</u>	<u>Re-Homes</u>
1.	9121	970,782	349,241	206802
2.	7563	869,665	326,707	5
3.	702	605,090	232,876	144523
4.	17557	576,974	178,044	175275
5.	17974	569,806	198,948	310
6.	7545	562,879	200,425	8931
7.	721	498,297	175,623	35866
8.	2706	418,542	196,136	16945
9.	9950	411,617	148,725	6
10.	17832	393,052	143,018	0

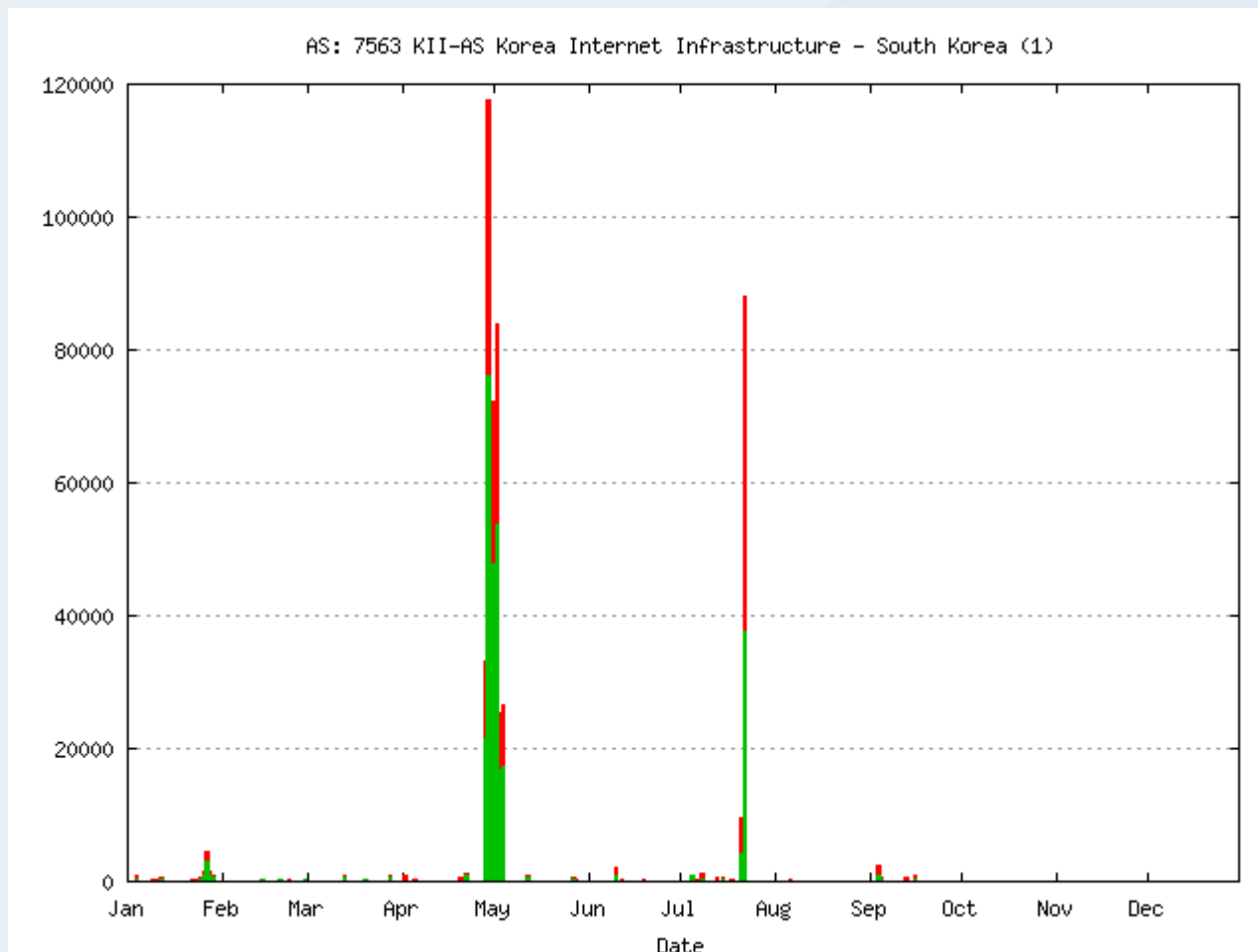
1 – AS 9121



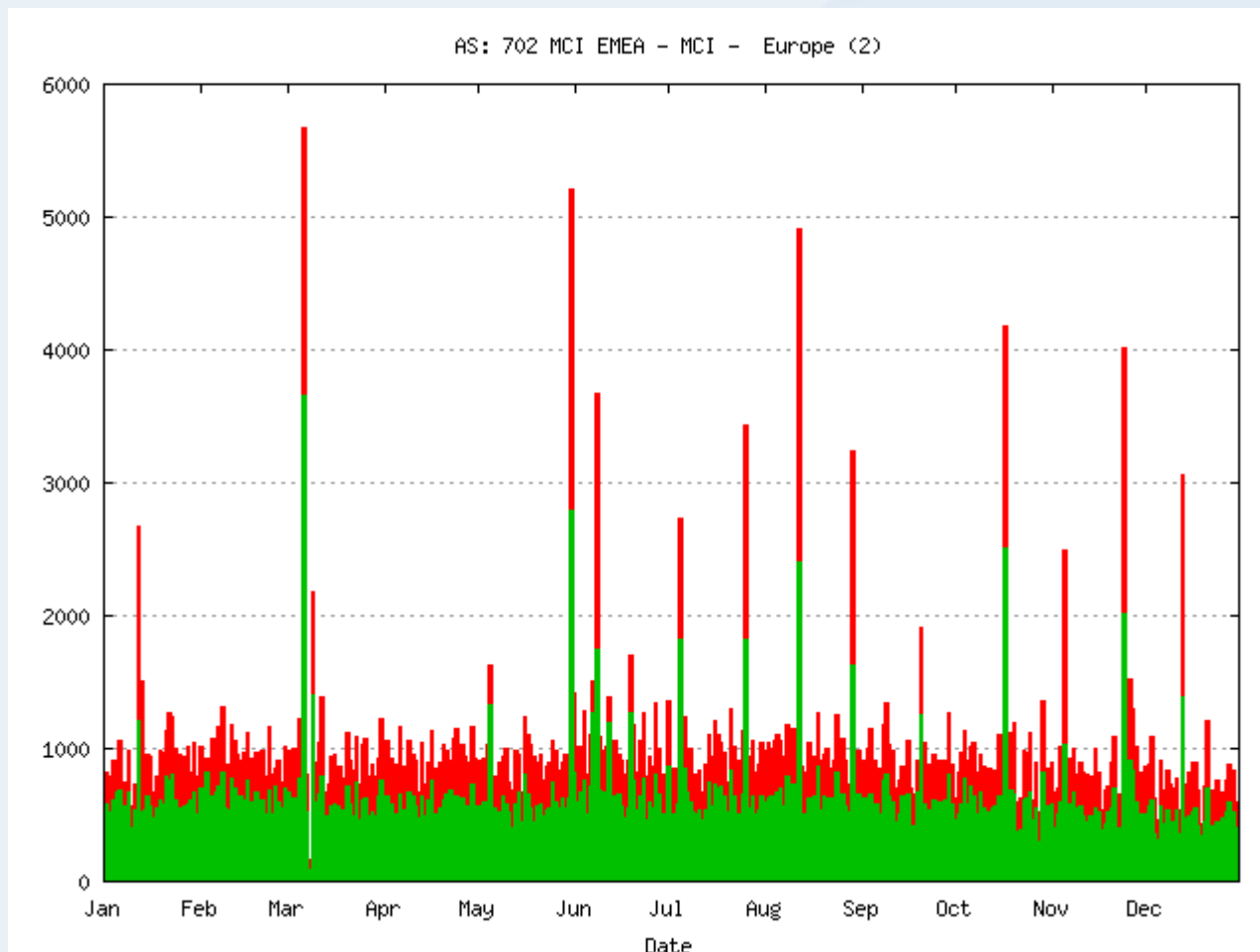
AS9121 Upstreams

- 9121 TTNET Ttnet Autonomous System Adjacency: 84 Upstream: 6 Downstream: 78
- Upstream Adjacent AS list
 - [AS1299](#) TELIANET TeliaNet Global Network
 - [AS3257](#) TISCALI-BACKBONE Tiscali Intl Network
 - [AS3356](#) LEVEL3 Level 3 Communications
 - [AS3549](#) GBLX Global Crossing Ltd.
 - [AS13263](#) METEKSAN-NET Meteksan.NET Autonomous System
 - [AS6762](#) SEABONE-NET Telecom Italia Sparkle

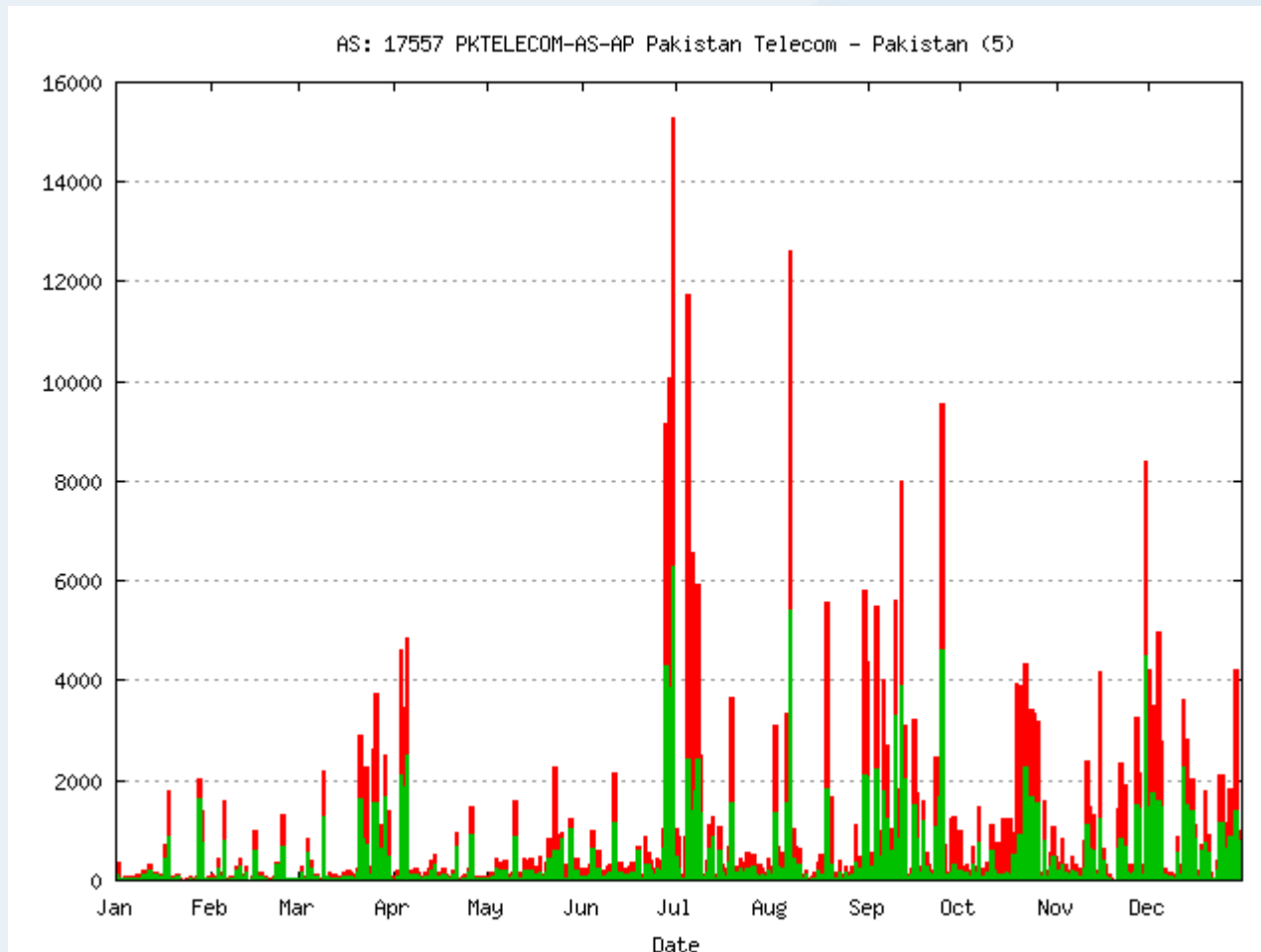
2 – AS 7563



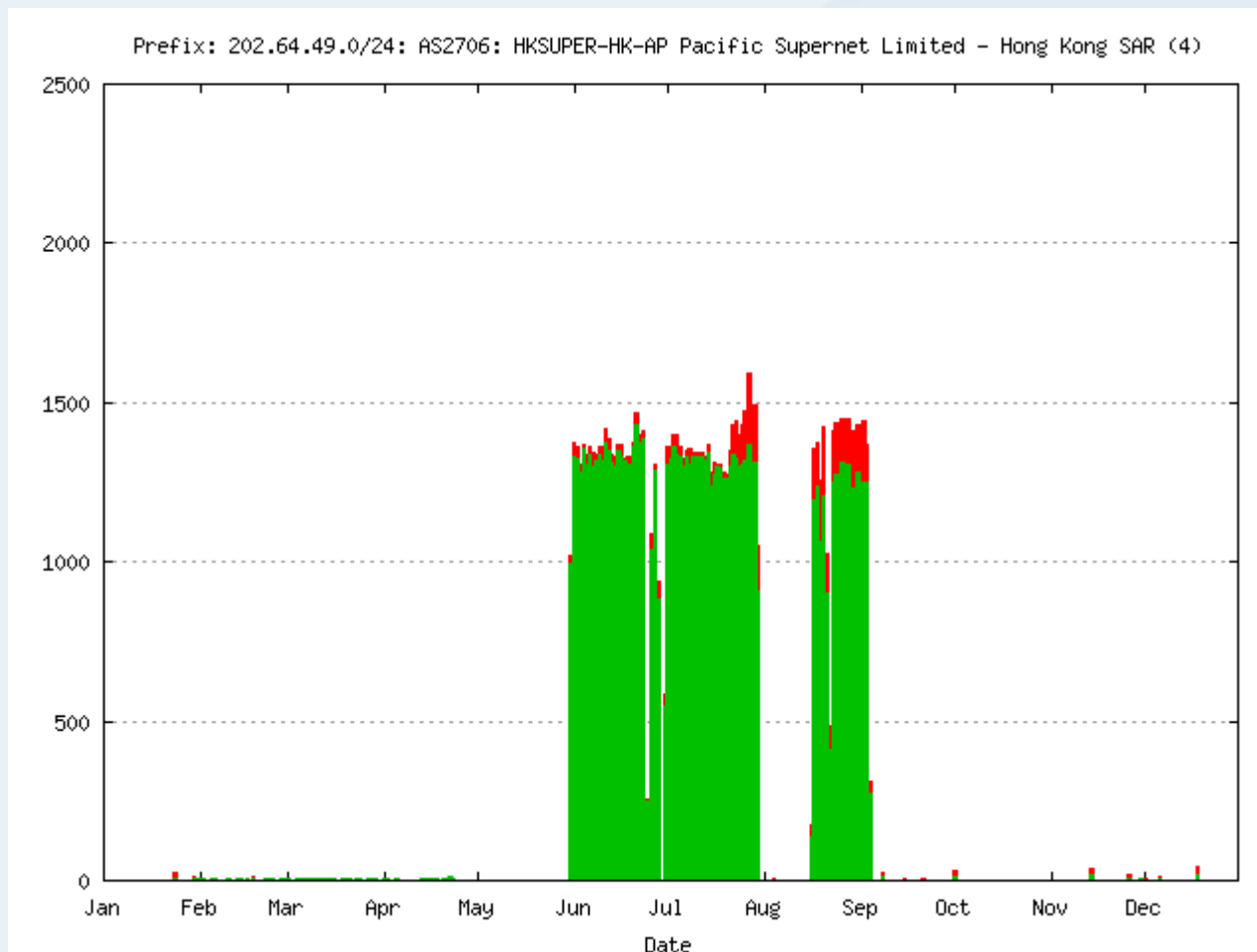
3 – AS 702



4 – AS 17557



5 – AS17974



So what's going on?

- It would appear that the BGP update rate is being strongly biased by a small number of origins with two forms of behaviour:
 - Traffic Engineering - consistent update rates sustained over weeks / months with a strong component of first hop change and persistent announce and withdrawal of more specifics
 - Unstable configuration states – a configuration which cannot stabilise and for a period of hours or days the update rate is extremely intense

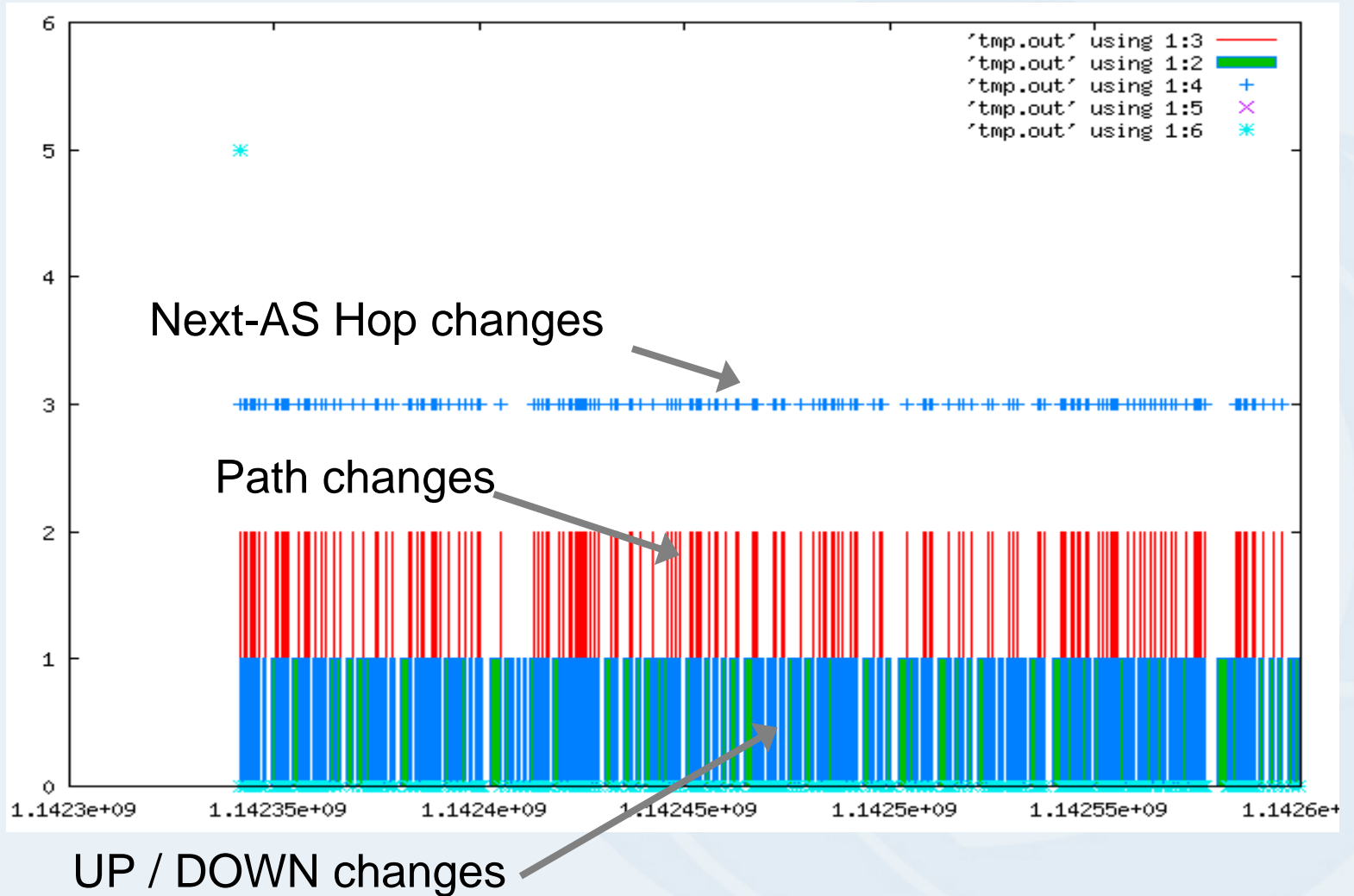
The Uncertainty Factor

- Given that the overwhelming majority of updates are being generated by a very small number of sources, the level of uncertainty in extrapolation of trend models of BGP update rates is extremely high
- This implies that the predictions of router capabilities in a 3 – 5 year interval is also extremely uncertain

Next Steps

- Generate per-Prefix and per-AS views and update stats summaries in an on-demand rolling 31 day window
- Correlation of path updates
- Example reports follow:

209.82.241.0/24 15/3 – 17/3



61.0.0.0/8 15/3 – 17/3

