



BGP Aggregation & The Deaggregation Report

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Route Aggregation Recommendations

- LINX attempted aggregation policy for members
 - It failed even though most members voted for policy
- RIPE Routing Working Group work item from early 2006
 - Based on early LINX concept
 - Authored by Philip Smith, Mike Hughes (LINX) and Rob Evans (UKERNA)



Route Aggregation Recommendations

- RIPE Document — RIPE-399
 - <http://www.ripe.net/ripe/docs/ripe-399.html>
- Discusses:
 - History of aggregation
 - Causes of de-aggregation
 - Impacts on global routing system
 - Available Solutions
 - Recommendations for ISPs



History:

- Classful to classless migration
 - Clean-up efforts in 192/8
- CIDR Report
 - Started by Tony Bates to encourage adoption of CIDR & aggregation
 - Mostly ignored through late 90s
 - Now part of extensive BGP table analysis by Geoff Huston
- Introduction of Regional Internet Registry system and PA address space



Deaggregation: Claimed causes (1):

- Routing System Security
 - “Announcing /24s means that no one else can DOS the network”
- Reduction of DOS attacks & miscreant activities
 - “Announcing only address space in use as rest attracts ‘noise’”
- Commercial Reasons
 - “Mind your own business”



Deaggregation: Claimed causes (2):

- Leakage of iBGP outside of local AS
 - eBGP is NOT iBGP – how many ISPs know this?
- Traffic Engineering for Multihoming
 - Spraying out /24s hoping it will work
 - Rather than do any **real engineering**
- Legacy Assignments
 - “All those pre-RIR assignments are to blame”
 - In reality it is both RIR and legacy assignments



Impacts (1):

- Router memory
 - Shortens router life time as vendors underestimate memory growth requirements
 - Depreciation life-cycle shortened
 - Increased costs for ISP and customers
- Router processing power
 - Processors are underpowered as vendors underestimate CPU requirement
 - Depreciation life-cycle shortened
 - Increased costs for ISP and customers



Impacts (2):

- Routing System convergence
 - Larger routing table → slowed convergence
 - Can be improved by faster control plane processors — see earlier
- Network Performance & Stability
 - Slowed convergence → slowed recovery from failure
 - Slowed recovery → longer downtime
 - Longer downtime → unhappy customers



Solutions (1):

- CIDR Report
 - Global aggregation efforts
 - Running since 1994
- Routing Table Report
 - Per RIR region aggregation efforts
 - Running since 1999
- Filtering recommendations
 - Training, tutorials, Project Cymru,...
- "CIDR Police"



Solutions (2):

- BGP Features:
 - NO_EXPORT Community
 - NOPEER Community
 - RFC3765 — but no one has implemented it
 - AS_PATHLIMIT attribute
 - Still working through IETF IDR Working Group
 - Provider Specific Communities
 - Some ISPs use them; most do not



RIPE-399 Recommendations:

- Announcement of initial allocation as a single entity
- Subsequent allocations aggregated if they are contiguous and bit-wise aligned
- Prudent subdivision of aggregates for Multihoming
- Use BGP enhancements already discussed
- (Oh, and all this applies to IPv6 too)



Looking at Deaggregation

- CIDR Report
 - www.cidr-report.org
 - Encourages aggregation following CIDRisation of Internet
 - Today: extensive suite of reports and tools covering state of BGP table
- Routing Report
 - BGP table status on per RIR basis
 - Original CIDR Report and a whole lot more



Deaggregation Factor

- Routing Report
 - One summary takes BGP table and aggregates prefixes by origin AS
 - Called “Max Aggregation” in report
 - Global and per RIR basis
 - <http://thyme.apnic.net/current/>
- New **Deaggregation Factor**:
 - Measure of Routing Table size/Aggregated Size
 - Global value has been increasing slowly and steadily since “records began”



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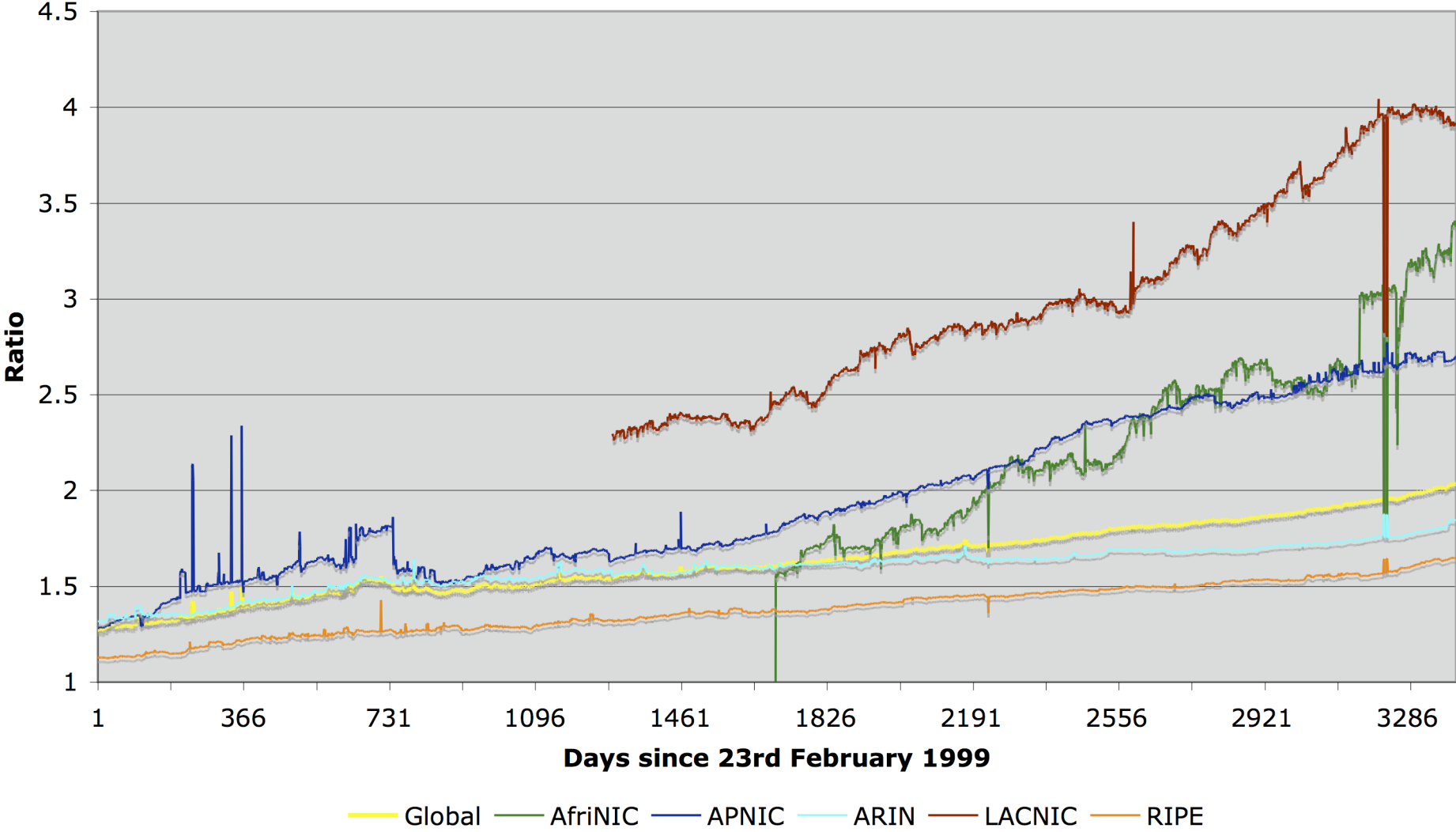
Total Prefixes

- Global BGP Table
 - 261k prefixes
- Europe & Middle East
 - 56k prefixes
- North America
 - 120k prefixes
- Asia & Pacific
 - 60k prefixes
- Africa
 - 4k prefixes
- Latin America & Caribbean
 - 20k prefixes

Deaggregation Factor

- Global Average
 - 2.04
- Europe & Middle East
 - 1.65
- North America
 - 1.85
- Asia & Pacific
 - 2.69
- Africa
 - 3.36
- Latin America & Caribbean
 - 3.93

Deaggregation: RIR Regions vs Global



Africa Aggregation Savings Summary

ASN	No of Nets	Poss Savings	Description
24863	475	445	LINKdotNET AS number
20858	397	394	EgyNet
6713	143	132	Itissalat Al-MAGHRIB
33783	135	123	EEPAD TISP TELECOM & INTERNET
2018	201	116	Tertiary Education Network
5536	121	105	Internet Egypt Network
29571	102	94	Ci Telecom Autonomous system
33776	99	91	Starcomms Nigeria Limited
24835	75	69	RAYA Telecom - Egypt
5713	155	62	Telkom SA Ltd
20484	63	60	Yalla Online Autonomous Syste
15475	63	59	Nile Online
15706	61	57	Sudatel Internet Exchange Aut
3741	273	49	The Internet Solution
29975	62	47	Vodacom
23889	68	45	MAURITIUS TELECOM
8094	42	39	PUKNET
16637	57	31	Johnnic e-Ventures
21152	32	31	AS for the uplinks of Soficom
12455	33	30	Jambonet Autonomous system

<http://thyme.apnic.net/current/data-CIDRnet-AFRINIC>

Asia & Pacific Aggregation Savings Summary

ASN	No of Nets	Poss Savings	Description
4755	1661	1485	Videsh Sanchar Nigam Ltd. Aut
17488	1188	1097	Hathway IP Over Cable Interne
9498	1079	1017	BHARTI BT INTERNET LTD.
9583	1157	739	Sify Limited
18101	686	652	Reliance Infocom Ltd Internet
4780	704	641	Digital United Inc.
9829	598	586	BSNL National Internet Backbo
4766	846	503	Korea Telecom (KIX)
4134	828	501	CHINANET-BACKBONE
17676	525	460	Softbank BB Corp.
7545	511	441	TPG Internet Pty Ltd
17974	456	439	PT TELEKOMUNIKASI INDONESIA
9443	468	394	Primus Telecommunications
4808	524	390	CNCGROUP IP network: China169
10091	341	330	SCV Broadband Access Provider
4668	333	326	LG-EDS Systems Inc.
4802	478	315	Wantree Development
23966	332	314	Dancom Pakistan (PVT) Limited
7552	296	292	Vietel Corporation
9304	300	268	Hutchison Telecom (HK)

<http://thyme.apnic.net/current/data-CIDRnet-APNIC>

North America Aggregation Savings Summary

ASN	No of Nets	Poss Savings	Description
6389	2670	2471	bellsouth.net, inc.
11492	1232	1220	Cable One
4323	1471	1094	Time Warner Telecom
18566	1045	1035	Covad Communications
1785	1080	976	AppliedTheory Corporation
22773	966	904	Cox Communications, Inc.
6478	956	779	AT&T Worldnet Services
19262	919	754	Verizon Global Networks
5668	694	661	CenturyTel Internet Holdings,
6517	700	653	Yipes Communications, Inc.
2386	1492	615	AT&T Data Communications Serv
3356	974	555	Level 3 Communications, LLC
855	598	545	Canadian Research Network
20115	1048	487	Charter Communications
19916	509	477	OLM LLC
6197	947	474	BellSouth Network Solutions,
7011	1015	461	Citizens Utilities
33588	447	421	Bresnan Communications, LLC.
7018	1395	419	AT&T WorldNet Services
8103	614	379	Florida Department of Managem

<http://thyme.apnic.net/current/data-CIDRnet-ARIN>

Latin America Aggregation Savings Summary

ASN	No of Nets	Poss Savings	Description
8151	1273	1046	UniNet S.A. de C.V.
11830	604	595	Instituto Costarricense de El
22047	565	551	VTR PUNTO NET S.A.
16814	426	416	NSS, S.A.
7303	469	404	Telecom Argentina Stet-France
14117	375	366	Telefonica del Sur S.A.
6471	411	363	ENTEL CHILE S.A.
11172	410	340	Servicios Alestra S.A de C.V
10620	404	339	TVCABLE BOGOTA
10481	310	301	Prima S.A.
28573	303	274	NET Servicios de Comunicacao S.A
20299	335	237	NEWCOM AMERICAS
14259	296	235	GTD Internet S.A.
7738	252	226	Telecomunicacoes da Bahia S.A
14522	194	186	SatNet S.A.
19169	205	184	Telconet
23216	243	183	RAMtelecom Telecomunicaciones
8163	187	174	METROTEL REDES S.A.
21826	205	164	INTERCABLE
6458	173	157	GUATEL

<http://thyme.apnic.net/current/data-CIDRnet-LACNIC>

EU & Middle East Aggregation Savings Summary

ASN	No of Nets	Poss Savings	Description
8452	347	336	TEDATA
8866	319	298	Bulgarian Telecommunication C
5462	296	269	Telewest Broadband
9155	265	253	QualityNet AS number
8551	287	249	Bezeq International
12479	229	223	Uni2 Autonomous System
9121	249	222	TTnet Autonomous System
29357	216	212	WATANIYA TELECOM
3352	246	204	Ibernet, Internet Access Netw
35141	206	200	Megalan Autonomous system of
3215	286	197	France Telecom Transpac
9198	204	194	Kazakhtelecom Data Network Ad
3269	241	169	TELECOM ITALIA
6830	187	145	UPC Distribution Services
9051	160	138	INCONET Autonomous System
3300	231	132	AUCS Communications Services
8877	137	130	BOL.BG Autonomous System
29314	148	129	Telewizja Kablowa Dami Sp. z
5486	140	123	Euronet Digital Communication
1267	156	119	Infostrada S.p.A.

<http://thyme.apnic.net/current/data-CIDRnet-RIPE>



Observations

- Range of operational “practices” between RIR regions
 - “Newer” Internet is growing rapidly
 - As is the deaggregation there
- RIPE-399 is only a recommendation
 - Hopefully all the RIRs will include pointers with each address allocation
 - Hopefully more ISPs will pay attention to it
 - Training is there — most ISPs choose to ignore it



Conclusion

- Make RIPE-399 your BGP good practice document