BGP Aggregation & The Deaggregation Report
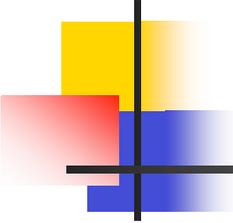
Philip Smith

UKNOF 8
17th September 2007
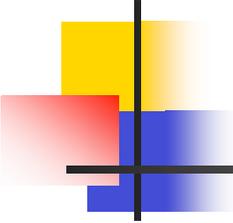Goodenough College, London

# 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
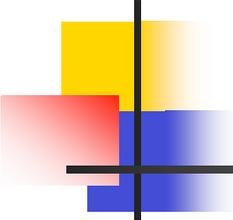
History:

- ## 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
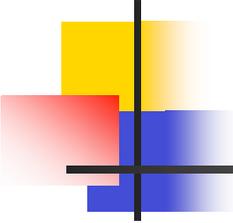
# Deaggregation: Claimed causes (1):

- **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"
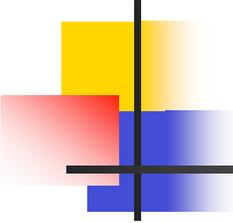
# Deaggregation: Claimed causes (2):

- 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
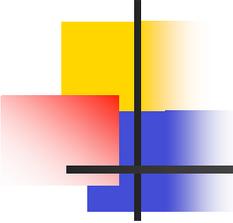
Impacts (1):

- **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
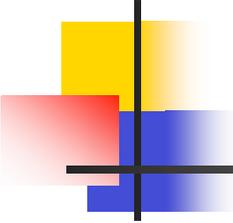
Impacts (2):

- 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
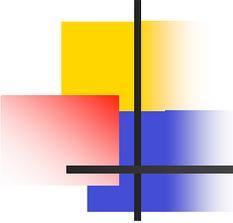
Solutions (1):

- 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"
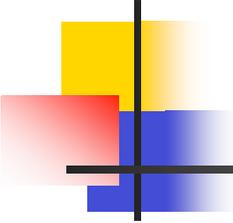
Solutions (2):

- 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
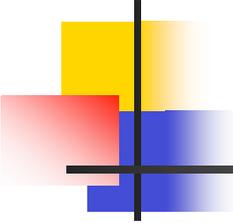
RIPE-399 Recommendations:

- 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)
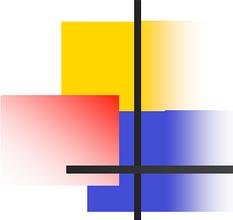
Looking at Deaggregation

- 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
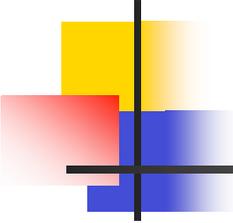
Deaggregation Factor

- **Routing Report**
  - One summary takes BGP table and aggregates prefixes by origin AS
    - Called "Max Aggregation" in report
  - Global and per RIR basis

- **New Deaggregation Factor:**
  - Measure of Routing Table size/Aggregated Size
  - Global value has been increasing slowly and steadily since "records began"
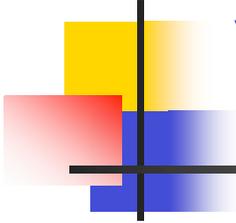
"Original Internet" — 2007/08

Total Prefixes

- **Global BGP Table**
  - 230k prefixes
- **North America**
  - 109k prefixes
- **Europe & Middle East**
  - 48k prefixes

Deaggregation Factor

- **Global Average**
  - 1.92
- **North America**
  - 1.73
- **Europe & Middle East**
  - 1.55
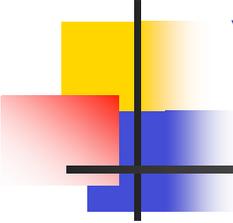
"Newer Internet" — 2007/08

Total Prefixes

- Global BGP Table
  - 230k prefixes
- Asia & Pacific
  - 54k prefixes
- Africa
  - 3k prefixes
- Latin America & Caribbean
  - 17k prefixes

Deaggregation Factor

- Global Average
  - 1.92
- Asia & Pacific
  - 2.61
- Africa
  - 2.69
- Latin America & Caribbean
  - 3.73

Deaggregation: RIR Regions vs Global

Ratio

Days since 23rd February 1999

Global — AfriNIC — APNIC — ARIN — LACNIC — RIPE
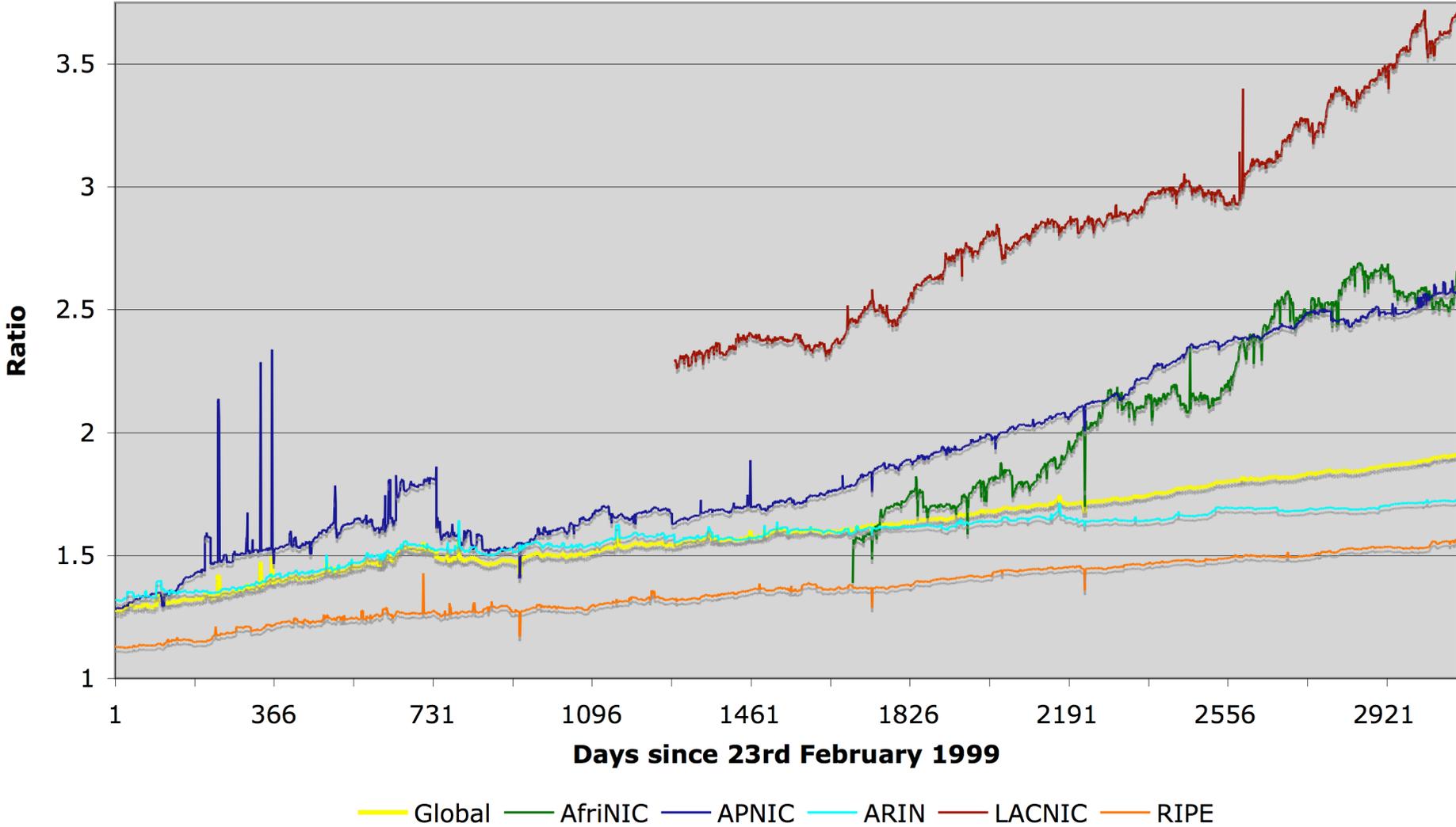
Africa Aggregation Savings Summary

ASN	No of Nets	Poss Savings	Description
8452	217	210	TEDATA
6713	142	131	Itissalat Al-MAGHRIB
5536	127	120	Internet Egypt Network
33783	126	115	EEPAD TISP TELECOM & INTERNET
33776	100	97	Starcomms Nigeria Limited
24835	87	81	RAYA Telecom - Egypt
15475	75	71	Nile Online
3741	286	60	The Internet Solution
2561	62	60	Egyptian Universities Network
23889	69	54	MAURITIUS TELECOM
15706	56	52	Sudatel Internet Exchange Aut
2018	148	33	Tertiary Education Network
12455	29	26	Jambonet Autonomous system
10798	27	26	Standard Bank of South Africa
21280	29	25	Swift Global Kenya Ltd.Is an
33774	47	22	AS Number for Telecom Algeria
21491	24	22	UTL On-line is RF broadband I
15804	23	22	AS of The Way Out Internet So
8524	31	21	AUCEGYPT Autonomous System
16637	46	17	Johnnic e-Ventures

Asia & Pacific Aggregation Savings Summary

| ASN	No of Nets	Poss Savings	Description
4755	1338	1267	Videsh Sanchar Nigam Ltd. Aut
9583	1134	1028	Sify Limited
9498	998	933	BHARTI BT INTERNET LTD.
4134	1072	782	CHINANET-BACKBONE
17488	796	741	Hathway IP Over Cable Interne
7545	730	611	TPG Internet Pty Ltd
18101	595	544	Reliance Infocom Ltd Internet
4668	516	506	LG-EDS Systems Inc.
4766	798	480	Korea Telecom (KIX)
4812	547	451	China Telecom (Shanghai)
17676	503	439	Softbank BB Corp.
9443	465	388	Primus Telecommunications
4808	483	369	CNCGROUP IP network: China169
17974	373	360	PT TELEKOMUNIKASI INDONESIA
9829	362	349	BSNL National Internet Backbo
7552	323	316	Vietel Corporation
4538	346	311	China Education and Research
4802	439	285	Wantree Development
9394	275	268	CHINA RAILWAY Internet(CRNET)
9929	307	260	China Netcom Corp.

North America Aggregation Savings Summary

ASN	No of Nets	Poss Savings	Description
11492	1136	1125	Cable One
18566	1023	1014	Covad Communications
6478	1134	965	AT&T Worldnet Services
4323	1322	949	Time Warner Telecom
22773	762	712	Cox Communications, Inc.
5668	657	634	CenturyTel Internet Holdings,
19262	770	591	Verizon Global Networks
6517	595	558	Yipes Communications, Inc.
15270	574	536	PaeTec.net -a division of Pae
6197	1028	520	BellSouth Network Solutions,
19916	568	517	OLM LLC
855	570	497	Canadian Research Network
2386	1215	478	AT&T Data Communications Serv
33588	458	433	Bresnan Communications, LLC.
20115	817	381	Charter Communications
7011	919	370	Citizens Utilities
3464	370	345	Alabama SuperComputer Network
7029	421	343	Alltel Information Services,
16852	401	325	Focal Data Communications of
6140	464	322	ImpSat

Latin America Aggregation Savings Summary

| ASN	No of Nets	Poss Savings	Description
8151	903	698	UniNet S.A. de C.V.
11830	514	505	Instituto Costarricense de El
16814	426	417	NSS, S.A.
14522	333	326	SatNet S.A.
11172	371	314	Servicios Alestra S.A de C.V
22047	318	305	VTR PUNTO NET S.A.
7303	341	291	Telecom Argentina Stet-France
6471	324	291	ENTEL CHILE S.A.
10481	278	269	Prima S.A.
14117	281	266	Telefonica del Sur S.A.
11556	235	232	Cable-Wireless Panama
10620	237	216	TVCABLE BOGOTA
6147	227	203	Telefonica Del Peru
8163	177	171	METROTEL REDES S.A.
23216	195	151	RAMtelecom Telecomunicaciones
19169	169	150	Telconet
20299	180	149	NEWCOM AMERICAS
7738	169	146	Telecomunicacoes da Bahia S.A
28573	157	141	NET Servicos de Comunicao S.A
14571	138	134	Internet Group do Brasil

EU & Middle East Aggregation Savings Summary

ASN	No of Nets	Poss Savings	Description
9116	355	329	Goldenlines main autonomous s
24863	367	327	LINKdotNET AS number
8551	248	220	Bezeq International
9121	214	190	TTnet Autonomous System
3352	227	189	Ibernet, Internet Access Netw
12479	192	186	Uni2 Autonomous System
20858	186	183	EgyNet
5089	222	168	NTL Group Limited
3215	258	160	France Telecom Transpac
3269	221	148	TELECOM ITALIA
5486	160	143	Euronet Digital Communication
6830	158	123	UPC Distribution Services
8866	143	121	Bulgarian Telecommunication C
15471	167	106	SNR - Societatea Nationala de
3300	192	100	AUCS Communications Services
5462	125	100	Telewest Broadband
702	492	98	UUNET - Commercial IP service
15611	96	94	Iranian Research Organisation
9051	148	93	INCONET Autonomous System
12302	127	89	MobiFon S.A.
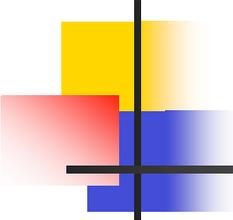
Observations

- Huge gulf in operational good practices between "older" and "newer" Internet
  - Could threaten the Internet as we know it
- 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
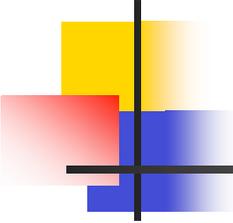
Conclusion

- "Newer" Internet is growing rapidly
  - As is the deaggregation there

- RIPE-399 now exists
- Make it your BGP good practice document