Running on Empty:
Challenges of Managing IP Addressing

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http://www.eyeconomics.com/backstage/References_files/Lehr-Vest-Lear-TPRC2008-080915.pdf

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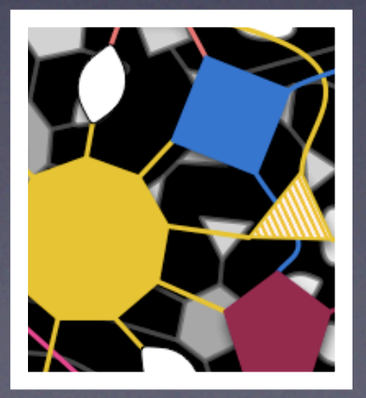
Disclosure*

The author is an External Consultant to the RIPE NCC Science Group. The author gratefully acknowledges the support of RIPE NCC in making this research possible. Observations and opinions expressed herein are the author's own, and in no way reflect the policy or positions of the RIPE NCC, its member institutions or staff.



Background

- **The Catalyst:**

  ...Cisco IP Exhaustion Workshop

- **The Finding(s):**

  ...Need more input, perspectives

- **The Requirement:**

  ...Structured, thematic workshop report

- **A Target of Opportunity**

  ...Telecom Policy Research Conference

The Co-Authors

- A university-based tech sector economist
- A "vendor" & IETF veteran (e.g., PIARA)
- An ex-operator and industry consultant

Lehr

Lear

Vest

The Paper

- **Background on addressing & routing**

  ...no need to recap here

- **Taxonomy of allocation mechanisms**

  ...eligibility vs. markets, centralized vs. decentralized

- **Prospective advantages of markets**

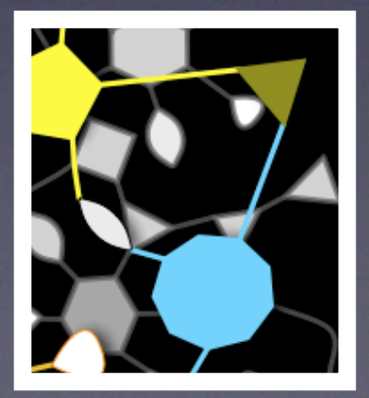
  ...efficiency, incentives, competition, a new kind of fairness, least worst option, most robust against intervention, impact on IPv6

- **Prospective complications of markets**

  ...incompatibility with current routing conventions, market liquidity failure, perverse incentives and market closure risk, privatization risk, risk of derailing IPv6

- **Wildcards**

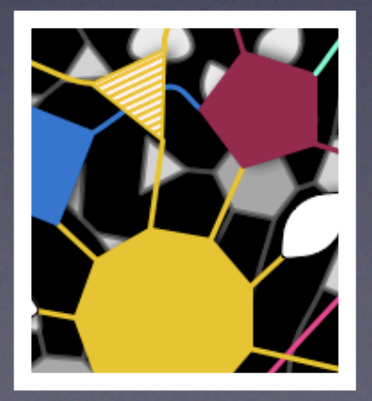
  ...resource certification?



Less
a consensus
document

More,
a shared
exploration

This talk focuses only on the paper elements of possible use to PDP participants



What will change in a resource transfer environment?

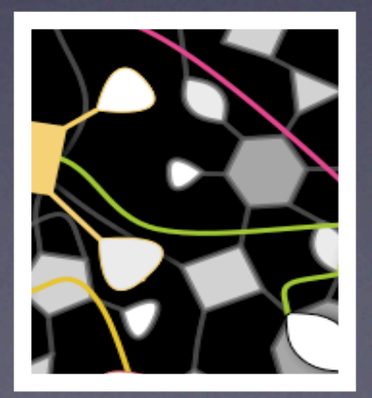
Transferred Prefixes as:

- **One possible source of expansion addresses for existing LIRs**

...vs. RFC 1918 and IPv6

- **Only source for (gateway) PI for aspiring new network-insourcing enterprises, and for aspiring new routing services providers**

...PI is the New PA
(New Provider Addressing)



What are the issues?

- **How to handle demands on finite routing system capacity?**

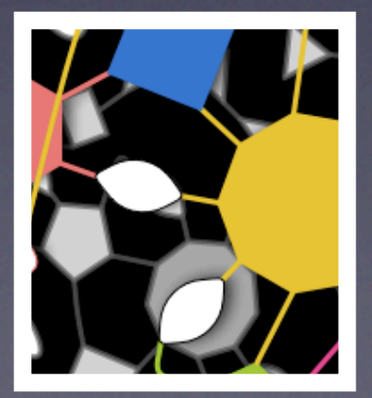
  ...Multiple independent top-level IPv4 sources, each with different allocation criteria

  ...As with the current system, CIDR can only mitigate inflation <u>below</u> that level

- **How to approach IP addressing "availability"?**

  ...In the current system, service providers apply address conservation policies

  ...If conservation policies seem too onerous to customers, they have the option to invest & satisfy eligibility requirements to apply for RIR IPv4...



What are the issues?

- **How to sustain addressing uniqueness?**

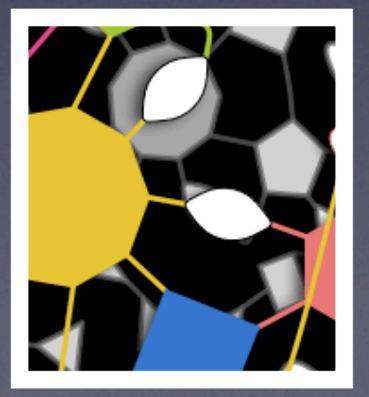
  ...In the current system, uniqueness is sustained through the maintenance of monolithic (RIR) address registries

  ...Maintenance of uniqueness over time is accomplished through a variety of passive, incentive-based mechanisms, including administrative control of the resource pool for subsequent IPv4 allocations

- **How to handle industry "openness"?**

  ...The original goals for which RIRs were established were to maintain an accurate registry, help conserve address resources, and to maintain an environment in which CIDR works

  ...However, one important by-product of these goals was maintenance of a consistent / objective / production-oriented eligibility rule for aspiring new IP-address resource seekers...



Possible approaches to addressing these issues

1. Don't address them here

... Resource transfer and other end-of-IPv4 policies only address how to wind down existing RIR IPv4 allocation services, nothing more
... "Legalize the inevitable"

2. Address them exclusively by *launching* markets

... Establish initial conditions for a transfer market with some goals in mind, but limit such goals to those which will be completely ***self-executing***

3. Address them through market design

... Establish a resource transfer market with some pre-defined goals, ***including goals that require mechanisms / provisions / rules to supplement natural / self-executing incentives***

Taxonomy of approaches

More shared, common factors, expectations

More rules, restrictions, requirements, compliance expectations

Few or no rules, restrictions, requirements

Few or no shared, common factors, expectations

(3)

(2)

(1)

The Taxonomy

	Administrative Processes	*Competitive Processes*
Centralized Mechanisms		*rules requiring reinforcement*
Decentralized Mechanisms		*self-executing rules only*
		no rules

(3)

(2)

(1)

Where Do the RIRs Fit In Now?

	Administrative Processes	Competitive Processes
Centralized Mechanisms	**Individual registry, staffed functions**	**Individual registry as PDP mechanism**
Decentralized Mechanisms	**Regional registries, staffed functions**	**RIR Global Policies (?)**

RIR

(3)

(2)

(1)

The Extremes

	Administrative Processes	*Competitive Processes*
Centralized Mechanisms	***FCFS*** ***Jon Postel*** ***Individual registry, staffed functions***	***Mandatory monolithic auction house*** ***Individual registry as PDP mechanism***
Decentralized Mechanisms	***Regional registries, staffed functions*** ***Self-enforcing rule-based transactions (a world full of Postels)***	***RIR Global Policies (?)*** ***Laissez faire, no fixed standards or rules***

RIR

(3)

(2)

(1)

Transfer Market Options

	Administrative Processes	*Competitive Processes*
Centralized Mechanisms	***FCFS*** ***Jon Postel***	***?*** ***Mandatory monolithic auction house*** ***?*** ***?***
Decentralized Mechanisms	***Internet Route Registries***	***?*** ***?*** ***Laissez faire, no fixed standards or rules***

Resource Transfer Market Design Possibilities

(1) ***(2)*** ***(3)***

Transfer Market Proposals

	Administrative Processes	Competitive Processes
Centralized Mechanisms	**FCFS** — **Jon Postel** **"Final Reservation" Pool / Proposals***	**?** **Mandatory monolithic auction house** **?** **?**
Decentralized Mechanisms	**Internet Route Registries**	**?** **?** **Laissez faire, no fixed standards or rules**

Resource Transfer Market Design Possibilities

(3)

(2)

(1)

***Examples:**
LACNIC 2008-4
ARIN 2008-5
APNIC Prop-050
RIPE 2008-6

Transfer Market Initiatives

	RIPE 2007-8[1]	*APNIC Prop-50*[1]	*ARIN 2008-6*	*ARIN 2008-2*[1]
Version	3	3	1	(abandoned)
Trigger(s)	Immediate upon ratification	Immediate upon ratification	Immediate upon ratification, automatically expiring in three years	Immediate upon ratification
Eligibility*	RIPE members only	APNIC members only	Between ARIN-recognized "legitimate holders" and xRSA signatories	Between xRSA signatories only
Transfer prefix parameters*	Policy-defined minimum allocation, unpopulated PA only, temp. transfers okay	/24 minimum, PA or PI, populated or unpopulated	Policy-defined minimum allocation, no more than 4x deaggregation per prefix	Policy-defined minimum allocation, unpopulated PA or PI
Trafficking restrictions*	Recipient org cannot transfer space within the next 24 months	Transferring org cannot receive space within the next 24 months	(none)	Transferring org cannot have received space in the previous 12 months; recipient can only receive one every six months
Needs assessment*	Yes	No	Yes	Yes

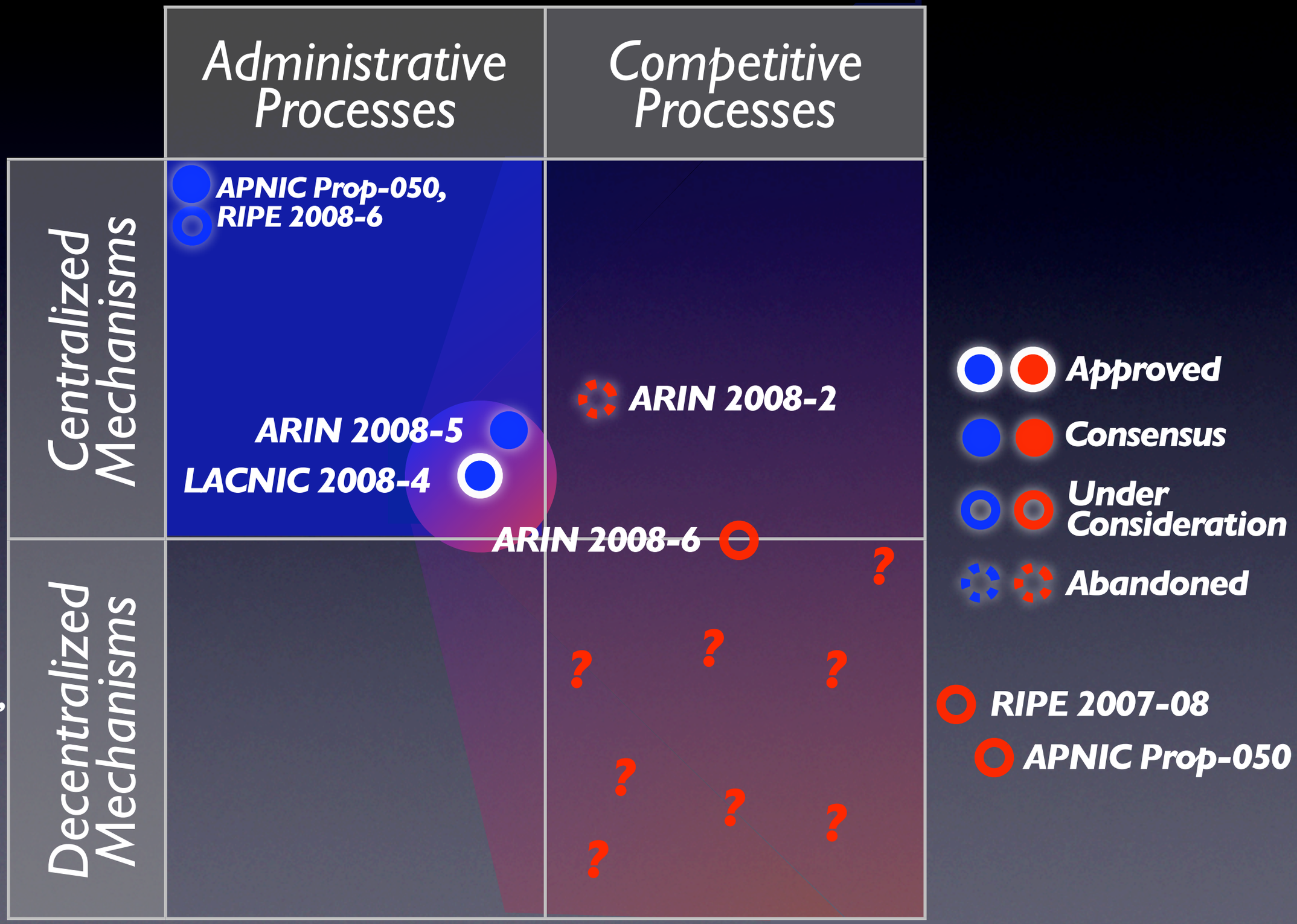
Not self-executing requirements

[1] **Source:** Filiz Yilmaz, Current Policy Topics: A Worldwide Look (RIPE 57 / Dubai)

“Final Reservation” Initiatives

	RIPE 2008-6	*APNIC Prop-62*	*LACNIC 2008-4*	*ARIN 2008-5*
Version	1	2	(implemented)	2
Trigger	Reservation will be created from the last /8 received from IANA	Reservation will be created from the last /8 received from IANA	Reservation will be created from the last /12 of the last /8 received from IANA	Reservation will be made upon the last /8 received from IANA
Reservation Size	/8	/8	/12	/10
Eligibility*	RIPE members only	APNIC members only	LACNIC members only	ARIN RSA signatories only
Allocation Details	Minimum allocation size under concurrent RIPE policy	Minimum allocation size under concurrent APNIC policy	/22 for LIRs, /24 for critical infrastructure	/28 to /24; renumbering may be required for subsequent allocation seekers
Frequency	One allocation only per institution, forever	One allocation only per institution, forever	One allocation only per institution, forever	One allocation max every six months
Needs assessment requirement	Normal needs-based justification	Normal needs-based justification	Justified need for at least one /24 over the next six months	Explicitly tied to IPv6 adoption-related requirements

Transfer Market Initiatives



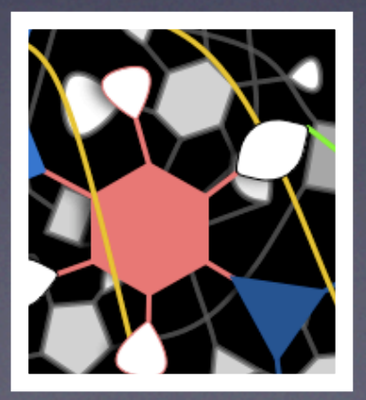
"Final Reservation" Pool / Proposals

- LACNIC 2008-4
- ARIN 2008-5
- APNIC Prop-050
- RIPE 2008-6

“Note: One may choose to ignore the fundamental technical [*and economic, and institutional*]* issues, but this doesn’t change the fundamental property of those issues”[2]

Yakov Rekhter, 1995

***[Not Yakov]**



[2] ftp://ftp.ietf.org/ietf-online-proceedings/95apr/area.and.wg.reports/ops/cidrd/cidrd.rekhter.slides.ps

Questions? Thanks!

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