Scaling the Root

A study of the impact on the DNS root system
of increasing the size and volatility of the root zone

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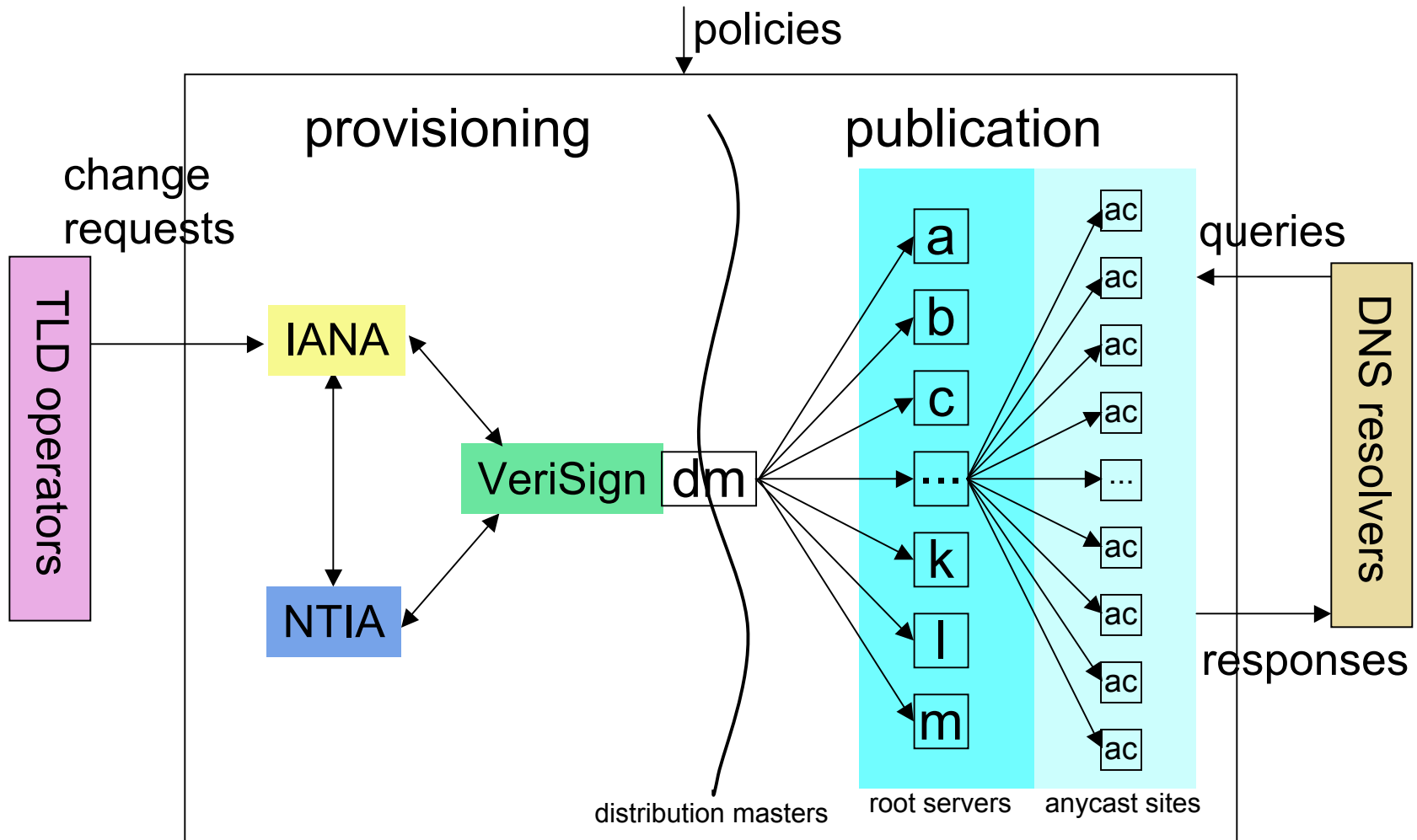## Discussion of Findings

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Root Zone Expansion

- New resource records for DNSSEC

- Internationalized top-level domain names

- New address records and glue for IPv6

- New gTLDs

$\rightarrow$ Root zone becomes larger (size)

$\rightarrow$ Change rate increases (volatility)

Root System Model

policies

provisioning

publication

change
requests

TLD operators

IANA

VeriSign dm

NTIA

a

b

c

...

k

l

m

ac

ac

ac

ac

...

ac

ac

ac

ac

queries

DNS resolvers

responses

distribution masters
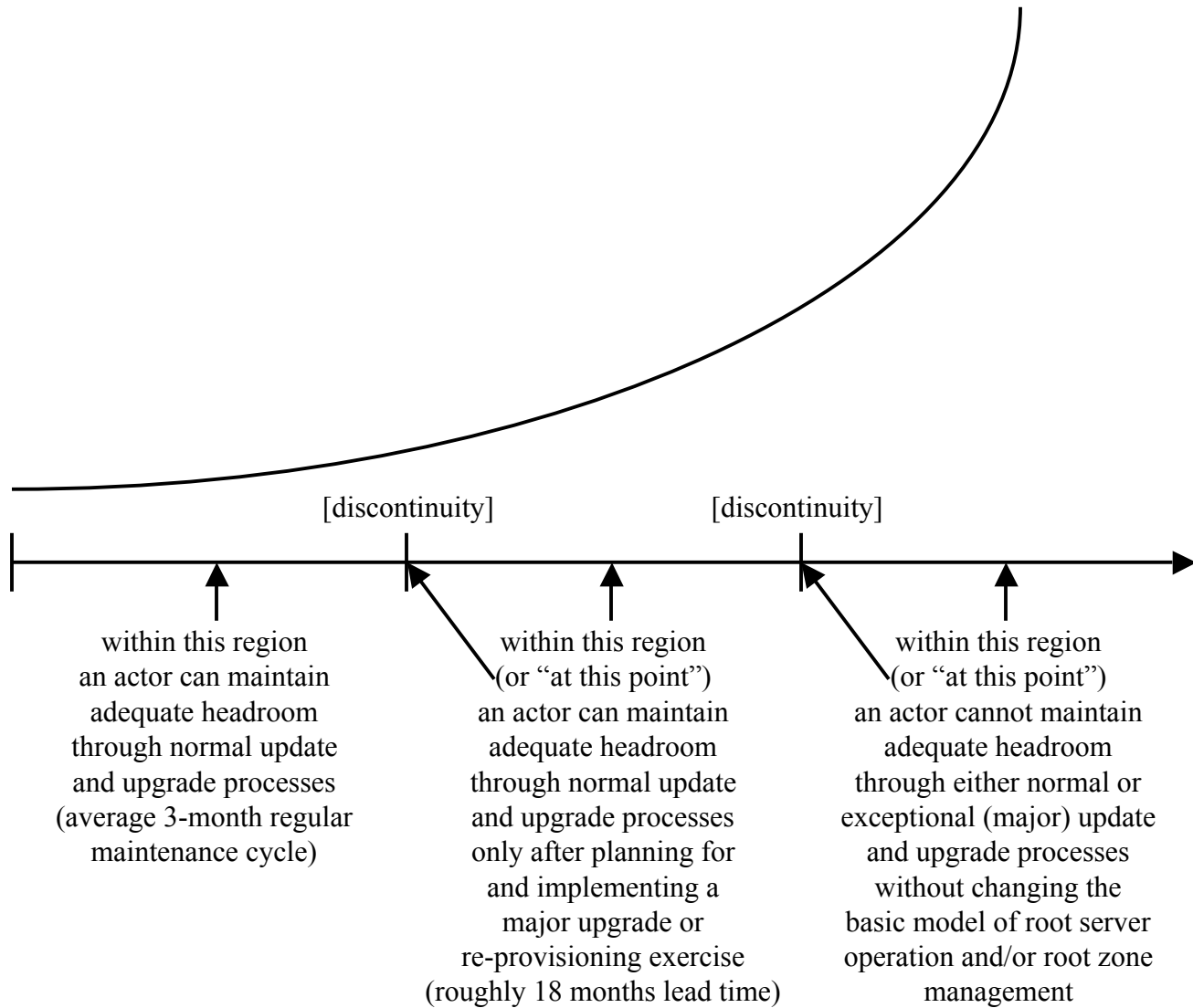
root servers

anycast sites

Findings

- The root is a highly decentralized dynamic system.

- Any increase in the size or volatility of the root zone involves risk.

- Root system oversight should focus on "early warning" rather than threshold prediction.

- In order for "early warning" to be effective, changes to the root must be made gradually.

Findings

- On the provisioning side, the ability to scale the root is completely dominated by the steps that involve human intervention.

- On the publication side, scaling the root primarily affects poorly-connected Internet locations.

- The risks associated with an annual increase in the size of the root zone on the order of hundreds of new entries can be managed without changing any actor's current arrangements.

- The risks associated with an annual increase in the size of the root zone on the order of thousands of new entries can be managed only with changes to the current arrangements of one or more actors.

Dynamic Operating Regions

[discontinuity]   [discontinuity]

within this region
an actor can maintain
adequate headroom
through normal update
and upgrade processes
(average 3-month regular
maintenance cycle)

within this region
(or "at this point")
an actor can maintain
adequate headroom
through normal update
and upgrade processes
only after planning for
and implementing a
major upgrade or
re-provisioning exercise
(roughly 18 months lead time)

within this region
(or "at this point")
an actor cannot maintain
adequate headroom
through either normal or
exceptional (major) update
and upgrade processes
without changing the
basic model of root server
operation and/or root zone
management

Effects of Root Zone Changes

	New TLDs	DNSSEC	IDNs	IPv6 addresses
Increases number of TLD entries in the root zone	X		X	
Increases size of the root zone file	X	X	X	X
Increases amount of data per TLD		X	X	X
Increases number of variables per TLD		X		X
Increases number of changes per TLD per year		X		X

Impact on Root System Components

	Increased number of TLD entries in the root zone	Increased size of the root zone file	Increased amount of data per TLD	Increased number of variables per TLD	Increased number of changes per TLD per year
Impact on IANA/NTIA/VeriSign automatic processing	X			X	X
Impact on IANA/NTIA/VeriSign manual processing	X			X	X
Impact on AXFR in publication system		X			
Impact on IXFR in publication system	X		X		X
Impact on root server memory requirements		X			
Impact on root server CPU requirements	X				
Impact on root server bandwidth requirements	X (query load)		X (response size)	X (response size and query load)	

Dedication

The root scaling study is dedicated to a root of impressive scale, the Mangelwurzel, which enjoys the dubious distinction of having suffered greater abuse and indignity than the root of the DNS.

A mangelwurzel hurling championship was revived in the north Wiltshire village of Sherston on October 7, 2006. Teams of three hurled mangelwurzels in turn, aiming to be the closest to a large leafless mangelwurzel known as "the Norman."

Contemporary accounts of this event do not record whether or not the villagers conducted a thorough study of the security and stability of "the Norman" before beginning their assault.