

Proposal to amend IPv6 utilisation requirement policy

AfriNIC-3
Cairo
14 Dec 2005

The Proposal

- Utilisation requirement for IPv6 to be increased to HD-Ratio value of 0.94
 - From current value of HD = 0.80
- Overview
 - Motivation and background
 - IPv6 populations and demands
 - Analysis – registry simulation
 - Implementation

Motivation and Background

- Analysis of overall lifetime and deployment size of IPv6
 - Concern to ensure adequate future for IPv6
- Presentation at APNIC-20
 - HD-Ratio = 0.94
 - Default SOHO assignment of /56
- Result:
 - HD-Ratio approved (subject to global coord)
 - No consensus on assignment size

Address Efficiency – HD=0.80

v6 prefix	Total site addrs	Utilised site addrs	Util%
32	65,536	7,132	10.88%
31	131,072	12,417	9.47%
30	262,144	21,619	8.25%
29	524,288	37,641	7.18%
28	1,048,576	65,536	6.25%
27	2,097,152	114,105	5.44%
26	4,194,304	198,668	4.74%
25	8,388,608	345,901	4.12%
24	16,777,216	602,249	3.59%
23	33,554,432	1,048,576	3.13%
22	67,108,864	1,825,677	2.72%
21	134,217,728	3,178,688	2.37%
20	268,435,456	5,534,417	2.06%
19	536,870,912	9,635,980	1.79%
18	1,073,741,824	16,777,216	1.56%
17	2,147,483,648	29,210,830	1.36%
16	4,294,967,296	50,859,008	1.18%

IPv6 Global Demand

- Commodity communications world
- Ubiquitous connectivity for households, workplaces, people, vehicles, devices etc
- Thousands of service enterprises serving millions of end sites
- Addressing technology to last for at least tens of decades
- Total end-site populations of tens of billions: Order(10^{11})

Longevity

- Shifting a technology base due to address scarcity leads to a scarcity solution, and likely compromise
- It would be preferable to provide for ample address supply over the entire anticipated technology lifecycle
 - i.e. still have ‘ample’ addresses at the end of the lifecycle
- Suggest IPv6 lifecycle target of 60–100 years, at least

A consumption scenario

- Simple address plan (/48s)
- Low utilisation factor (HD = 0.8)
- Projected end-site population (10^{11})
- 60 years time frame
- 50 billion – 200 billion sites
- Total prefix usage: /1 – /4
 - 6-50% of entire address space

Factors and Uncertainties

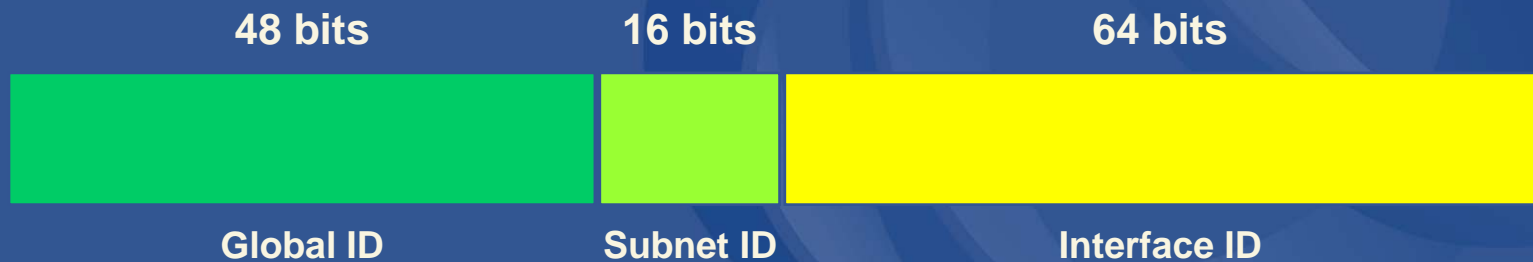
- Time period estimates (decades vs centuries)
- Consumption models (recyclable vs one-time manufacture)
- Network models (single domain vs overlays)
- Network Service models (value-add-service vs commodity distribution)
- Device service models (discrete devices vs ubiquitous embedding)
- Population counts (human populations vs device populations)
- Address Distribution models (cohesive uniform policies vs diverse supply streams)
- Overall utilization efficiency models (aggregated commodity supply chains vs specialized markets)

If this seems uncomfortable...

- ... then we need to re-look at the basic assumptions to see where there may be some room to shift the allocation and/or architectural parameters to obtain some additional expansion space.

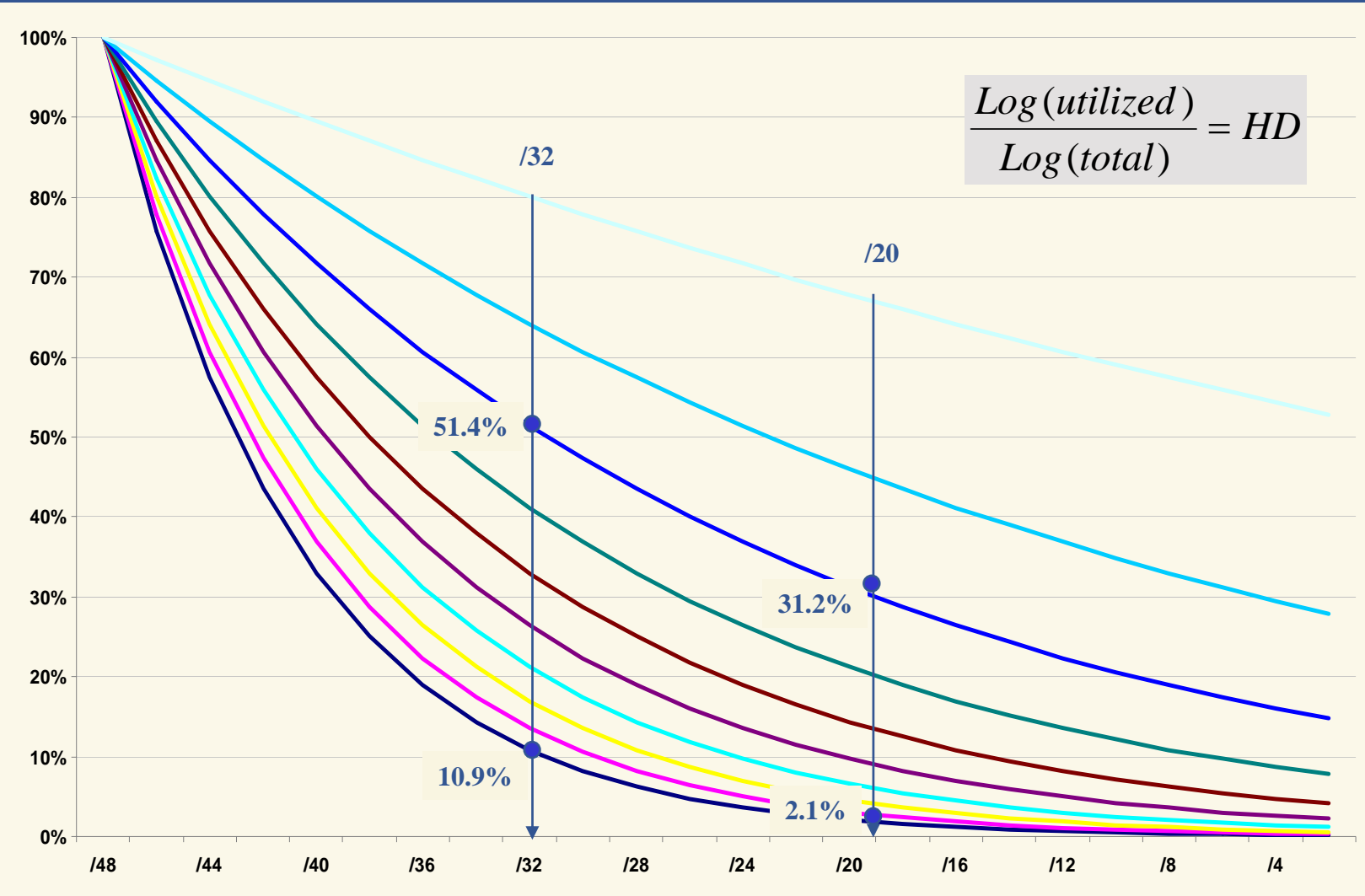
Where's the “Wriggle Room”?

- IPv6 Allocation Policies
 - The **HD-Ratio** target for address utilization
 - The **subnet ID** used for end-site assignment
- IPv6 Address Architecture
 - 64 bit **Interface ID**



Varying the HD Ratio

$$\frac{\text{Log}(\text{utilized})}{\text{Log}(\text{total})} = HD$$



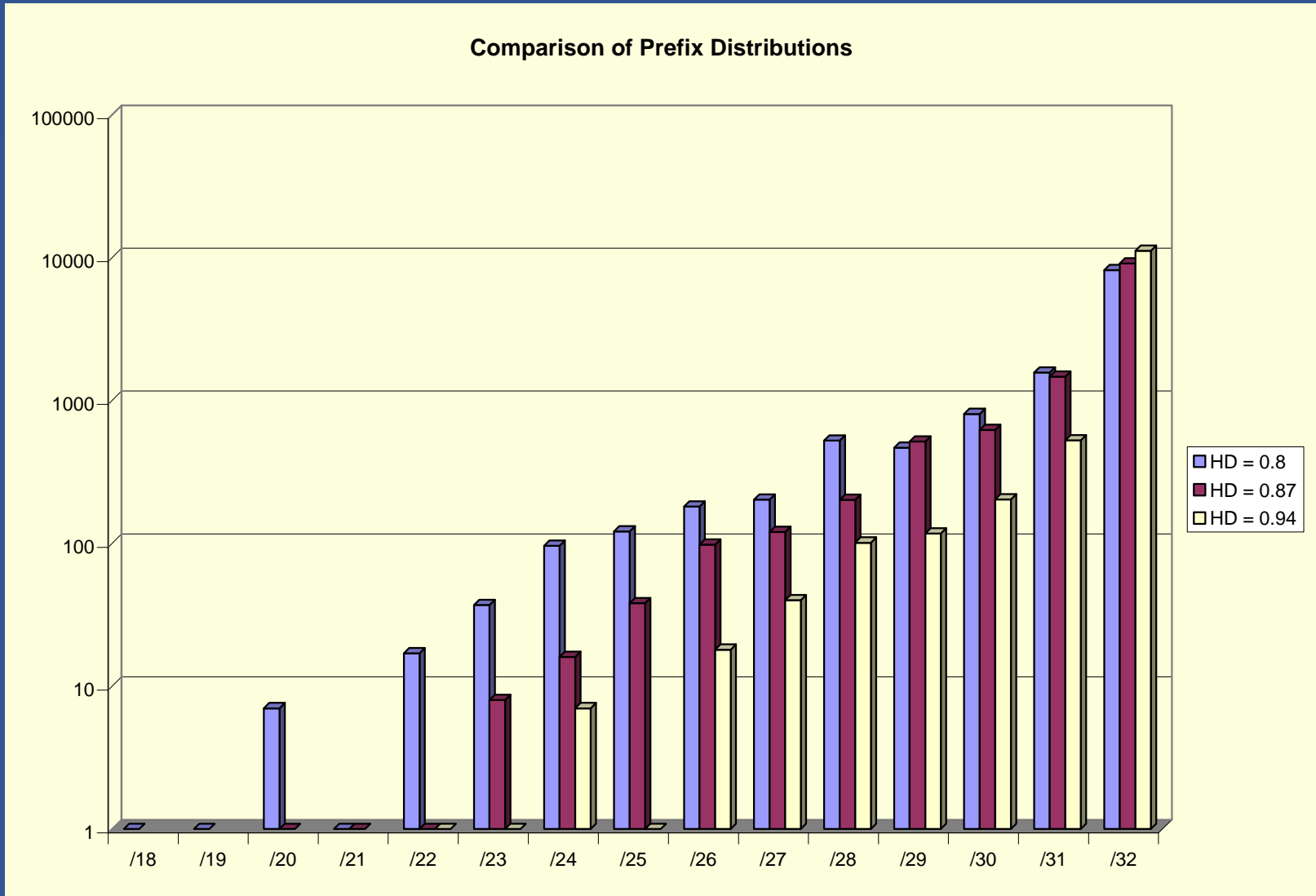
0.98
0.96
0.94
0.90
0.80



Address Efficiency – HD=0.94

v6 prefix	Total site addrs	Utilised site addrs	Util%
32	65,536	33,689	51.41%
31	131,072	64,634	49.31%
30	262,144	124,002	47.30%
29	524,288	237,901	45.38%
28	1,048,576	456,419	43.53%
27	2,097,152	875,653	41.75%
26	4,194,304	1,679,965	40.05%
25	8,388,608	3,223,061	38.42%
24	16,777,216	6,183,533	36.86%
23	33,554,432	11,863,283	35.36%
22	67,108,864	22,760,044	33.92%
21	134,217,728	43,665,787	32.53%
20	268,435,456	83,774,045	31.21%
19	536,870,912	160,722,871	29.94%
18	1,073,741,824	308,351,367	28.72%
17	2,147,483,648	591,580,804	27.55%
16	4,294,967,296	1,134,964,479	26.43%

Registry simulation: prefix size distribution (log scale)



Registry simulation: Observations

- 80% of all allocations are /31 or /32 for HD ratio of 0.8 or higher
 - Changing the HD ratio will not impact most allocations in a steady state registry function
- Only 2% of all allocations are larger than a /27
 - For these larger allocations the target efficiency is lifted from 4% to 25% by changing the HD Ratio from 0.8 to 0.94
- Total 3 year address consumption is reduced by a factor of 10 in changing the HD ratio from 0.8 to 0.94

Summary

- The HD ratio
 - If HD = 0.8 consumes 1 block of address space
 - Then HD = 0.87 consumes 1/2 as much space
 - And HD = 0.94 consumes 1/10 as much space
 - i.e. a higher HD ratio will save up to 3 bits
- The subnet field
 - /56 SOHO default subnet assignment size may alter cumulative total by 6 – 7 bits
 - /10 – /17 total consumption given original demand estimates
- Is this sufficient margin for uncertainties in the initial assumptions about the deployment lifetime for IPv6?

Now or Later?

- RFC3177

“Therefore, if the analysis does one day turn out to be wrong, our successors will still have the option of imposing much more restrictive allocation policies on the remaining 85%.”

- Do we want to create early adopter rewards and late adopter restrictions?
- Should we attempt to operate with more stable policies across the anticipated technology lifecycle?

Implementation

- Part of a global coordination effort across all RIRs
 - Possible review of policy proposal following consideration from other RIR forums

Thanks

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