



Draft Recommendation Y.IPv6RefModel

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Contact

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ITU-T Study Group 20

Internet of things (IoT) and smart cities and communities (SC&C)

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Origin and Context



Foundation & Research Centre

- Promote international cooperation
- International Research

Active engagement in International Cooperation

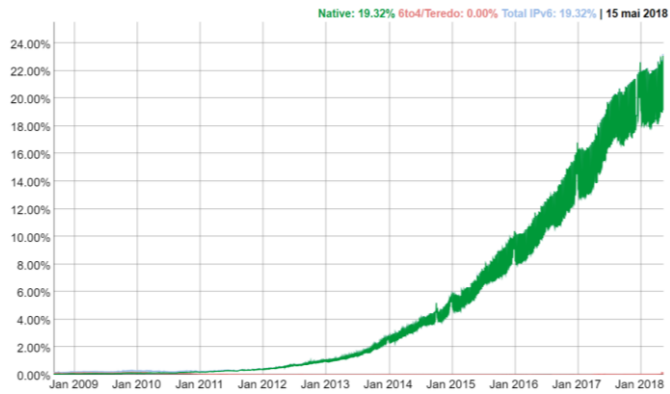


Research path

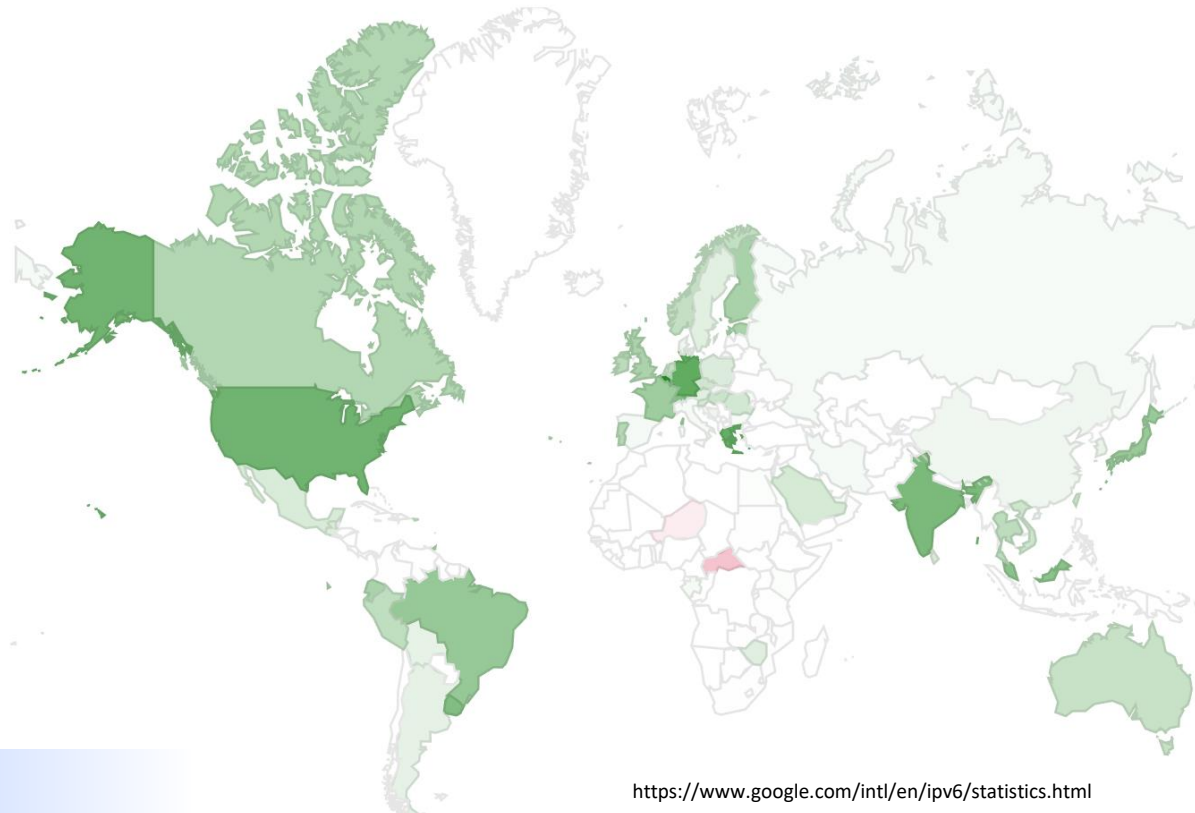


Key concepts published through IEEE: S. Ziegler et L. Ladid, « Towards a Global IPv6 Addressing Model for the Internet of Things », in 2016 30th International Conference on Advanced Information Networking and Applications Workshops (WAINA) (2016) p. 622-627, DOI: 10.1109/WAINA.2016.178

IPv6 at a Crossroad



Per-Country IPv6 adoption



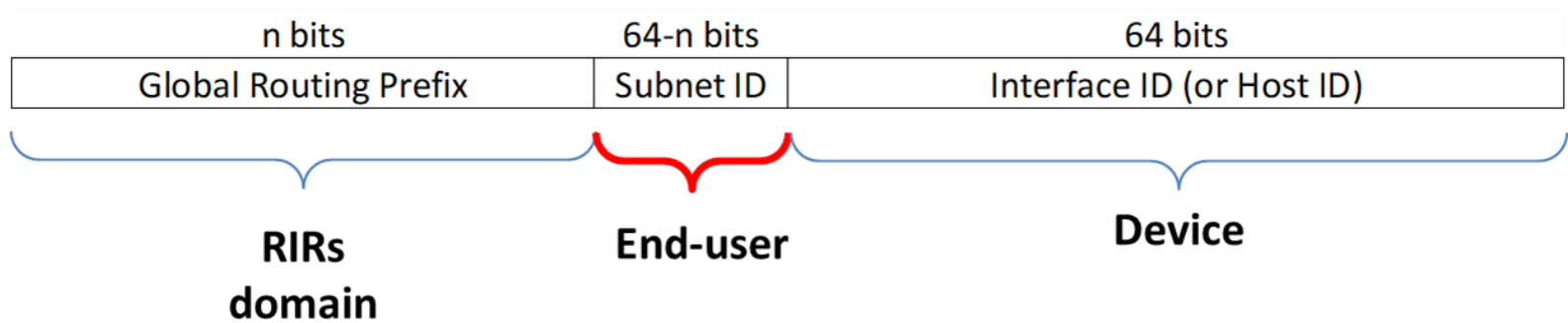
Why a Recommendation?

- Ease global adoption and deployment of IPv6 by end-users
- Prevent an IPv6 digital divide
- Anticipate IoT expansion (>50 Bio connected devices)
- Provide a practical and customizable reference model
- Ease security management through bit-based filtering
- Ease the interconnection and/or federation of multiple IoT networks and testbeds

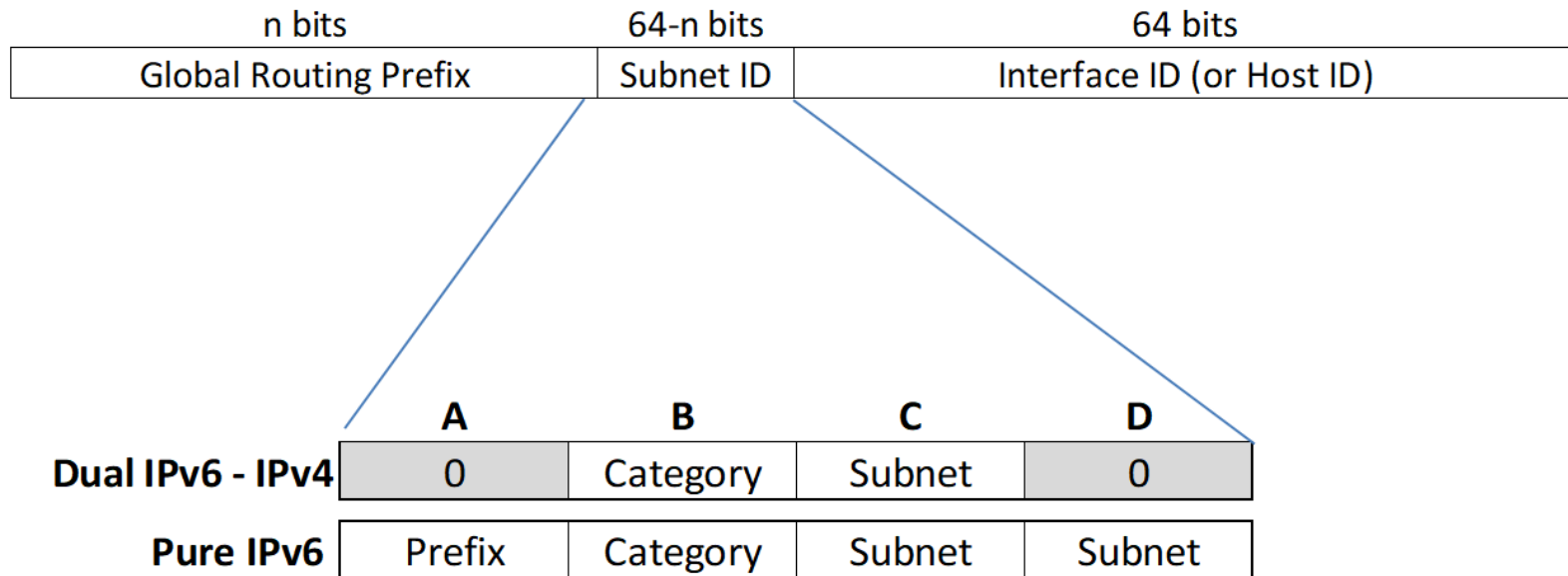
Considered Requirements

- Clarity & Manageability
- Scalability & Evolution
- Transition from IPv4 to IPv6
- Enable simple and consistent filtering rules for security policies

Focus on the IPv6 Subnet Addressing Plan



/48 Subnet Structure



/48 Subnet Structure

Dual IPv6 - IPv4

Allocation	IPv6				IPv4	Nb
	A	B	C	D	octet	
DMZ	0	0	0-f	0	0 - 15	32
	0	1	0-f	0	16 - 31	
Internal Servers	0	2	0-f	0	32 - 47	32
	0	3	0-f	0	48 - 63	
Regular LAN	0	4	0-f	0	64 - 79	64
	0	5	0-f	0	80 - 95	
	0	6	0-f	0	96 - 111	
	0	7	0-f	0	112 - 127	
IoT & Building Automation	0	8	0-f	0	128 - 143	64
	0	9	0-f	0	144 - 159	
	0	a	0-f	0	160 - 175	
	0	b	0-f	0	176 - 191	
Others	0	c	0-f	0	192 - 207	64
	0	d	0-f	0	208 - 223	
	0	e	0-f	0	224 - 239	
	0	f	0-f	0	240 - 255	

Reserved for flexibility



Pure IPv6

IPv6				
A	B	C	D	Nb
0-f	0	0-f	0-f	16 x
0-f	1	0-f	0-f	8'192
0-f	2	0-f	0-f	16 x
0-f	3	0-f	0-f	8'192
0-f	4	0-f	0-f	16'384
0-f	5	0-f	0-f	
0-f	6	0-f	0-f	
0-f	7	0-f	0-f	
0-f	8	0-f	0-f	16'384
0-f	9	0-f	0-f	
0-f	a	0-f	0-f	
0-f	b	0-f	0-f	
0-f	c	0-f	0-f	16'384
0-f	d	0-f	0-f	
0-f	e	0-f	0-f	
0-f	f	0-f	0-f	

/56 Subnet Structure

Allocation	Range			Dual IPv4 IPv6 Range			
	A	B	Nb	A	B	IPv4 octet	Nb
DMZ	0	0-f	32	0	0-f	0 - 15	32
	1	0-f		1	0-f	16 - 31	
Internal Servers	2	0-f	32	2	0-f	32 - 47	32
	3	0-f		3	0-f	48 - 63	
Default LAN	4	0-f	64	4	0-f	64 - 79	64
	5	0-f		5	0-f	80 - 95	
	6	0-f		6	0-f	96 - 111	
	7	0-f		7	0-f	112 - 127	
Internet of Things	8	0-f	64	8	0-f	128 - 143	64
	9	0-f		9	0-f	144 - 159	
	a	0-f		a	0-f	160 - 175	
	b	0-f		b	0-f	176 - 191	
Reserved & Others	c	0-f	64	c	0-f	192 - 207	64
	d	0-f		d	0-f	208 - 223	
	e	0-f		e	0-f	224 - 239	
	f	0-f		f	0-f	240 - 255	
				256			
				256			

/44 Subnet Structure

Allocation							Dual IPv6 - IPv4 Range						IPv6 Only Range							
	A	B	C	D	E	Nb	IPv6			IPv4			Nb	IPv6					Nb	
							A	B	C	D	E	octet B-C		octet D-E		A	B	C		D
DMZ	0-f	0	0-f	0-f	0-f	2 ¹⁷	0	0	0-f	0-f	0-f	0 - 15	0-255	2 ¹³	0-f	0	0-f	0-f	0-f	2 ²¹
	0-f	1	0-f	0-f	0-f		0	1	0-f	0-f	0-f	16 - 31	0-256		0-f	1	0-f	0-f	0-f	
Internal Servers	0-f	2	0-f	0-f	0-f	2 ¹⁷	0	2	0-f	0-f	0-f	32 - 47	0-256	2 ¹³	0-f	2	0-f	0-f	0-f	2 ²¹
	0-f	3	0-f	0-f	0-f		0	3	0-f	0-f	0-f	48 - 63	0-256		0-f	3	0-f	0-f	0-f	
Default LAN	0-f	4	0-f	0-f	0-f	2 ¹⁸	0	4	0-f	0-f	0-f	64 - 79	0-256	2 ¹⁴	0-f	4	0-f	0-f	0-f	2 ²²
	0-f	5	0-f	0-f	0-f		0	5	0-f	0-f	0-f	80 - 95	0-256		0-f	5	0-f	0-f	0-f	
	0-f	6	0-f	0-f	0-f		0	6	0-f	0-f	0-f	96 - 111	0-256		0-f	6	0-f	0-f	0-f	
	0-f	7	0-f	0-f	0-f		0	7	0-f	0-f	0-f	112 - 127	0-256		0-f	7	0-f	0-f	0-f	
Internet of Things	0-f	8	0-f	0-f	0-f	2 ¹⁸	0	8	0-f	0-f	0-f	128 - 143	0-256	2 ¹⁴	0-f	8	0-f	0-f	0-f	2 ²²
	0-f	9	0-f	0-f	0-f		0	9	0-f	0-f	0-f	144 - 159	0-256		0-f	9	0-f	0-f	0-f	
	0-f	a	0-f	0-f	0-f		0	a	0-f	0-f	0-f	160 - 175	0-256		0-f	a	0-f	0-f	0-f	
	0-f	b	0-f	0-f	0-f		0	b	0-f	0-f	0-f	176 - 191	0-256		0-f	b	0-f	0-f	0-f	
Reserved & Others	0-f	c	0-f	0-f	0-f	2 ¹⁸	0	c	0-f	0-f	0-f	192 - 207	0-256	2 ¹⁴	0-f	c	0-f	0-f	0-f	2 ²²
	0-f	d	0-f	0-f	0-f		0	d	0-f	0-f	0-f	208 - 223	0-256		0-f	d	0-f	0-f	0-f	
	0-f	e	0-f	0-f	0-f		0	e	0-f	0-f	0-f	224 - 239	0-256		0-f	e	0-f	0-f	0-f	
	0-f	f	0-f	0-f	0-f		0	f	0-f	0-f	0-f	240 - 255	0-256		0-f	f	0-f	0-f	0-f	

2²⁰

2¹⁶

2²⁴

/40 Subnet Structure

Allocation	Dual IPv6 - IPv4 Range								Nb
	IPv6						IPv4		
	A	B	C	D	E	F	octet C-D	octet E-F	
DMZ	0	0	0	0-f	0-f	0-f	0 - 15	0-255	2 ¹³
	0	0	1	0-f	0-f	0-f	16 - 31	0-256	
Internal Servers	0	0	2	0-f	0-f	0-f	32 - 47	0-256	2 ¹³
	0	0	3	0-f	0-f	0-f	48 - 63	0-256	
Default LAN	0	0	4	0-f	0-f	0-f	64 - 79	0-256	2 ¹⁴
	0	0	5	0-f	0-f	0-f	80 - 95	0-256	
	0	0	6	0-f	0-f	0-f	96 - 111	0-256	
	0	0	7	0-f	0-f	0-f	112 - 127	0-256	
Internet of Things	0	0	8	0-f	0-f	0-f	128 - 143	0-256	2 ¹⁴
	0	0	9	0-f	0-f	0-f	144 - 159	0-256	
	0	0	a	0-f	0-f	0-f	160 - 175	0-256	
	0	0	b	0-f	0-f	0-f	176 - 191	0-256	
Reserved & Others	0	0	c	0-f	0-f	0-f	192 - 207	0-256	2 ¹⁴
	0	0	d	0-f	0-f	0-f	208 - 223	0-256	
	0	0	e	0-f	0-f	0-f	224 - 239	0-256	
	0	0	f	0-f	0-f	0-f	240 - 255	0-256	

2¹⁶

IPv6 Only Range							
IPv6							Nb
A	B	C	D	E	F		
0-f	0-f	0	0-f	0-f	0-f	2 ²¹	
0-f	0-f	1	0-f	0-f	0-f		
0-f	0-f	2	0-f	0-f	0-f	2 ²¹	
0-f	0-f	3	0-f	0-f	0-f		
0-f	0-f	4	0-f	0-f	0-f	2 ²²	
0-f	0-f	5	0-f	0-f	0-f		
0-f	0-f	6	0-f	0-f	0-f		
0-f	0-f	7	0-f	0-f	0-f		
0-f	0-f	8	0-f	0-f	0-f	2 ²²	
0-f	0-f	9	0-f	0-f	0-f		
0-f	0-f	a	0-f	0-f	0-f		
0-f	0-f	b	0-f	0-f	0-f		
0-f	0-f	c	0-f	0-f	0-f	2 ²²	
0-f	0-f	d	0-f	0-f	0-f		
0-f	0-f	e	0-f	0-f	0-f		
0-f	0-f	f	0-f	0-f	0-f		

2²⁴

/36 Subnet Structure

Allocation	Address Range								Nb
	IPv6							Nb	
	A	B	C	D	E	F	G		
DMZ	0-f	0-f	0	0-f	0-f	0-f	0-f	2 ²⁵	
	0-f	0-f	1	0-f	0-f	0-f	0-f		
Internal Servers	0-f	0-f	2	0-f	0-f	0-f	0-f	2 ²⁵	
	0-f	0-f	3	0-f	0-f	0-f	0-f		
Default LAN	0-f	0-f	4	0-f	0-f	0-f	0-f	2 ²⁶	
	0-f	0-f	5	0-f	0-f	0-f	0-f		
	0-f	0-f	6	0-f	0-f	0-f	0-f		
	0-f	0-f	7	0-f	0-f	0-f	0-f		
Internet of Things	0-f	0-f	8	0-f	0-f	0-f	0-f	2 ²⁶	
	0-f	0-f	9	0-f	0-f	0-f	0-f		
	0-f	0-f	a	0-f	0-f	0-f	0-f		
	0-f	0-f	b	0-f	0-f	0-f	0-f		
Reserved & Others	0-f	0-f	c	0-f	0-f	0-f	0-f	2 ²⁶	
	0-f	0-f	d	0-f	0-f	0-f	0-f		
	0-f	0-f	e	0-f	0-f	0-f	0-f		
	0-f	0-f	f	0-f	0-f	0-f	0-f		

2²⁸

Dual IPv6 - IPv4										Nb
IPv6							IPv4		Nb	
A	B	C	D	E	F	G	octet C-D	octet E-F		
0	0	0	0-f	0-f	0-f	0	0 - 15	0-255	2 ¹³	
0	0	1	0-f	0-f	0-f	0	16 - 31	0-256		
0	0	2	0-f	0-f	0-f	0	32 - 47	0-256	2 ¹³	
0	0	3	0-f	0-f	0-f	0	48 - 63	0-256		
0	0	4	0-f	0-f	0-f	0	64 - 79	0-256	2 ¹⁴	
0	0	5	0-f	0-f	0-f	0	80 - 95	0-256		
0	0	6	0-f	0-f	0-f	0	96 - 111	0-256		
0	0	7	0-f	0-f	0-f	0	112 - 127	0-256		
0	0	8	0-f	0-f	0-f	0	128 - 143	0-256	2 ¹⁴	
0	0	9	0-f	0-f	0-f	0	144 - 159	0-256		
0	0	a	0-f	0-f	0-f	0	160 - 175	0-256		
0	0	b	0-f	0-f	0-f	0	176 - 191	0-256		
0	0	c	0-f	0-f	0-f	0	192 - 207	0-256	2 ¹⁴	
0	0	d	0-f	0-f	0-f	0	208 - 223	0-256		
0	0	e	0-f	0-f	0-f	0	224 - 239	0-256		
0	0	f	0-f	0-f	0-f	0	240 - 255	0-256		

2¹⁶

Pure IPv6									Nb
IPv6							Nb		
A	B	C	D	E	F	G			
0-f	0-f	0	0-f	0-f	0-f	0-f	2 ²⁵		
0-f	0-f	1	0-f	0-f	0-f	0-f			
0-f	0-f	2	0-f	0-f	0-f	0-f	2 ²⁵		
0-f	0-f	3	0-f	0-f	0-f	0-f			
0-f	0-f	4	0-f	0-f	0-f	0-f	2 ²⁶		
0-f	0-f	5	0-f	0-f	0-f	0-f			
0-f	0-f	6	0-f	0-f	0-f	0-f			
0-f	0-f	7	0-f	0-f	0-f	0-f			
0-f	0-f	8	0-f	0-f	0-f	0-f	2 ²⁶		
0-f	0-f	9	0-f	0-f	0-f	0-f			
0-f	0-f	a	0-f	0-f	0-f	0-f			
0-f	0-f	b	0-f	0-f	0-f	0-f			
0-f	0-f	c	0-f	0-f	0-f	0-f	2 ²⁶		
0-f	0-f	d	0-f	0-f	0-f	0-f			
0-f	0-f	e	0-f	0-f	0-f	0-f			
0-f	0-f	f	0-f	0-f	0-f	0-f			

2²⁸

Invitation to RIPE-NCC for

1. Sending comments to enrich and fine tune the reference model
2. Supporting its adoption and dissemination

THANK YOU !

Contact

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