

Proposed IEEE 802.11ah Use Cases

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Objective

- **This contribution proposes use cases following the IEEE 802.11ah Call for Proposals [1].**
- **This contribution combines the use cases as reported in DCN#1044r0 [2] and DCN#1458r0 [3] and proposes additional helpful use cases.**
- **Provide use cases to help guide standardization effort.**

About IEEE 802.11ah

- **Scope:**

This amendment defines an OFDM PHY operating in the license-exempt bands below 1 GHz, e.g., 868-868.6 MHz (Europe), 950-958 MHz (Japan), 314-316 MHz, 430-434 MHz, 470-510 MHz, and 779-787 MHz (China), 917-923.5 MHz (Korea) and 902-928 MHz (USA) and enhancements to the IEEE 802.11 MAC to support this PHY, and provides mechanisms that enable coexistence with other systems in the bands including IEEE 802.15.4 and IEEE P802.15.4g. [1]

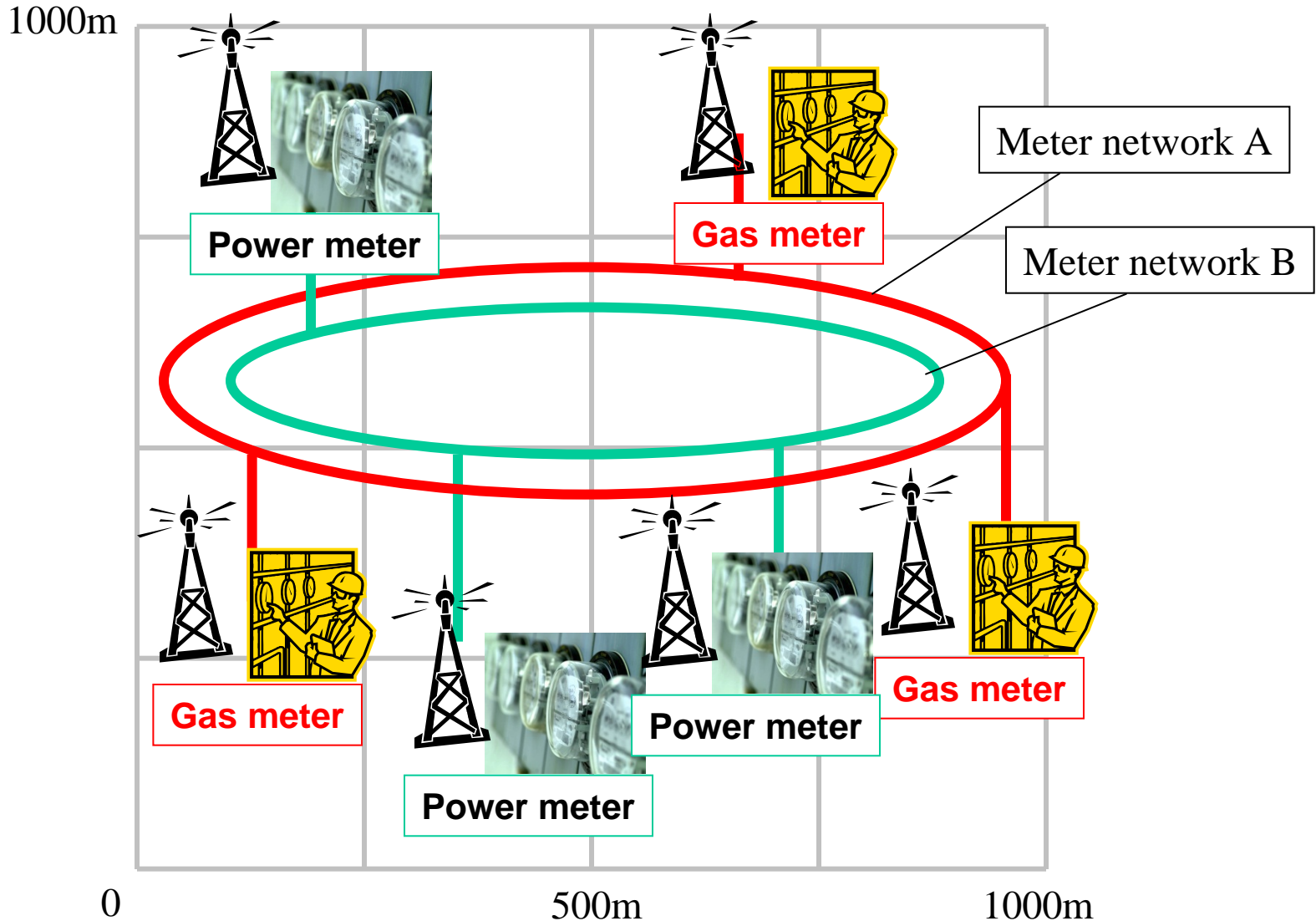
Motivation

- **Combined proposal of IEEE 802.11ah use case candidates dedicated to different locations (indoor/outdoor) and system requirements.**

Proposed list of IEEE 802.11ah Use Cases

- **Use case 1: Sub 1GHz Smart Grid**
 - Type of data traffic
 - Meter information
 - Power delivery/distribution data
 - Billing information
- **Use case 2: Sub 1GHz Intelligent Transport Systems (ITS)**
 - Type of data traffic
 - Traffic information
 - Logistics data
 - Toll data
- **Use case 3: Outdoor Sub 1GHz Surveillance System**
 - Type of data traffic
 - Location/position information
 - Emergency call data
 - Video/sound/motion data
- **Use case 4: Indoor Sub 1GHz Surveillance System**
 - Type of data traffic
 - Video/sound/motion data
- **Use case 5: Indoor Sub 1GHz Home Entertainment System**
 - Type of data traffic
 - Audio/video data

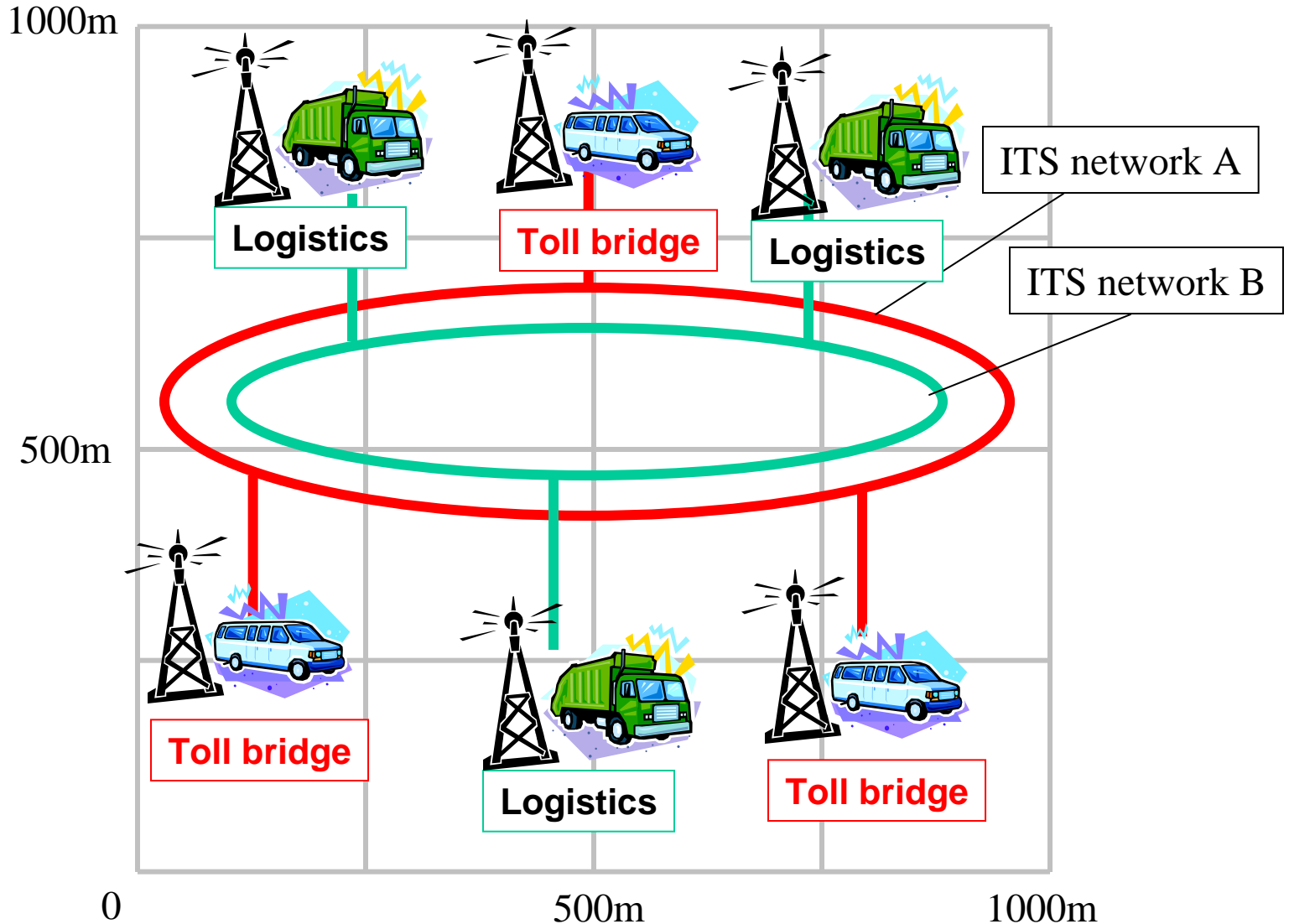
Use Case 1: Sub 1GHz Smart Grid



Sub 1GHz Smart Grid: Requirements

#	Category	Comment
1	Location	Outdoor
2	Environment type	Urban, sub-urban
3	STA/non-STA communication	Send/receive (meter & control)
4	Data rate	>100 kbps
5	BER/PER requirement	PER<10%
6	Mobility	Stationary
7	Traffic type	Burst
8	Security requirement	High
9	Reliability	High
10	STA/non-STA capacity	STA: 1000, non-STA: 100
11	STA/non-STA category	STA: fixed, non-STA: fixed
12	STA/non-STA elevation	STA: 1-2m, non-STA: 2-10m

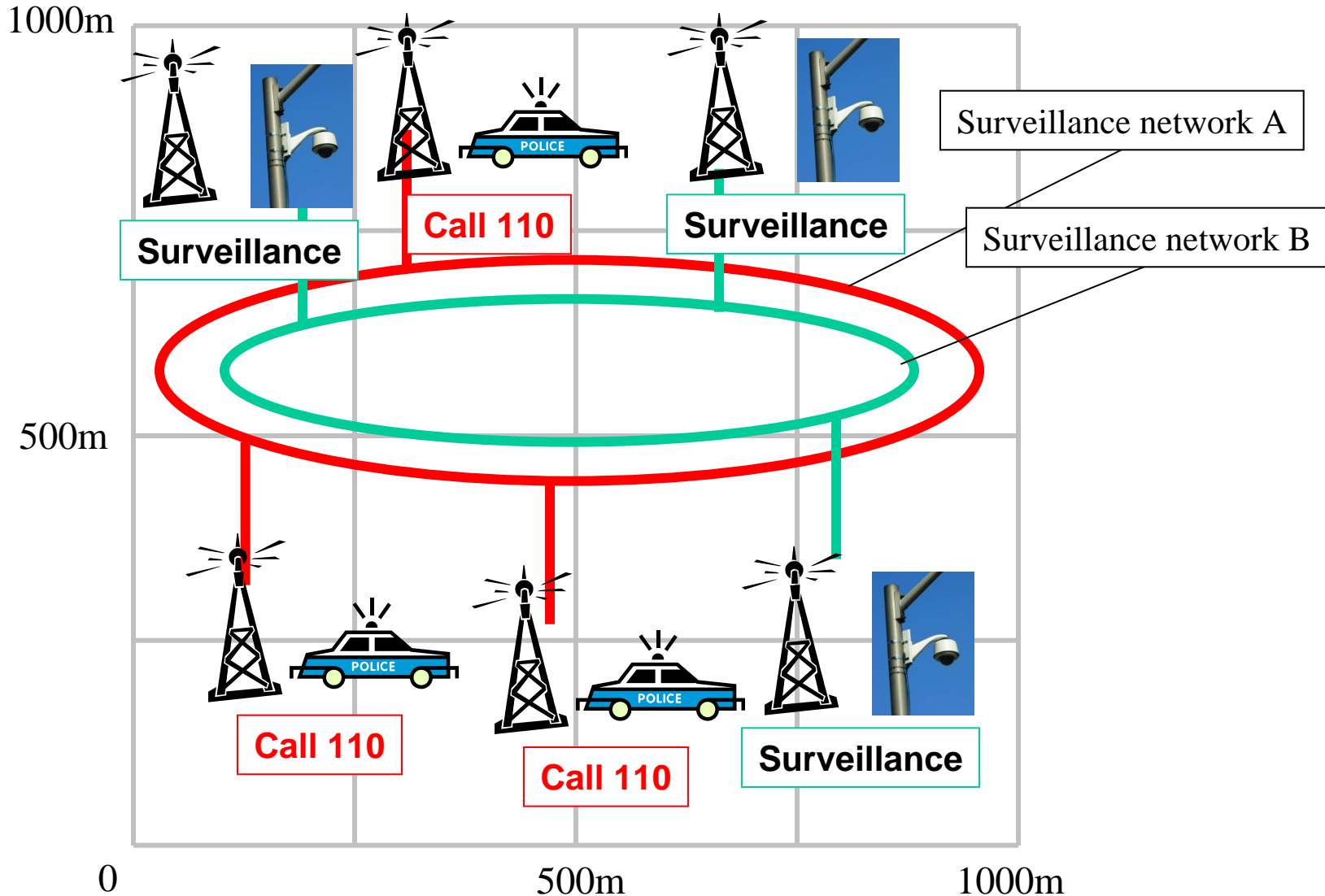
Use Case 2: Sub 1GHz Intelligent Transport System (ITS)



Sub 1GHz Intelligent Transport System (ITS): Requirements

#	Category	Comment
1	Location	Outdoor
2	Environment type	Sub-urban, rural
3	STA/non-STA communication	Send/receive (ID & control)
4	Data rate	100 kbps
5	BER/PER requirement	PER<10%
6	Mobility	Low/high velocity
7	Traffic type	Burst
8	Security requirement	High
9	Reliability	High
10	STA/non-STA capacity	STA: 50, non-STA: 20
11	STA/non-STA category	STA: mobile, non-STA: fixed
12	STA/non-STA elevation	STA: 1-2m, non-STA: 2-5m

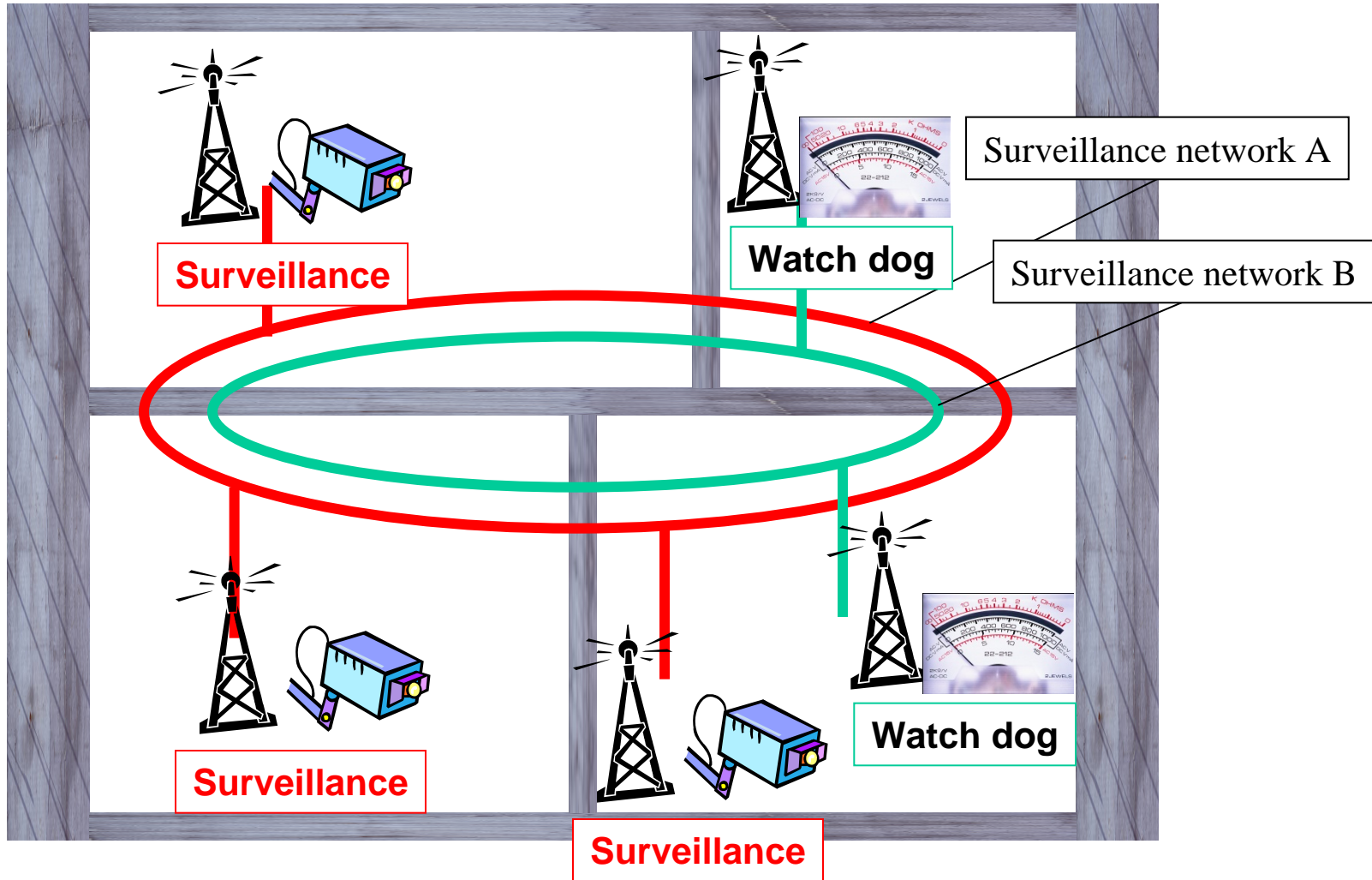
Use Case 3: Outdoor Sub 1GHz Surveillance System



Outdoor Sub 1GHz Surveillance System: Requirements

#	Category	Comment
1	Location	Outdoor
2	Environment type	Urban, Sub-urban
3	STA/non-STA communication	Send/receive (monitor & feedback)
4	Data rate	10 Mbps
5	BER/PER requirement	PER>10%
6	Mobility	Stationary
7	Traffic type	Burst, permanent
8	Security requirement	Medium
9	Reliability	Medium
10	STA/non-STA capacity	STA: 50, non-STA: 20
11	STA/non-STA category	STA: fixed, non-STA: fixed
12	STA/non-STA elevation	STA: 1-2m, non-STA: 2-5m

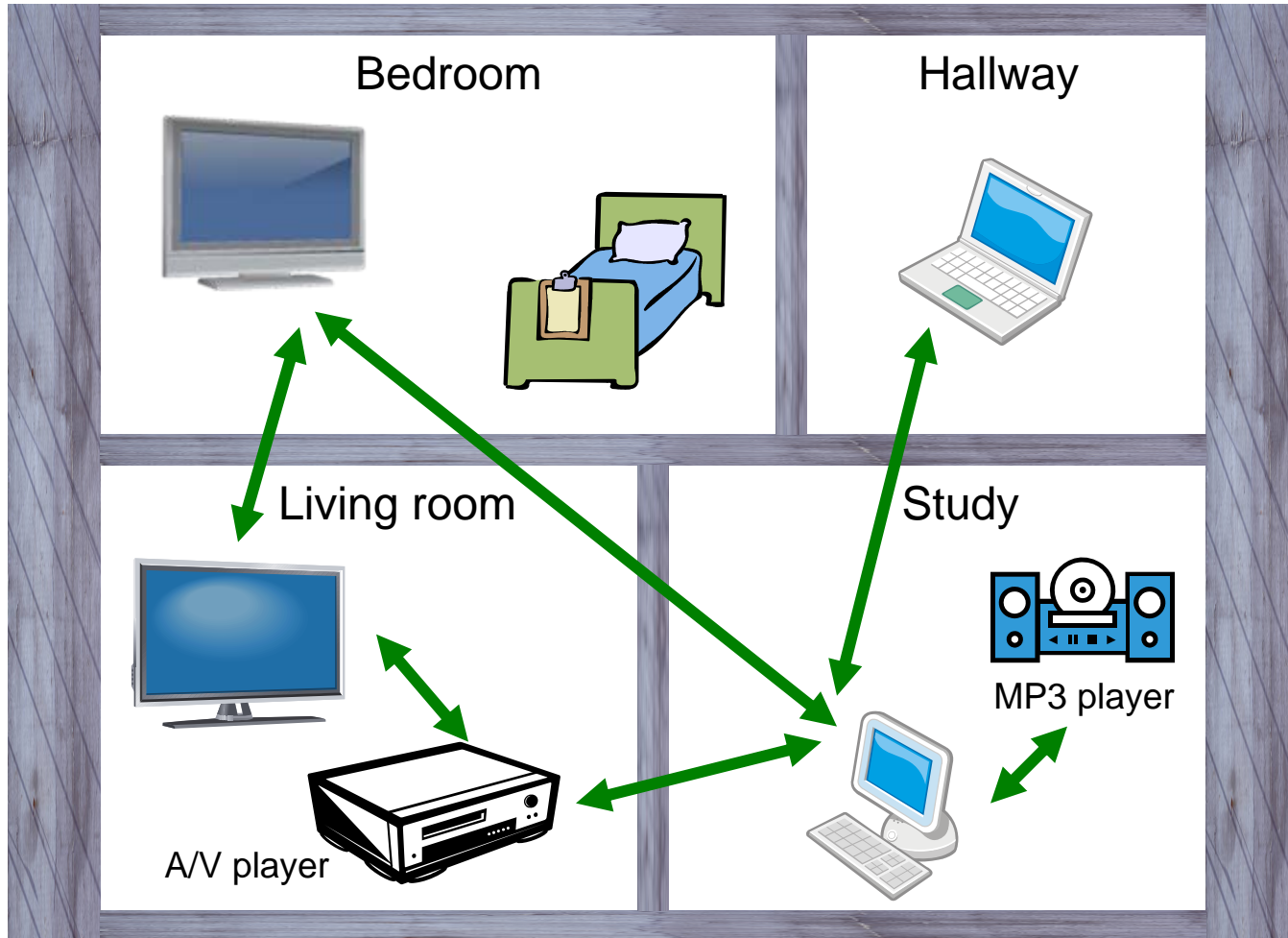
Use Case 4: Indoor Sub 1 GHz Surveillance System



Indoor Sub 1 GHz Surveillance System: Requirements

#	Category	Comment
1	Location	Indoor
2	Environment type	Office, lab, arena
3	STA/non-STA communication	Send (monitor)
4	Data rate	20 Mbps
5	BER/PER requirement	PER>10%
6	Mobility	Stationary
7	Traffic type	Burst, permanent
8	Security requirement	Low
9	Reliability	Low
10	STA/non-STA capacity	STA: 20, non-STA: 10
11	STA/non-STA category	STA: fixed, non-STA: fixed
12	STA/non-STA elevation	STA: 1-2m, non-STA: 2m

Use Case 5: Indoor Media Streaming for Home Entertainment



↔ A/V streaming through a Sub 1GHz link (5/10/20MHz)

Indoor Sub 1 GHz Home Entertainment System: Requirements

#	Category	Comment
1	Location	Indoor
2	Environment type	Home
3	STA/non-STA communication	Send/receive (content & control)
4	Data rate	20 Mbps
5	BER/PER requirement	PER>10%
6	Mobility	Low velocity/stationary
7	Traffic type	Burst, permanent
8	Security requirement	Low
9	Reliability	Low
10	STA/non-STA capacity	STA: 20, non-STA: 10
11	STA/non-STA category	STA: mobile/fixed, non-STA: fixed
12	STA/non-STA elevation	STA: 0.5-1.5m, non-STA: 1-2m

Backup Slides: Video Codecs and Data Rates

H.264 Levels and Profiles

Level	Max macroblocks		Max video bit rate (VCL)				Examples for high resolution @ frame rate (max stored frames)
	per second	per frame	BP, XP, MP (kbit/s)	HiP (kbit/s)	Hi10P (kbit/s)	Hi422P, Hi444PP (kbit/s)	
1	1,485	99	64	80	192	256	128 × 96@30.9 (8) 176 × 144@15.0 (4)
1b	1,485	99	128	160	384	512	128 × 96@30.9 (8) 176 × 144@15.0 (4)
1.1	3,000	396	192	240	576	768	176 × 144@30.3 (9) 320 × 240@10.0 (3) 352 × 288@7.5 (2)
1.2	6,000	396	384	480	1,152	1,536	320 × 240@20.0 (7) 352 × 288@15.2 (6)
1.3	11,880	396	768	960	2,304	3,072	320 × 240@36.0 (7) 352 × 288@30.0 (6)
2	11,880	396	2,000	2,500	6,000	8,000	320 × 240@36.0 (7) 352 × 288@30.0 (6)
2.1	19,800	792	4,000	5,000	12,000	16,000	352 × 480@30.0 (7) 352 × 576@25.0 (6)
2.2	20,250	1,620	4,000	5,000	12,000	16,000	352 × 480@30.7(10) 352 × 576@25.6 (7) 720 × 480@15.0 (6) 720 × 576@12.5 (5)

H.264 Levels and Profiles

Level	Max macroblocks		Max video bit rate (VCL)				Examples for high resolution @ frame rate (max stored frames)
	per second	per frame	BP, XP, MP (kbit/s)	HiP (kbit/s)	Hi10P (kbit/s)	Hi422P, Hi444PP (kbit/s)	
3	40,500	1,620	10,000	12,500	30,000	40,000	352 × 480@61.4 (12) 352 × 576@51.1 (10) 720 × 480@30.0 (6) 720 × 576@25.0 (5)
3.1	108,000	3,600	14,000	17,500	42,000	56,000	720 × 480@80.0 (13) 720 × 576@66.7 (11) 1280 × 720@30.0 (5)
3.2	216,000	5,120	20,000	25,000	60,000	80,000	1,280 × 720@60.0 (5) 1,280 × 1,024@42.2 (4)
4	245,760	8,192	20,000	25,000	60,000	80,000	1,280 × 720@68.3 (9) 1,920 × 1,080@30.1 (4) 2,048 × 1,024@30.0 (4)
4.1	245,760	8,192	50,000	62,500	150,000	200,000	1,280 × 720@68.3 (9) 1,920 × 1,080@30.1 (4) 2,048 × 1,024@30.0 (4)
4.2	522,240	8,704	50,000	62,500	150,000	200,000	1,920 × 1,080@64.0 (4) 2,048 × 1,080@60.0 (4)
5	589,824	22,080	135,000	168,750	405,000	540,000	1,920 × 1,080@72.3 (13) 2,048 × 1,024@72.0 (13) 2,048 × 1,080@67.8 (12) 2,560 × 1,920@30.7 (5) 3,680 × 1,536@26.7 (5)
5.1	983,040	36,864	240,000	300,000	720,000	960,000	1,920 × 1,080@120.5 (16) 4,096 × 2,048@30.0 (5) 4,096 × 2,304@26.7 (5)

MPEG-2 Main Profile and Levels

Abbr.	Name	Picture Coding Types	Chroma Format	Aspect Ratios	Scalable modes	Intra DC Precision
MP (main profile)	Main profile	I, P, B	4:2:0	square pixels, 4:3, or 16:9	none	8, 9, 10

Abbr.	Name	Frame rates (Hz)	Max horizontal resolution	Max vertical resolution	Max luminance samples per second (approximately height x width x framerate)	Max bit rate in Main profile (Mbit/s)
LL	Low Level	23.976, 24, 25, 29.97, 30	352	288	3,041,280	4
ML	Main Level	23.976, 24, 25, 29.97, 30	720	576	10,368,000, except in High profile, where constraint is 14,475,600 for 4:2:0 and 11,059,200 for 4:2:2	15
H-14	High 1440	23.976, 24, 25, 29.97, 30, 50, 59.94, 60	1440	1152	47,001,600, except that in High profile with 4:2:0, constraint is 62,668,800	60
HL	High Level	23.976, 24, 25, 29.97, 30, 50, 59.94, 60	1920	1152	62,668,800, except that in High profile with 4:2:0, constraint is 83,558,400	80

VC-1 Profiles and Levels

Profile	Level	Maximum Bit Rate	Resolutions by Framerate
Simple	Low	96 kbit/s	176 x 144 / 15 (QCIF)
	Medium	384 kbit/s	240 x 176 / 30 352 x 288 / 15 (CIF)
Main	Low	2 Mbit/s	320 x 240 / 24 (QVGA)
	Medium	10 Mbit/s	720 x 480 / 30 (480p) 720 x 576 / 25 (576p)
	High	20 Mbit/s	1920 x 1080 / 30 (1080p)
Advanced	L0	2 Mbit/s	352 x 288 / 30 (CIF)
	L1	10 Mbit/s	720 x 480 / 30 (NTSC-SD) 720 x 576 / 25 (PAL-SD)
	L2	20 Mbit/s	720 x 480 / 60 (480p) 1280 x 720 / 30 (720p)
	L3	45 Mbit/s	1920 x 1080 / 24 (1080p) 1920 x 1080 / 30 (1080i) 1280 x 720 / 60 (720p)
	L4	135 Mbit/s	1920 x 1080 / 60 (1080p) 2048 x 1536 / 24

References

- [1] **IEEE P802.11 Wireless LANs, IEEE 802.11ah Call for proposals, IEEE 802.11-10/1373r0, 11.11.2010**
- [2] **IEEE P802.11 Wireless LANs, Sub 1 GHz license-exempt Use Cases, IEEE 802.11-10/1044r0**
- [3] **IEEE P802.11 Wireless LANs, Additional Use Cases for Sub 1 GHz license-exempt Frequency Bands, IEEE 802.11-10/1458r0**