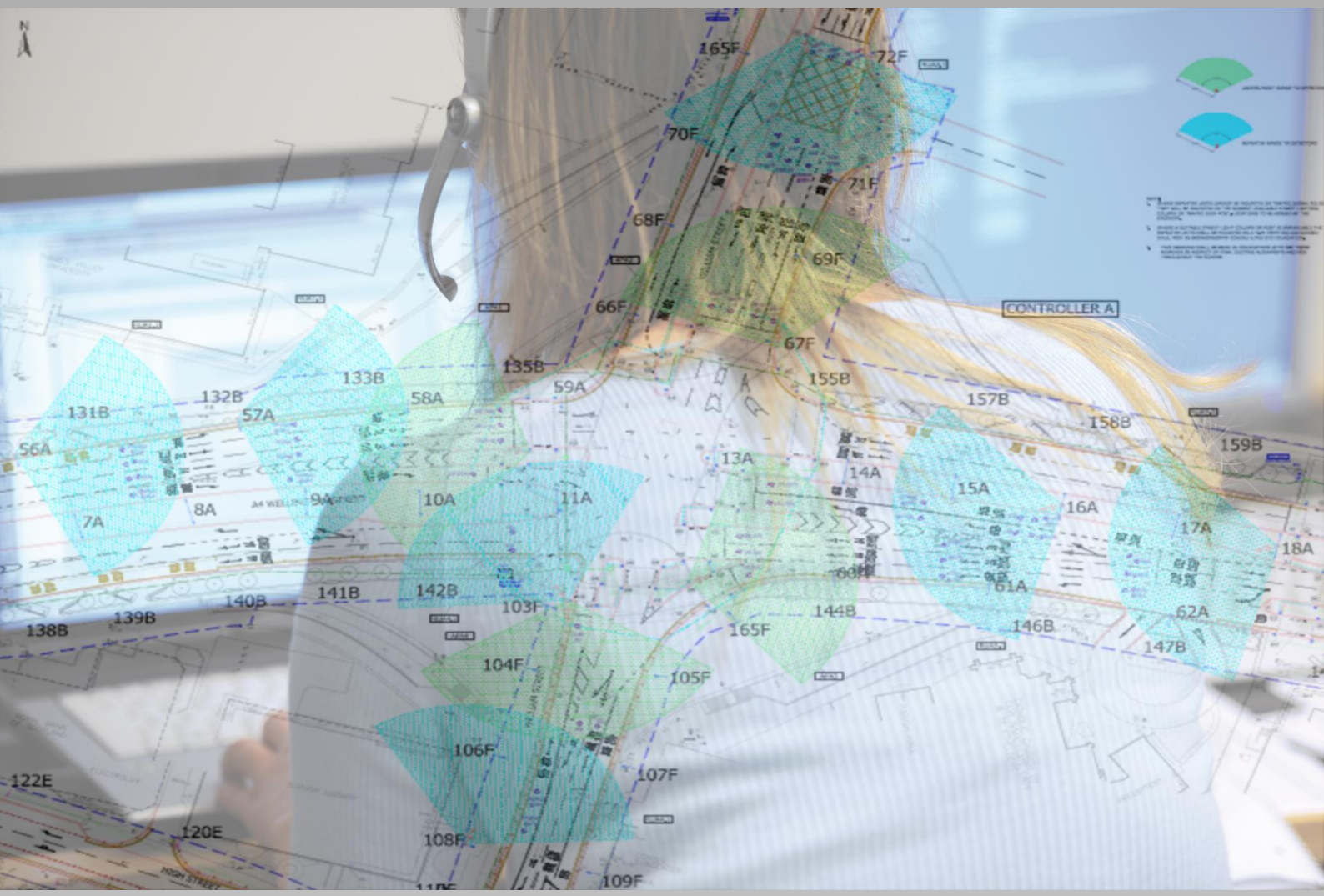
SIEMENS



IPS WIMAG

System Design Guide

July 16

Issue 1

667/HB/47200/001

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Health and Safety Protection

Safety of Installation and Maintenance Personnel

For complete details of the safe installation and operation the reader is referred to the installation and commissioning handbook (667/HB/47200/000).

1. Introduction

1.1. Purpose

This System Design Guide describes the many different ways the basic IPS and WiMag product elements can be used to implement Intelligent Parking for STRATOS (IPS) or a WiMag systems. The following information is provided:

- Overview of the main system elements that are used to build up an IPS or WiMag implementation
- Basic rules for a IPS/WiMag system design
- Example implementations of IPS/WiMag system design.

1.2. Document References

External Document References	
QAPROC-01-000	TS Engineering Glossary
667/CI/52251/000	Quick Start Guide for ProRoute Modem
667/HQ/46000/001	STRATOS Outstation Connection Options Quick Start Guide
667/HB/52250/000	STRATOS Outstation Installation and Commissioning Handbook
667/CI/47230/000	WiMag Signal Head Mounting Bracket Installation Instructions
667/CI/47235/000	WiMag Banded Pole Mounting Instructions
667/PA/47200/000	Global Service Support Plan
667/CC/47200/000	Parking Sensor Installation Instructions
667/HB/47200/000	WiMag User Handbook
667/HB/52800/000	User Manual for IPS On Street Equipment
667/HK/47200/ETC	WiMag Junction Configuration Spreadsheet

Table 1 External Document References

2. System Components

Intelligent Parking for STRATOS (IPS) and the WiMag product range utilise a combination of third party equipment, supplied by Sensys, and Siemens equipments to deliver a wireless sensor solution flexible enough for a wide range of traffic and parking applications.

The sections below summarise the main components that are referenced when putting together the system design.

2.1. IPS/WiMag Sensor device range

	IPS/WiMag Sensor Device Range			
	Standard Vehicle Sensor	**Deep Vehicle Sensor**	**Bicycle Sensor**	**Parking Sensor**
				
Traffic Solutions Part Number	640/4/90028/000 V24764-Z2000-A122	640/4/90028/003 V24764-Z2000-A120	640/4/90028/001 V24764-Z2001-A102	640/4/90028/002 V24764-Z2001-A104
Sensys Part Number	VSN240-F-2	VSN240-F-GR	VSN240-M-2	VSN240-MP-2
Description	• Magnotometer based • Standard vehicle detection • Count, presence (max 30 mins) • Length • Speed[α]	• Magnotometer base • Standard vehicle detection • Count, presence (max 30 mins) • Length	• µR based • Bicycle detection • Count, presence (max 30 mins)	• µR based • Parked vehicle detection • Presence (indefinite)
Installation	• Flush mounted installation	• Installation up to 12cm below road surface	• Flush mounted installation	• Flush mounted installation
Performance Range **5m Mounting**	• Range to Std/flex Repearter/AP is 30m	• Range to Std/flex Repearter/AP is 25m	• Range to Std/flex Repearter/AP is 30m	• Range to Std/flex Repearter/AP is 30m
Performance Range **6m Mounting**	• Range to Std/flex Repearter/AP is 45m	• Range to Std/flex Repearter/AP is 40m	• Range to Std/flex Repearter/AP is 45m	• Range to Std/flex Repearter/AP is 45m
*Assumes mounting height of repeater/AP is 5m [α] Feature is used in DE market only				

Table 2 : IPS/WiMag Sensor Device Range

2.2. IPS/WiMag Repeater device range

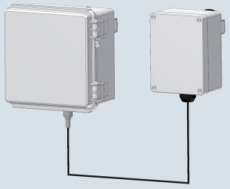
	IPS/WiMag Repeater Device Range	
	Standard Repeater	**Flex Repeater**
		
Traffic Solutions Part Number	640/4/90029/000 V24764-Z2004-A101	640/4/90029/004 [α] V24764-Z2000-A124 [α Δ]
Sensys Part Number	RP240-BH-LL-2	FLEX-RP-B-LL-2
Description	• Long Life • Non-replaceable battery	• Long Life[Δ] • Non-replaceable battery[Δ]
Installation	• 5m minimum • Range of pole mounting brackets available	• 5m minimum • Range of pole mounting brackets available
Performance **5m Mounting**	• Range to Ver 2 sensor is 30m • Range to Std/Flex RP/AP is 180m[Δ] • 120 degree for sensors and upstream RP/AP	• Range to Ver 2 sensor is 30m • Range to Std/Flex RP/AP is 180m[Δ] • Separate 120 for sensors and 120 for upstream RP/AP
Performance **6m Mounting**	• Range to Ver 2 sensor is 45m • Range to Std/Flex RP/AP is 240m[Δ] • 120 degree for sensors and upstream RP/AP	• Range to Ver 2 sensor is 45m • Range to Std/Flex RP/AP is 240m[Δ] • Separate 120 degree for sensors and upstream RP/AP
[α] Requires and assumes std external antenna (V24764-Z2000-A125 : FLEX-ANT-1) [Δ] DE part is currently short life battery version		

Table 3 : IPS/WiMag Repeater Device Range

2.3. IPS/WiMag Access Point range

	IPS/WiMag Access Point Device Range		
	Standard Access Point	**FlexControl**	**SPP**
			
Traffic Solutions Part Number	640/4/90030/001 V24764-Z2003-A100	640/4/90030/150	640/4/90030/150
Sensys Part Number	AP240-E	FLEX-CTRL-M	APCC-SPP
Description	• 48V DC over POE	• Controls one or two radios (SPP) • 12V /24V DC	• Wireless inteface for FlexControl • Power over interface cable
Installation	• 5m minimum • Range of pole mounting brackets available	• Cabinet Mounted • DIN and bracket mounting	• 5m minimum • Range of pole mounting brackets available
Performance **5m Mounting**	• Range to Ver 2 sensor is 30m • Range to Std/Flex RP is 180m [α] • 120 degree for sensors and upstream RP	• Wired range to SPP 30m • Can manage two SPP radios**	• Range to Ver 2 sensor is 30m • Range to Std/Flex RP is 180m [α] • Separate 120 degree per attached radio
Performance **6m Mounting**	• Range to Ver 2 sensor is 45m • Range to Std/Flex RP is 240m [α] • 120 degree for sensors and upstream RP	• Wired range to SPP 30m • Can manage two SPP radios**	• Range to Ver 2 sensor is 45m • Range to Std/Flex RP is 240m [α] • Separate 120 degree per attached radio
[α] Requires and assumes std external antenna (V24764-Z2000-A125 : FLEX-ANT-1)			

** Requires at least one SPP radio 640/4/90030/150 (APCC-SPP)

Table 4 : IPS/WiMag Access Point Device Range

2.4. IPS/WiMag Interface Cards Device Range

	IPS/WiMag Interface Device Range			
	Standard Interface Card	**Loop Detector Replacement Card**	**BVD Interface Card**	**STRATOS Outstation (parking only)**
Traffic Solutions Part Number	667/1/47221/000	667/1/47280/000	S24734-A629-A1	667/1/52250/005 667/1/50070/001
Description	• 20 sensor traffic controller interface • GSPI protocol • BVD software • ST950	• 4 sensor traffic controller interface • Solid State Relay (SSR) • BVD Software • ST800/ST9XX • Builtin PoE for two AP	• 20 sensor traffic controller interface • Open Collector Outputs • BVD software • C8x0 / C9x0	• 200 sensor STRATOS interface • XML-RPC • Open VPN
Installation	• 19” rack mounting • 24V AC/DC (via GSPI or backplane)	• 19” rack mounting • 24V AC/DC (via std backplane) • UK Std Loop Detector Backplane	• 19” rack mounting • 24V AC/DC (via system bus)	• 19” rack mounting • 240VAC

Table 5 : IPS/WiMag Access Point Device Range

3. Implementation Workflow

3.1. Overview

The successful implementation of a WiMag or IPS installation requires a number of steps to be fulfilled correctly. Figure 1below outlines the recommended workflow. The first step, confirm design, is pivotal and relies on an accurate site design document. Poor system design techniques are likely to causes delays in the implementation. Any improper installations, for example due to poor positioning of equipment, are almost certainly going to impact time and costs negatively, as the errors are rectified.

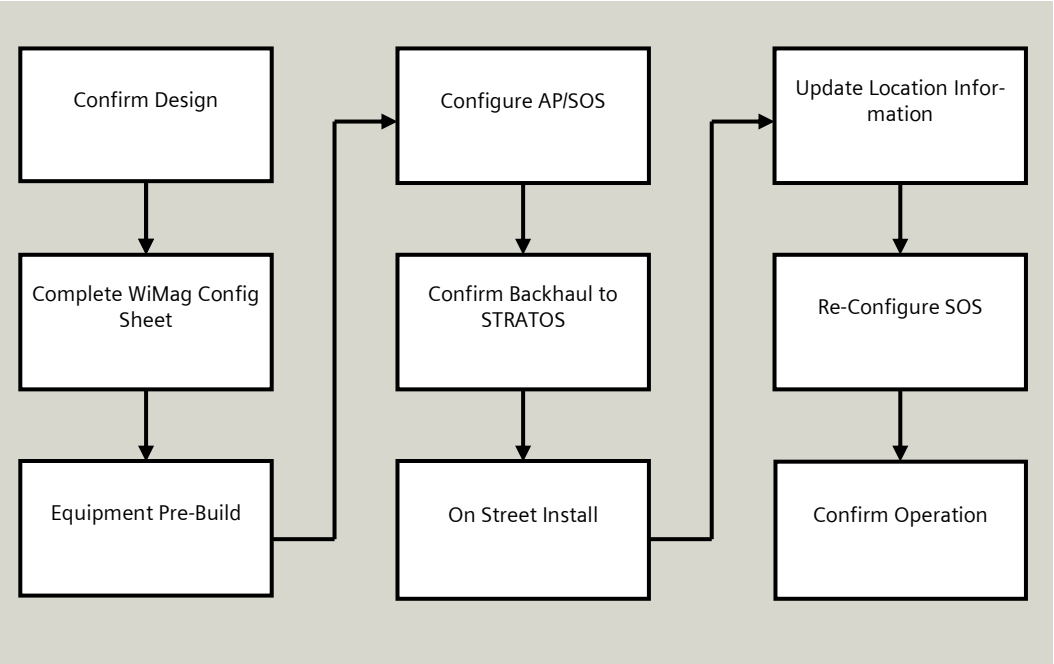


Figure 1 : Implementation Workflow

4. Basic Rules for IPS/WiMag System Design

4.1. Main Considerations – Roadside Equipments

The main considerations when designing a WiMag system are;

- **Range** - Sensor to Access Point, Sensor to Repeater, Repeater to Access Point
- **Line of Sight** – Each element is expected to have clear line of sight (LOS) to the next element in the design (traffic not included)
- **Angles** – The default viewing angle of each wireless element is 120 degrees. The range of AP radio and repeaters allows the system designer to optimize for installation specifics.
- **Height** – The minimum recommended installation height for Access Points and Repeaters is 5m. There are a range of mounting options available to ensure this can be achieved. Improve performance (signal and/or range) can be achieved by higher installation heights.

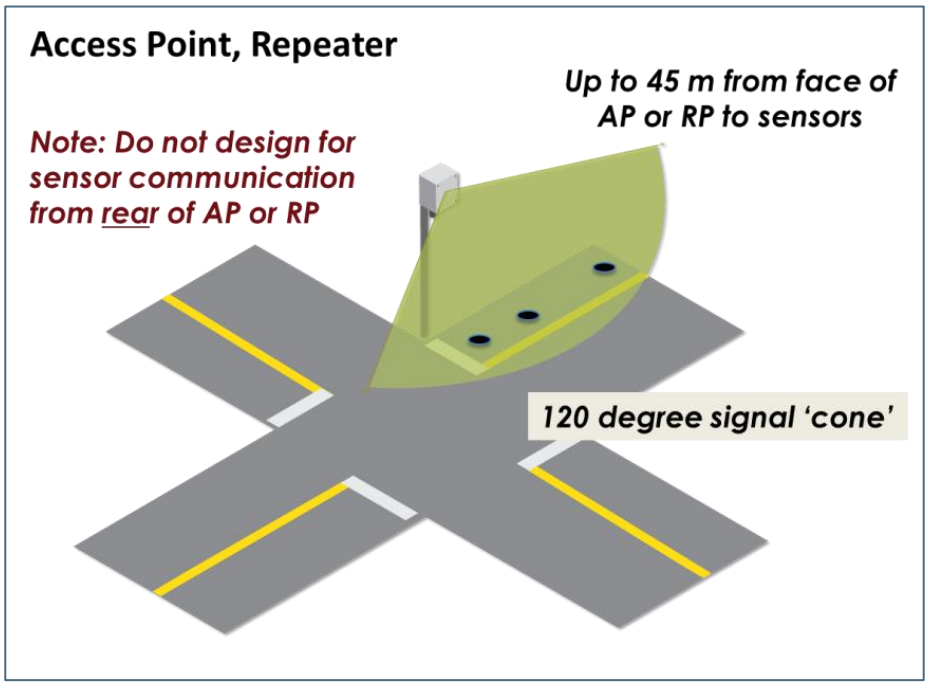


Figure 2 : 120 degree signal 'cone'

4.2. Range and Angle

The design process starts with locating the sensors in the required locations. This is dependant on the aim of the sensors (stop line, VA approach, count, SCOOT etc).

On the design drawing, place the standard Access Point (AP240E) at locations that are likely to be considered easiest for installation/maintenance. Examples are, the traffic pole/cantilever nearest to the controller cabinet. It normally expected that only a single AP is required per junction.

If a FlexControl is to be used, two SPP's can be employed in the junction design.

For each AP/SPP highlight a cone that is 120 degrees and represents 30m radial distance .

Angle the AP so that the highlighted cone overlaps the maximum number of sensors.

Note

Each SPP radio is the equivalent to having a AP, with respect to range and coverage angle. The fact that a FlexControl can mange two SPP radio's provides the designer with added flexibility in site design.

Standard Repeater

Any sensors that are beyond the 30m cone, will require at least a standard repeater to be situated beyond the sensor(s).

For each standard repeater added to the design, add two 120 degree cone that represents 30 m and a 180m radial distances (both in the same direction).

Ensure that the 30m cone overlaps the sensor and that the 180m cone overlaps the AP/SPP.

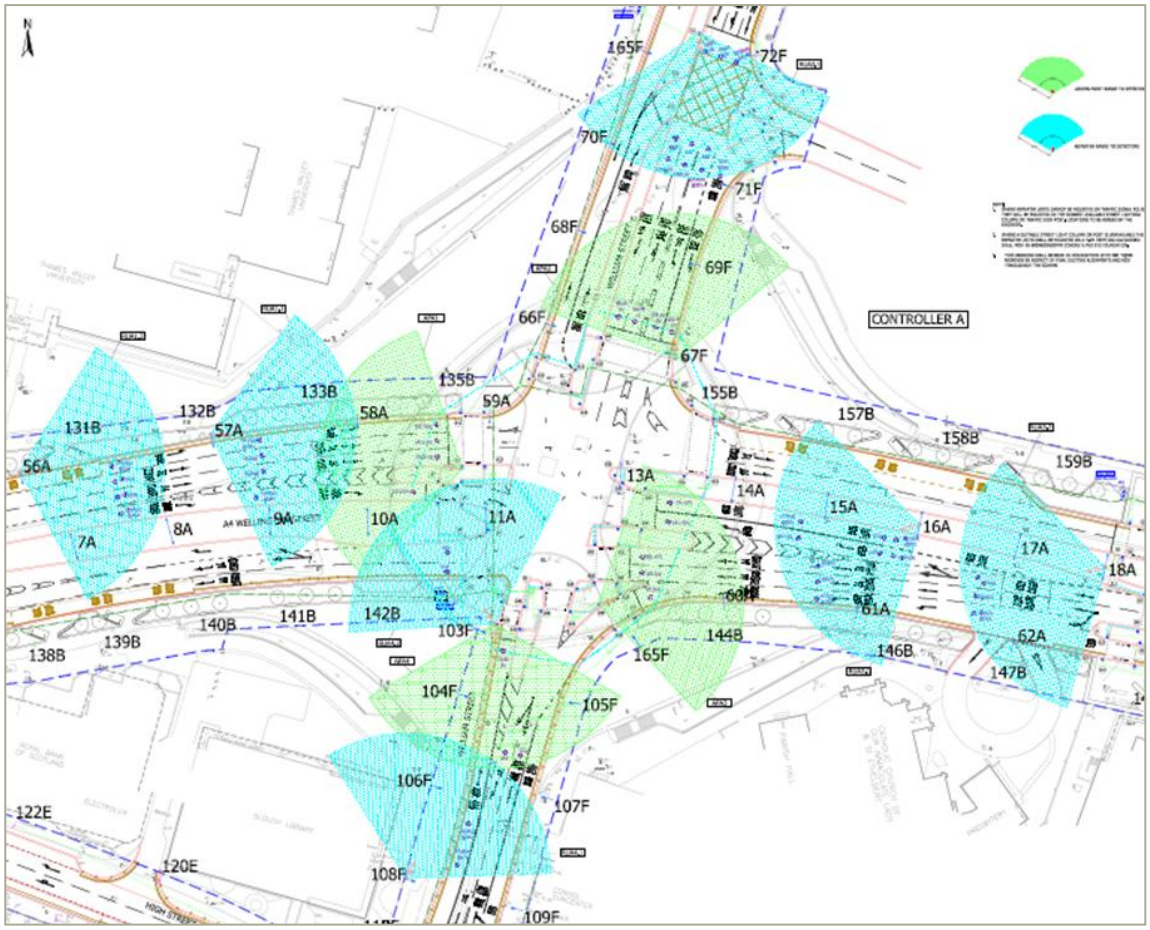


Figure 3 : Example Design with 120degree AP and RP Cones

If there some sensors that are within the 30m distance of the AP/SPP, but are not covered by the alignment chosen for the AP/SPP, then a standard repeater can be placed close to (<1m) the AP/SPP (known as a back 2 back arrangement) and aligned to cover those sensors.

If the sensors are not covered by the alignment chosen for the AP/SPP and are beyond 30m, then a standard repeater could be mounted close to (<1m) the AP/SPP and second located beyond the sensors, by no more than 30m.

The far repeater must have the 120 degree cone overlap the sensor and the also the repeater that is located close to the AP/SPP.

Note

If the APs and RPs are mounted 6m above the road surface, then the 30m radial cone can be **extended to 45m**.

Flex Repeater

The Flex Repeater can be used to get round difficult angels and/or distances.

One antenna is used to backhaul (default is the external antenna) and the other is used to 'see' the sensors.

Examples for Flex Repeater use are;

- Sensors located beyond the 30m AP/SPP range but less than 210m, but also outside of the 120 degree AP/SPP cone. The Flex Repeater can be placed within 30m of the sensors and up to 180m of the AP/SPP. The advantage is that the flex-repeater can be placed in a position that allows two independent 120 cones to be used.

- To locate a repeater such that it is located more optimally for a design such as if a standard repeater located beyond the sensors does not have LOS, or requires additional mounting infrastructure installed.

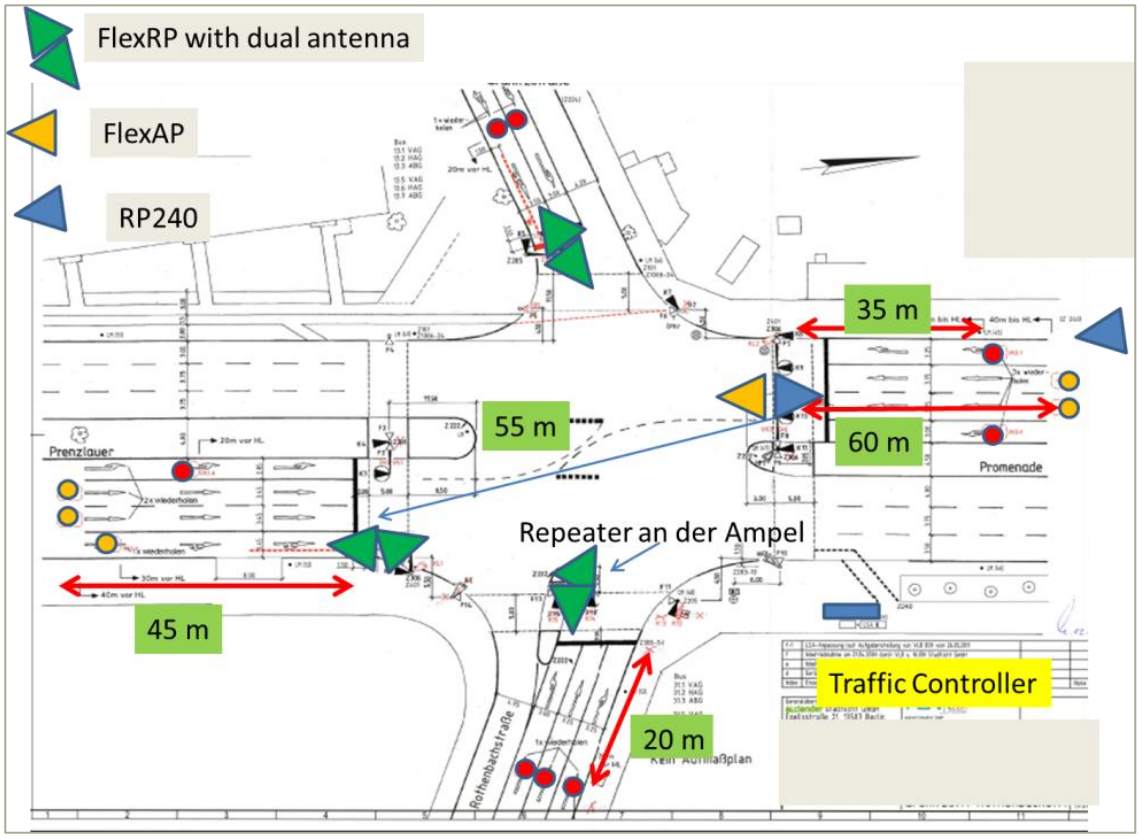


Figure 4 : Example locations of three flex-repeaters

5. System Design Specifics for IPS

5.1. Overview of Parking Design Configurations

The parking system will have the 'Transmit Interval' set to **1 second**. This will allow for the following;

- **250 sensors** – There will be 512 time slots total which has a theoretical of limit of 432 sensors. However, the IPS gateway performance is the limiting factor.
- **15 repeaters** – per SPP which is 30 repeaters per FlexController
- **4m apart** – is the sensor spacing in linear, un marked, parking arrangements.

Alongside this the 'double timeslots' will be considered the default setting for Parking Applications. The result of this, in combination with the 1 second 'Transmit Interval, is as follows;

- A first stage repeater can support **160 sensors**. The 160 supported sensors include those that are derived from repeaters further upstream.
- A second stage 'tandem' will support a maximum **96 sensors**
- Third stage repeater will take **64 sensors**

Note

Higher figures can be derived from increased transmit intervals, but the latency is increased accordingly.

5.2. Linear Parking Groups

The parking applications are categorised into two formats namely linear and grouped.

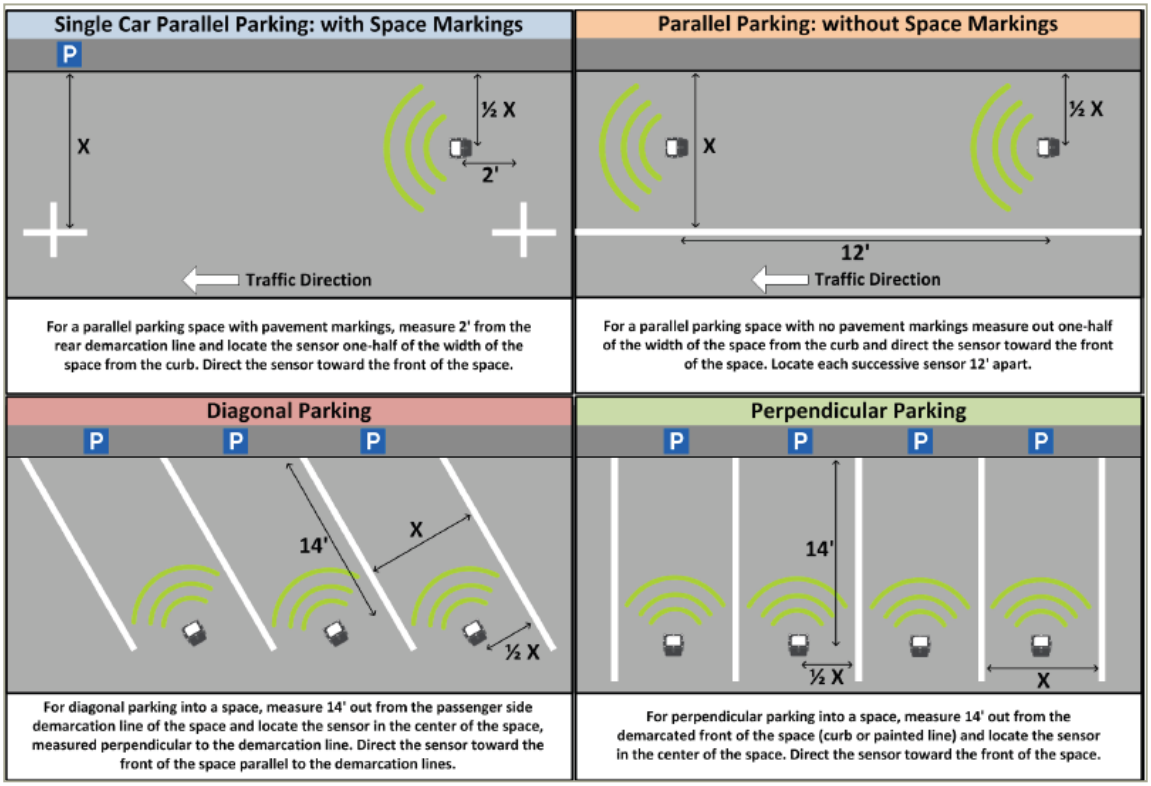


Figure 5 : Example Vehicle Parking Configurations

The linear parking groups (parallel parking), both marked and un-marked, will tend to lend themselves to the use of both Standard and Flex Repeaters. This due to the nature of the antenna performance which has a antenna beam pattern of 120 degrees over a range of ~30m (40m if the repeaters are installed at 6m).

If the AP is installed towards one end of a linear parking zone then the use of Standard Repeaters are expected (Figure 6).

However, if there is a 'jump' between the AP and the repeater, in which there are no sensors , the first repeater that should be chosen is a Flex Repeater (Figure 7).

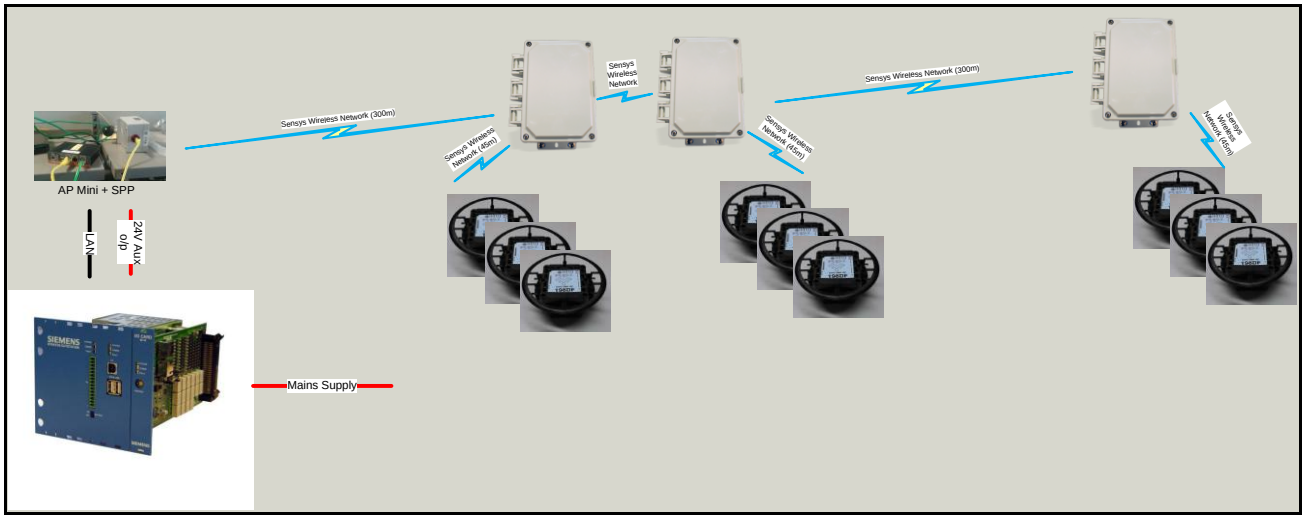


Figure 6 : Linear Parking Arrangements Using Standard Repeaters

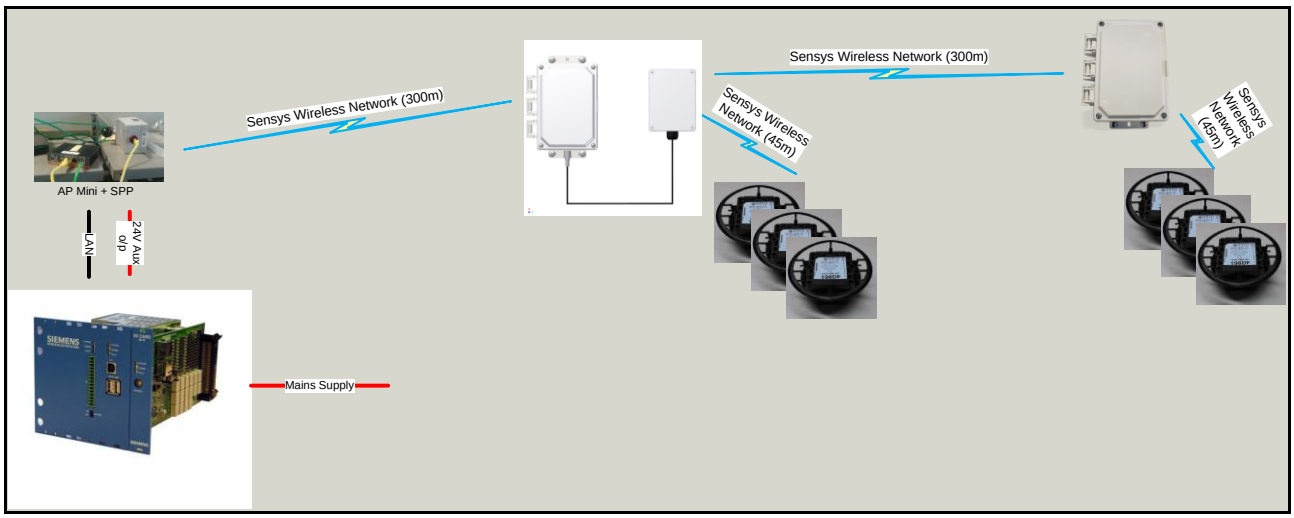


Figure 7 : Flex Repeater Installation Scenario

5.3. Sensor Location

The positioning of the sensor must be carefully considered during the design stage.

Figure 8 below highlights some of the recommended sensor positions.

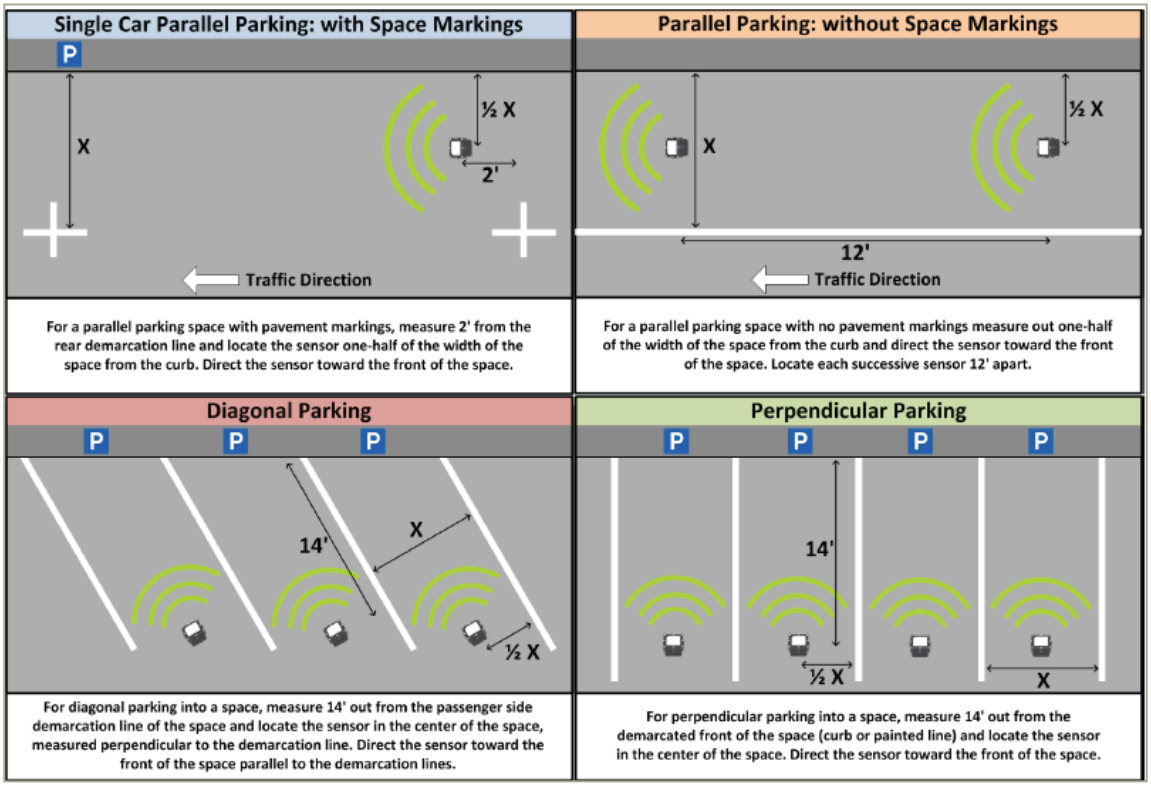


Figure 8 : Sensor Locations Examples

Note

For parallel parking without space markings, the first sensor is normally expected to be installed at least 2m from the start of the unmarked parking block delineator.

6. Design Output

6.1. WiMag Configuration Sheet

The configuration of the WiMag and IPS can be a very complex process, for an untrained user. In order to assist the installers/commissioning team, Siemens has developed a 'configuration tool'.

The tool is a spreadsheet that simplifies the configuration of a junction installation.

The configuration uses a series of macros to generate a number of configuration files. One is used to 'auto-configure' the AP/FlexControl device and the other is used to configure the STRATOS Outstation when an IPS application is required.

6.2. Output Data

The system design must be able to generate the following data;

- **Location of sensors** – This information is used for inventory and mapping, in the case of and IPS application.
- **Location of AP/SPP** – This is used for inventory management
- **Sensor and AP/SPP Identification** – this is not the sensor ID but a user defined ID or Name.

Note

The location data for IPS applications must be in Easting/Northing format and must be accurate to within 25cm of actual position.

This positioning data will be used to map the senor onto the customer/user map.

A Appendix

A.1 Key Terms and Abbreviations

	Key Terms and Abbreviations
AP	Access Point
BMS	Business Management System (Siemens Electronic Document Storage Tool for Process Documents)
IPS	Intelligent Parking for STRATOS
LOS	Line of sight
MOL	Mobility
N/A	Not Applicable
NC	No Connection
RP	Repeater
SOS	STRATOS Outstation
SPP	Serial Port Protocol – Sensys name for radio part of an Access Point system
TS	Traffic Solutions (Mobility)
µR	MicroRadar
WiMag	Wireless Magnotometer

Table 6 Terms and Abbreviations

A.2 Example Configuration for AP/FlexControl ‘Auto Configuration’

Radio,FinalChannel,,,,

SPP0,1,,,,

dotID16,parent,isRP,currentUP,currentDWN,newDWN

13E9,81E3,FALSE,0,,

81E3,SPP0,TRUE,4,5,2

A.3 Example of generated SOS Configuration

Type,NAME,Position X,Position Y,Position Z,device ID,channel,colour,parent device

STUD,SEN1,789,12,0,13E9,2,0,81E3

REPEATER,RP1,123,456,0,81E3,1,0,207B

AP,SPP0,0,0,0,207B,1,0,0

More information

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