

# Training Presentation

## Public Address and Voice Alarm

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# What is a Voice Alarm?

- Provides a secure method of voice reproduction
- Deliver emergency recorded messages instead of bells.
- Deliver emergency live announcements (i.e. Fire Officer).

# Benefits of voice alarm?

- Public take more notice of spoken word than bells or sounders.
- A spoken message identifies the nature of the problem and provides clear instruction.
- Specific and detailed information can be provided (phased evacuation).
- Can be used by emergency services for directing staff or the public.
- Can provide a public address/music system .

# What does it consist of?

- Interface to the fire detection system
- Pre-recorded messages
- Amplifiers
- Loudspeakers
- Fault monitoring
- Battery back-up (allows the system to operate when mains fails)

# What standards apply?

- Primarily regulated by BS5839 (Fire Detection & Alarm Systems for Buildings) part 8 in the UK
- EN60849 (Sound Systems for Emergency Purposes) throughout Europe
- BS7827 (Designing, Specifying, Maintaining & Operating Emergency Sound Systems at Sports Venues)

# What standards apply?

- The Standards cover;
  - The original design of the voice alarm hardware, both central equipment and loudspeakers
  - The planning of the system
  - The performance of the **installed** system
  - The maintenance of the system

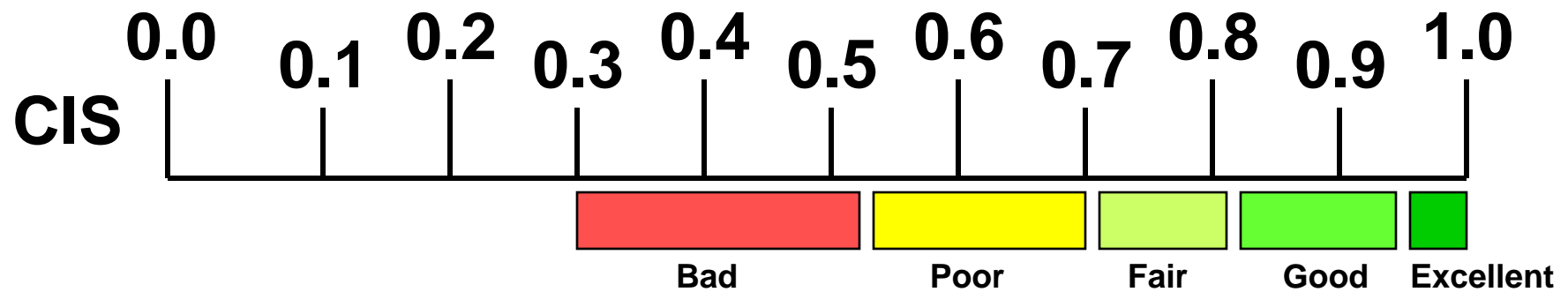
## What are the loudspeaker, selection, placement and intelligibility requirements?

- the messages must be intelligible (clearly heard and ***understood***)
- Speakers need safety features in order to comply with the standard
  - Ceramic terminal block
  - Thermal fuse
- Cabling requirements same as fire alarm sounders.
- Intelligibility defined within BS5839 as meeting CIS (Common Intelligibility Scale) of 0.7 (STI of 0.5) or greater

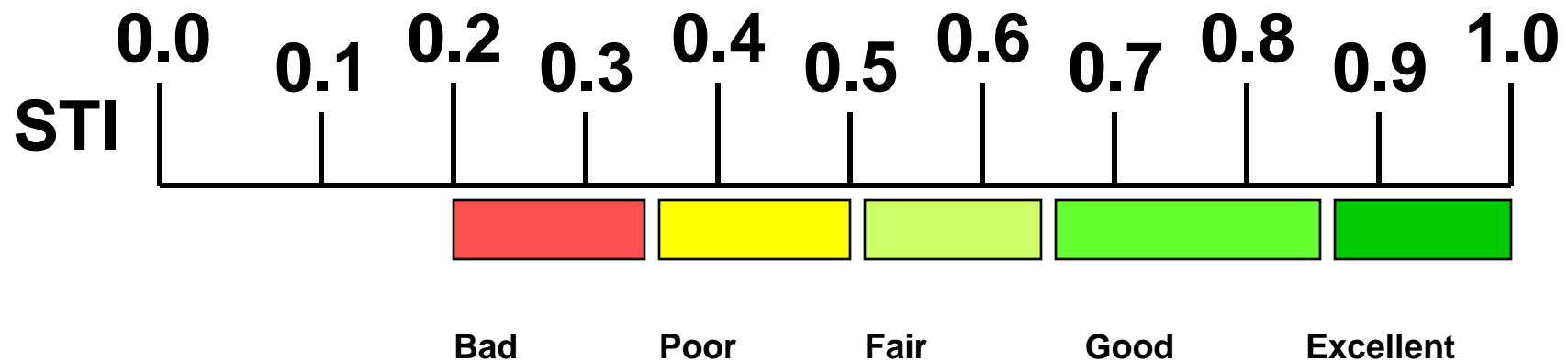
## **Intelligibility in a measurement of how easily understood the **INSTALLED** system is.**

- Can be measured using real people (word scores)
- Can be measured using electronic test equipment (Rapid Assessment of Speech Transmission Index RASTI)

**Common Intelligibility Scale (CIS).** Unifies the most common intelligibility measures into one scale



**Speech Transmission Index (STI)** still referred to often in specifications

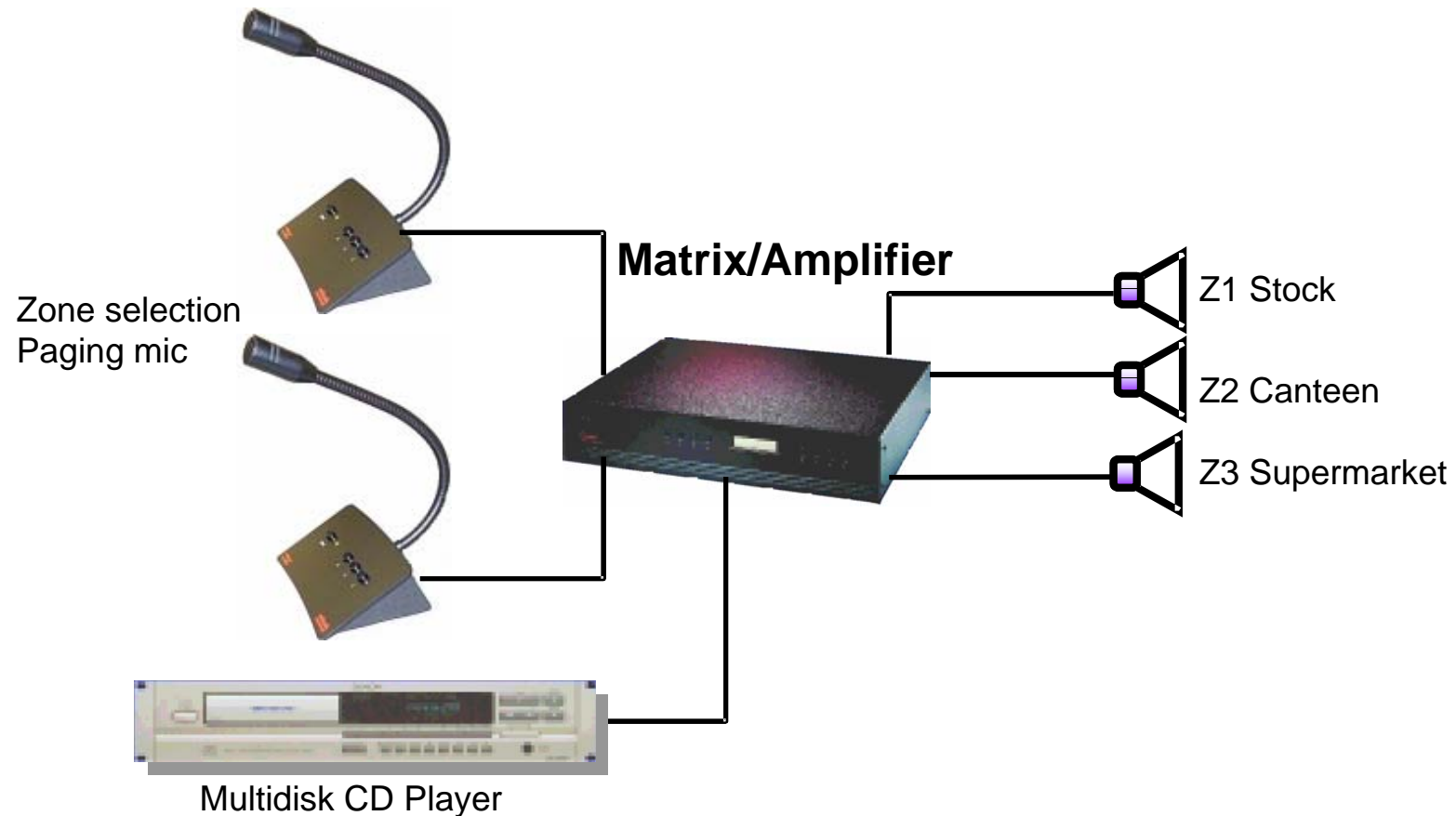


# What are the issues when designing a voice alarm?

- Sound pressure level (SPL) & intelligibility
- Number of inputs.
  - Fire mic
  - Fire Alarm
  - Paging mic
  - Music
- Number of Outputs (Zones)
- Single or phased evacuation
- Distributed (racks located *around* the site) or centralised (one central rack)

# Public Address Overview

# Typical Small Public Address



## Purpose of a PA

- To switch or 'route' audio signals from an announcement station i.e. a microphone to a speaker zone or zones
- Interface various announcement stations and other line level audio inputs such as a CD or cassette player
- Requests for a 'route' from the announcement stations are made to the central processor. The processor manages these requests with regard to their priority.

## The core of a PA system is the Audio Switching Matrix

- The matrix routes the input sources (mic, music etc) to output destinations (speaker zones)
- The matrix can also incorporate message cards for alarms or announcements.
- All parameters (including microphone controls, signal routing, priority settings and fault monitoring) are programmable
- Activating an input controller makes a request to the matrix. The matrix manages the request (source/priority/destination) according to the configuration.

# Input Controllers

- Microphones
  - Desk, wall or equipment rack mounting
  - Single or multiple selection buttons
  - Single button unit (PTT press to talk)
  - Control of microphone or audio source such as a CD player
  
- Controllers
  - Control of audio source such as a CD player
  - Pre recorded messages within the system

# Microphones

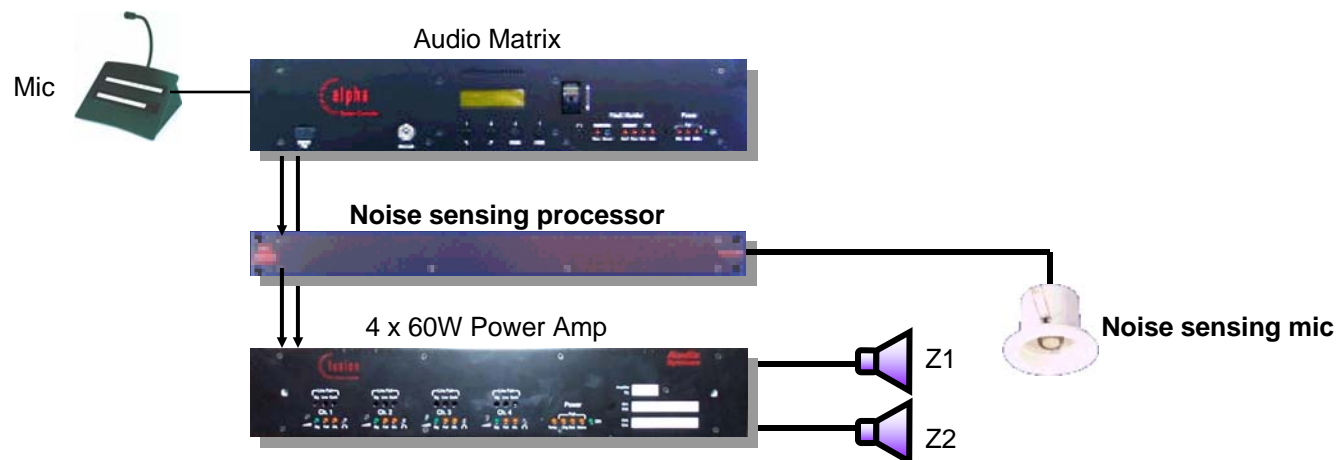
- Typically comprise;
  - Goose neck or fist microphone
  - Zone selectors with busy and confirm LED indication
  - PTT button and speak indicator
  - Microphone to line level pre amplifier. Microphone signals are too small to be transmitted over distance. Need to amplify at the microphone.
  - Audio limiter (boosts quiet voice, reduces loud voice), digital chime and 20KHz-surveillance.
  - All these elements would be housed within the microphone unit.

## Amplifiers

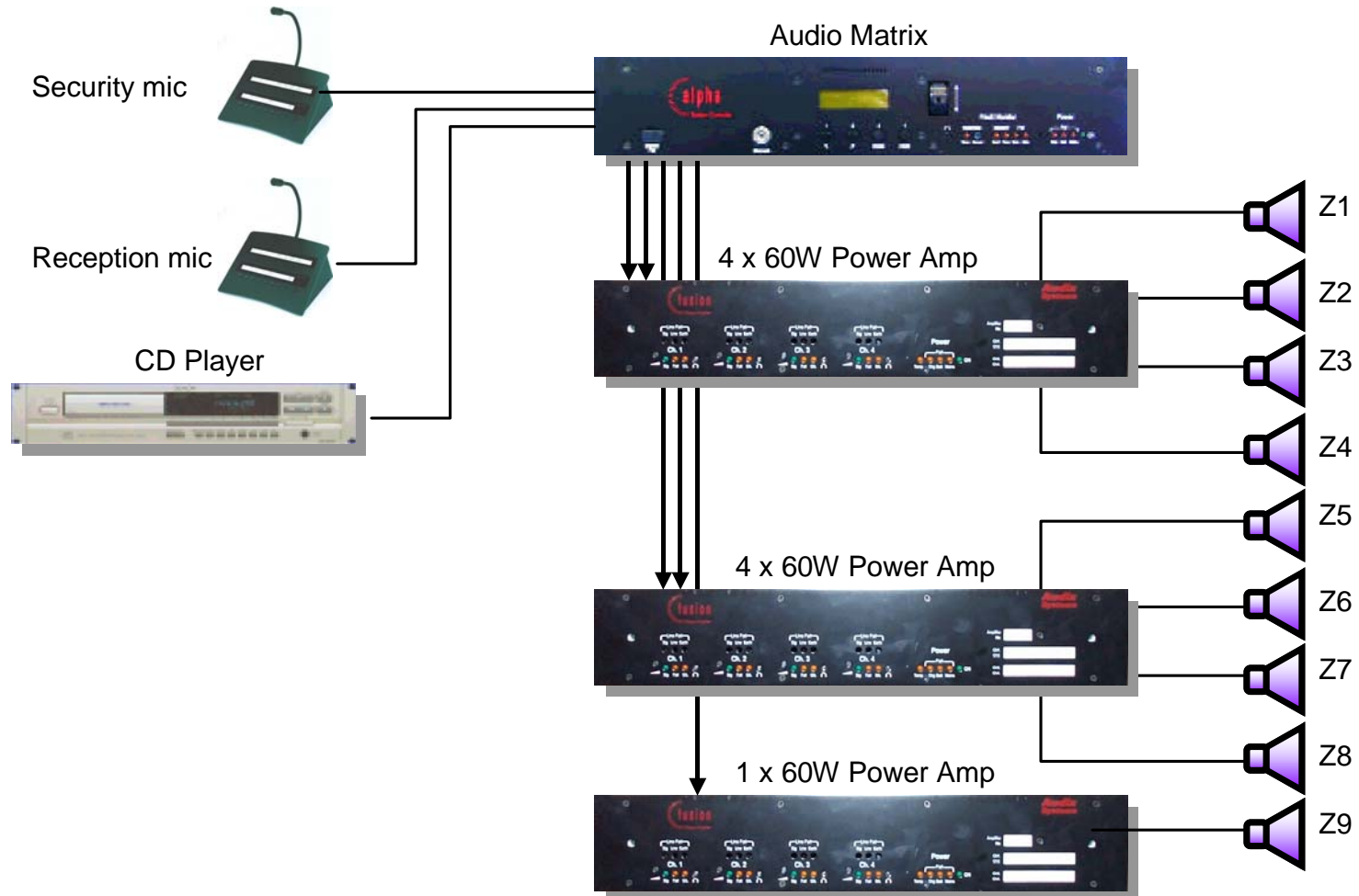
- Grouped together to meet the specific power requirements of each zone.
- Efficient use of output power and reduces the mechanical size of the power racks
- Protected from short circuit speaker lines.
- The amplifiers are protected from being over-driven by thermal cut-out.

# Noise sensing

- Typically used in Airports, Exhibition Halls and Convention Centres or where background noise levels vary
- Provides automatic adjustment of system sound pressure level to compensate for fluctuations in background noise.
- Background noise picked up by microphones in the zone



# Typical Public Address



# Voice Alarm Overview

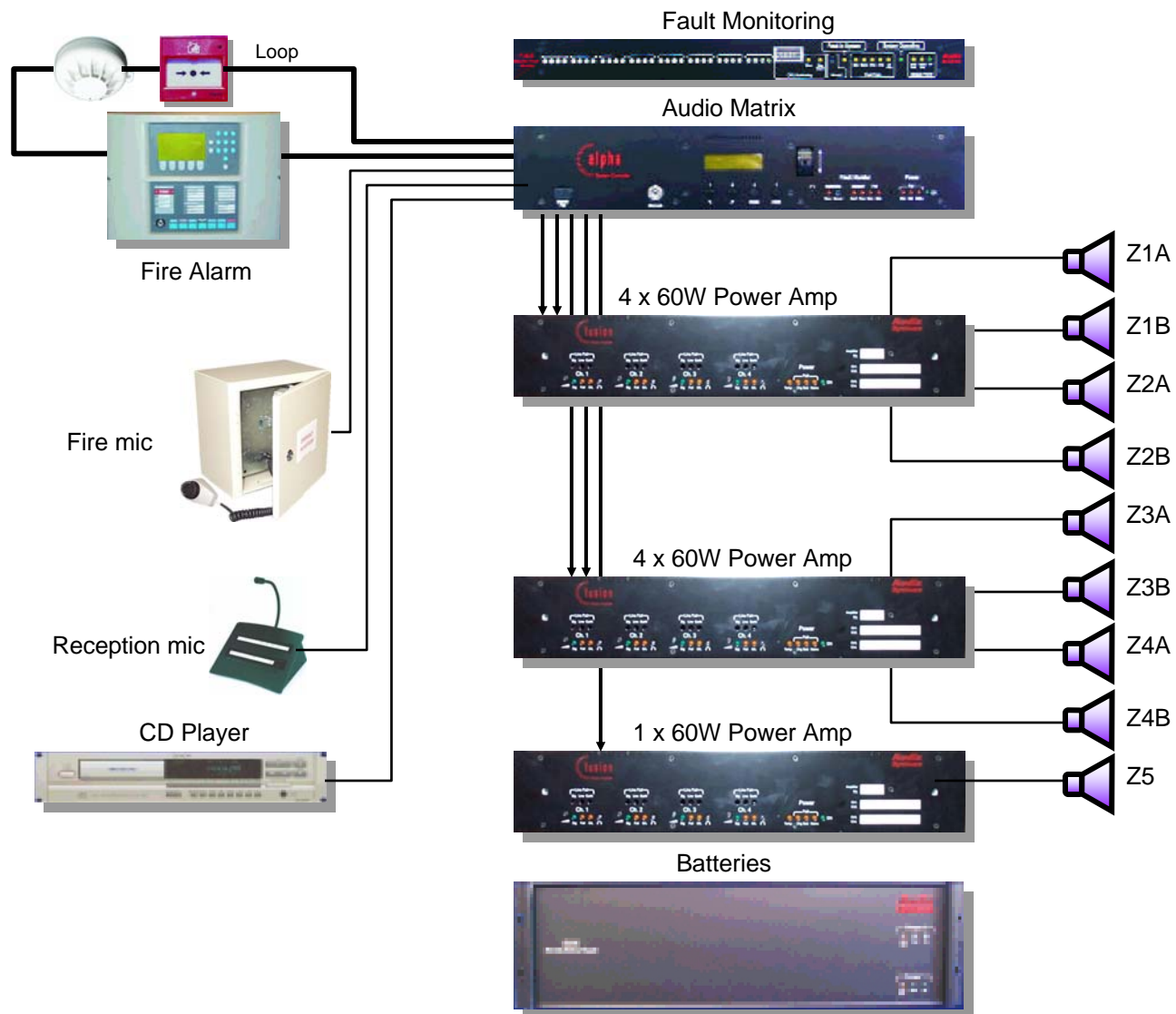
# Voice Alarm

- Voice alarm is basically *Public Address **Plus***
  - + *Fire Interface*
  - + *Fault Monitoring*
  - + *Battery Back-up*
  - + *Voice message storage*
  - + *Fire protected equipment (ie cable, speaker fire domes, ceramic terminals)*

## Fire alarm Interface

- Either;
  - Dry contact relays in the fire panel selecting zones for evacuation/alert
  - The voice alarm can be an addressable Node on a fire alarm's digital bus reducing wiring and programming
- When fire alarm activates, fire alarm interface sends data to matrix, triggers emergency message.
- Any voice and/or alarm message can be recorded and stored

# Typical Voice Alarm

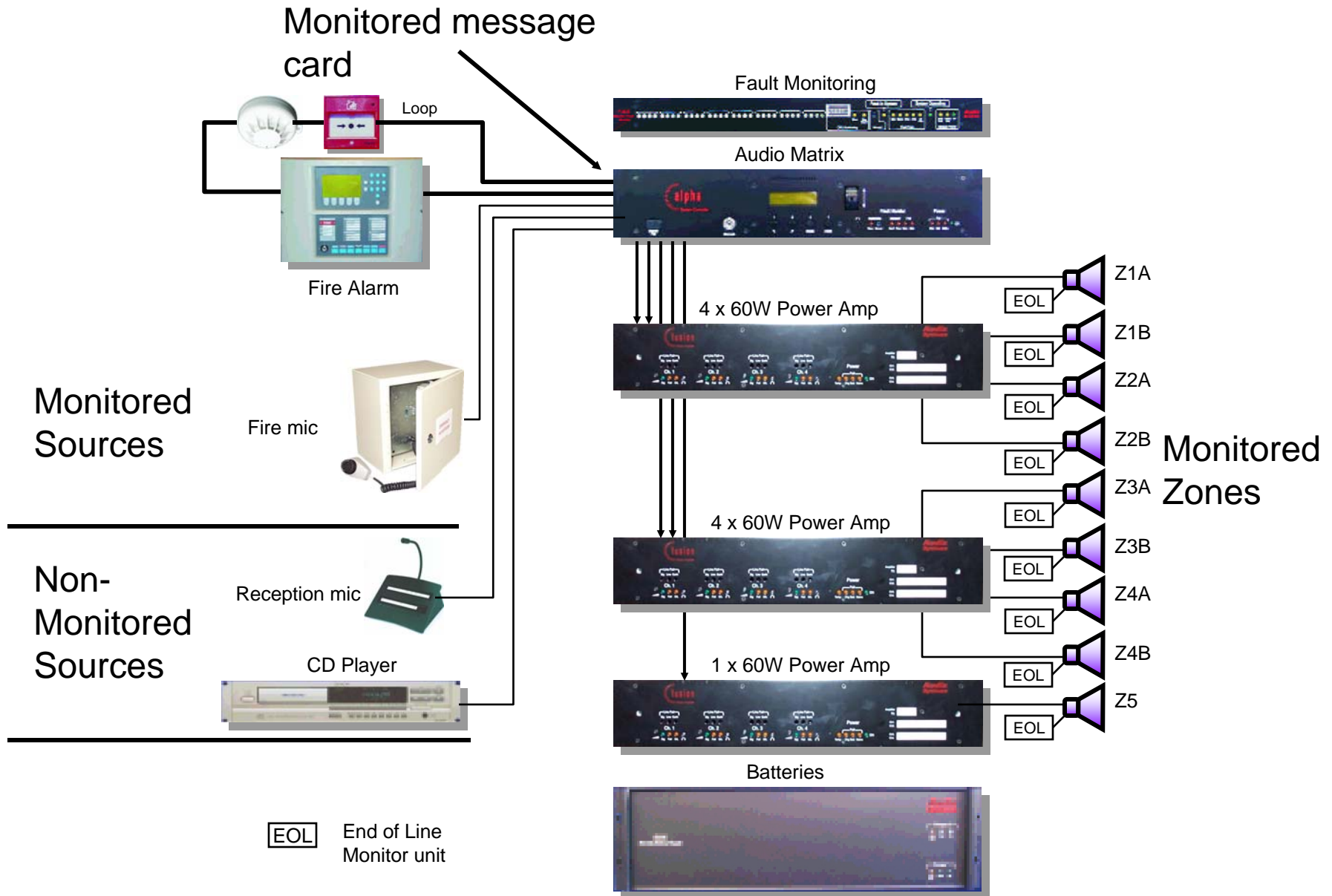


# Fault Monitoring

- Required by BSEN60849
- Must be monitored on critical paths and components (paths through the voice alarm system that rely on equipment and the connections between them to achieve a voice alarm broadcast)
  - Audio paths
  - Data links
  - Control contacts
  - Amplifiers
  - Mains and battery supplies

## Audio surveillance

- Surveillance tone (20kHz) is injected into the audio path via the microphone pre-amplifier or message card.
- This tone follows the same audio path as the microphone signal, through the matrix, amplifier, speaker lines and back to the surveillance detector at the rack.
- If the tone level falls a fault is indicated on the Fault Monitoring Panel on the rack.
- The switching matrix receives up to three sources carrying the surveillance tone and has a number of destination channels requiring surveillance.



## Data Path Surveillance

- Controller microphones or serial interfaces continually polled by matrix.
- On failing to receive a valid response from a serial input, the matrix will report a fault.
- The Matrix provides Fault indications for; Power supply, Battery Supply, and Battery Charger Supply.
- Fault indications for Program and configuration errors in compliance with BS5839.
- The matrix has watchdog circuits (identifies processor errors) on it's CPU and message cards.

## Battery Backup

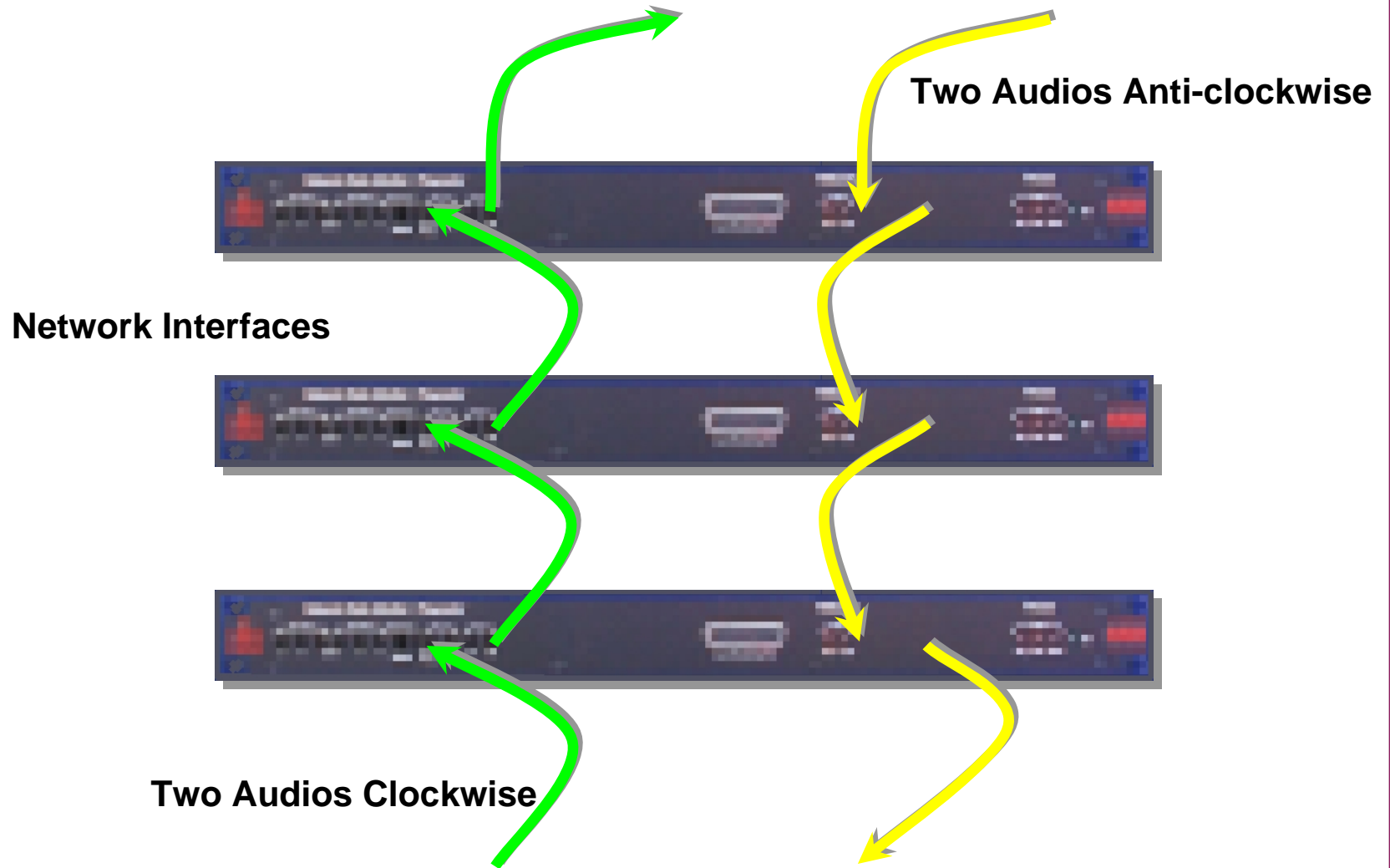
- Voice Alarm Systems require battery Backup to comply with BS 5839 pt 8 or local standards
- Standby battery units provide a self-contained 24V DC supply. Sized to provide the standby supply capability required (more kit = more batteries).
- Typically 24 hours standby (no calls) followed by 0.5 hour Full Alarm

# Network Voice Alarm Overview

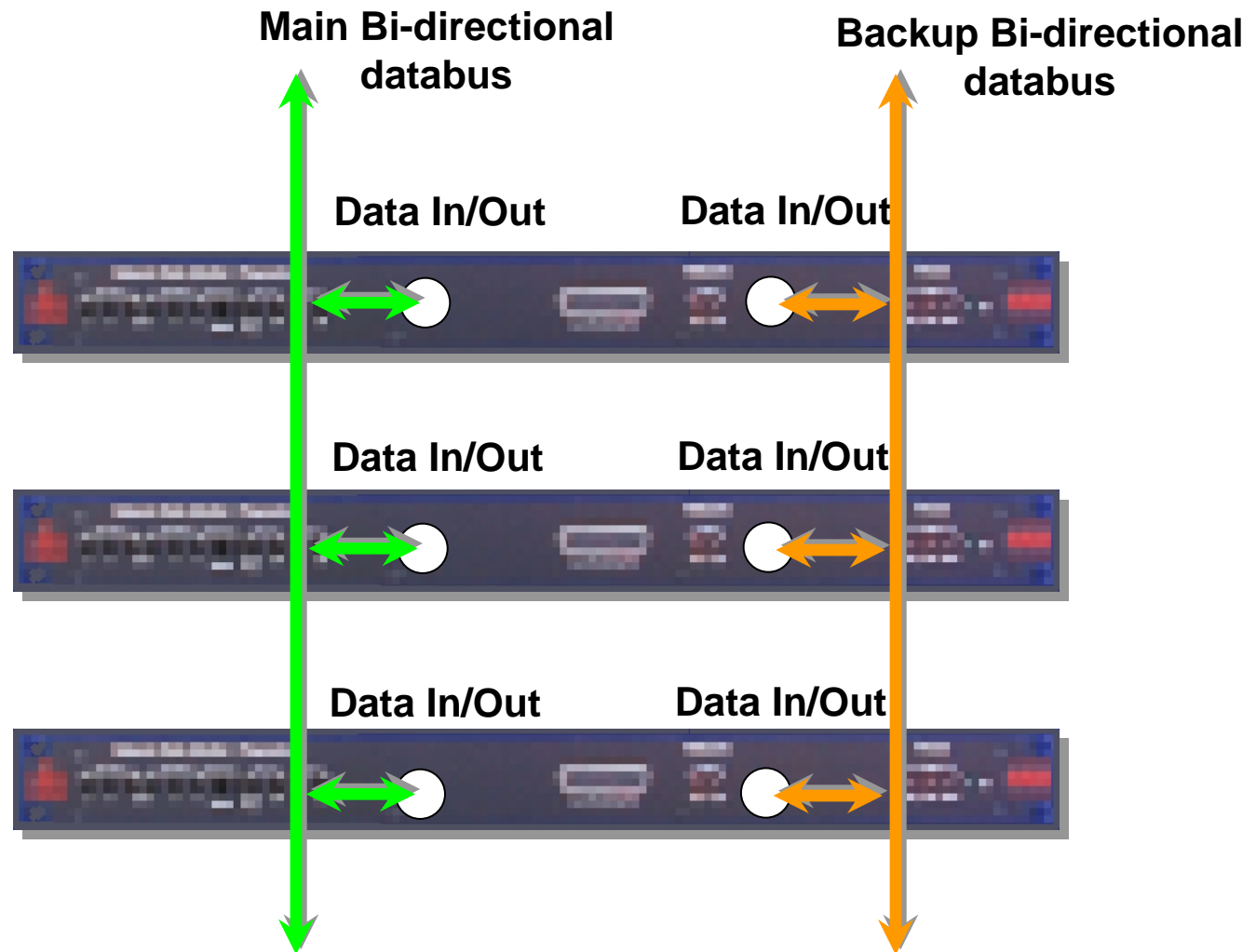
# Voice Alarm Network

- Voice Alarm standards apply to a network if the network is used for Emergency communication.
- Each rack operates as a stand alone equipment.
- Each audio and data line is monitored
- Dual redundancy allows broken lines to be bypassed by automatically switching to the working line
- Each microphone or fire interface on the system can be programmed to access any zone (or group) on the system.
- The whole network can be programmed from any network node
- Network interface unit operates as a physical bypass unit in event of equipment failure or for maintenance.

- Dual redundant Audio lines



- Dual redundant Data lines



# Acoustic Design

# Loudspeakers

- There are 5 main types of loudspeaker;
  - Ceiling mounted .
  - Surface mounted (Cabinet).
  - Column.
  - Projection.
  - Horn

## ***ACOUSTIC DESIGN***

- When selecting loudspeakers for a particular application, there are two basic requirements to take into account.
  - 1) Sound Level
  - 2) Intelligibility
- Output level should be such that messages can be comfortably heard by all people with normal hearing in 95% of the area.
- The information must be intelligible (understood)

## ***SOUND PRESSURE LEVEL (SPL)***

- Sound pressure level (loudness) measured in decibels (dB).
- “Sensitivity” of speaker is a measure of it’s efficiency.
- Sensitivity = SPL at a distance of 1 metre with a speaker input level of 1 watt.

## ***SOUND PRESSURE LEVEL (SPL).*** *How loud it is*

### ■ Power

- Each time the power input to loudspeaker is *doubled* the output level *increases by 3 dB*. E.g.. a loudspeaker having a sensitivity of 90 dB 1W/1m;

$$1W = 90dB (@1m)$$

$$2W = 93dB (@1m)$$

$$4W = 96dB (@1m)$$

### ■ Distance

- Each time the distance from the speaker is *doubled*, sound level will *decrease by 6 dB*. E.g.. a loudspeaker having a sensitivity of 90 dB 1W/1m tapped at 1W;

$$90dB @1m$$

$$84dB @2m$$

$$78dB @4m$$

## ***Intelligibility***

- Voice Alarms should meet the requirements of British Standard BSEN60849
- Meet or exceed a CIS of **0.7**; Speech Transmission Index (STI) of **0.5**
- STI is a measure of how well a broadcast can be understood. 1 = best, 0.1 = worst
- RASTI (Rapid Assessment of Speech Transmission Index) Computer based programme using coded digital “noise”
- Affected by signal to noise, reverberation, time delays (echo)

## ***Loudspeaker positioning***

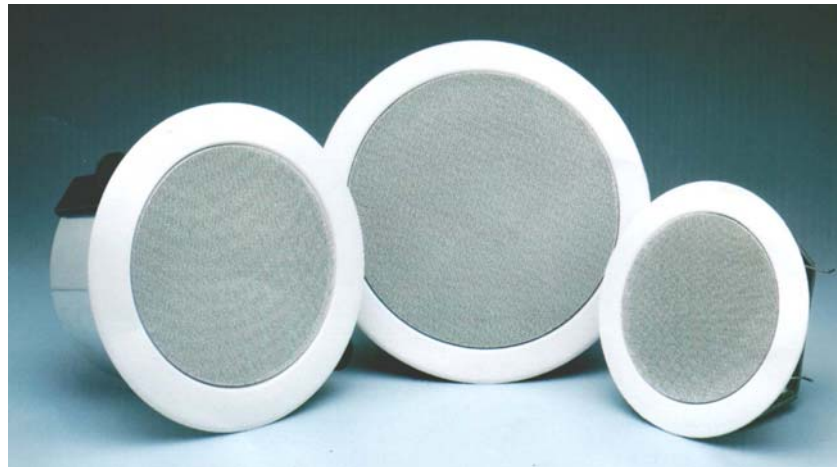
- Loudspeakers should be distributed evenly over the site to avoid local areas of excessive output (too loud) or blind spots (too quiet).

## ***Loudspeaker selection***

- Loudspeakers may be;
  - omni-directional; flush mounting ceiling, cabinet and sphere speakers
  - bi-directional; sound omitted from each end of, typically, a horizontal cylinder
  - uni-directional; horn speakers, columns, phased arrays

## ***Loudspeaker selection***

- **Ceiling Speakers;**
  - flush mounted in suspended ceiling panels
  - spring clips or screws
  - provide good wide coverage



- **Typical applications;**
  - Offices, schools, hospitals, shops, airport lounges

## ***Loudspeaker selection***

- **Cabinet Speakers;**

- Wall/surface mount

- **Typical applications;**

- Escape stairs, store rooms, kitchens



- **Column Speakers**

- More than one cone speaker mounted in an enclosure
  - Typically 4 to 10 cones mounted vertically
  - Creates very directional beam of sound

- **Typical applications;**

- Airport check-in halls, sports halls, churches

# Loudspeaker selection

## ■ Horn Speakers

- Directional beam
- Higher sound pressure levels as they are more efficient
- Ideal for outdoor and industrial use.
- Explosion proof available suitable for hazardous area installation.
- The frequency range small therefore not suitable for high quality music broadcast (except “music horns”!)

## ■ Typical applications;

- Factories, power stations, car parks



# System Check List

## ■ Type of System

- Public address
- Voice Alarm

## ■ Site Conditions

- Industrial;
- Factory
- Warehouse
- Intrinsically Safe
- IP rated
- Marine;
- Cruise liner
- Offshore industrial
- Merchant ship
- Office
- MOD/Military
- Leisure Centre
- Shopping Centre
- Airport

## ■ Type of Job

- New system
- Upgrade to existing system
- Replacement of existing system

## ■ Information provided

- Detailed specification
- Drawings of site including speaker locations
- Zone and loudspeaker tapping schedule
- Drawings of site without speaker locations
- No specification
- Rough specification, no detail
- Bill of quantities

# System Check List

## ■ System inputs

- Messages;
  - Evacuate
  - Alert
  - Test
  - Bomb Alert
  - Security
  - Other
- Microphones;
  - Multiple button microphone
  - Single button microphone
  - Fireman's emergency microphone
  - Rack mounted microphone
  - Custom microphone (ie panel mount)
- Background music
  - CD Player
  - Tuner
  - Cassette player
  - Other music source
- Background music zone controller
- Fire alarm interface
  - Digital loop Interface
  - Closing contacts
- Telephone interface
  - Telephone interface with zone selection
  - Telephone interface without zone selection

# System Check List

## ■ System outputs

- Number of Zones
- A & B Circuits?
- Volume controls
- Zone loading
- Induction Loops;
  - Desk top
  - Small area
  - Medium area
  - Large Area
  - Infra-red

## ■ Loudspeakers

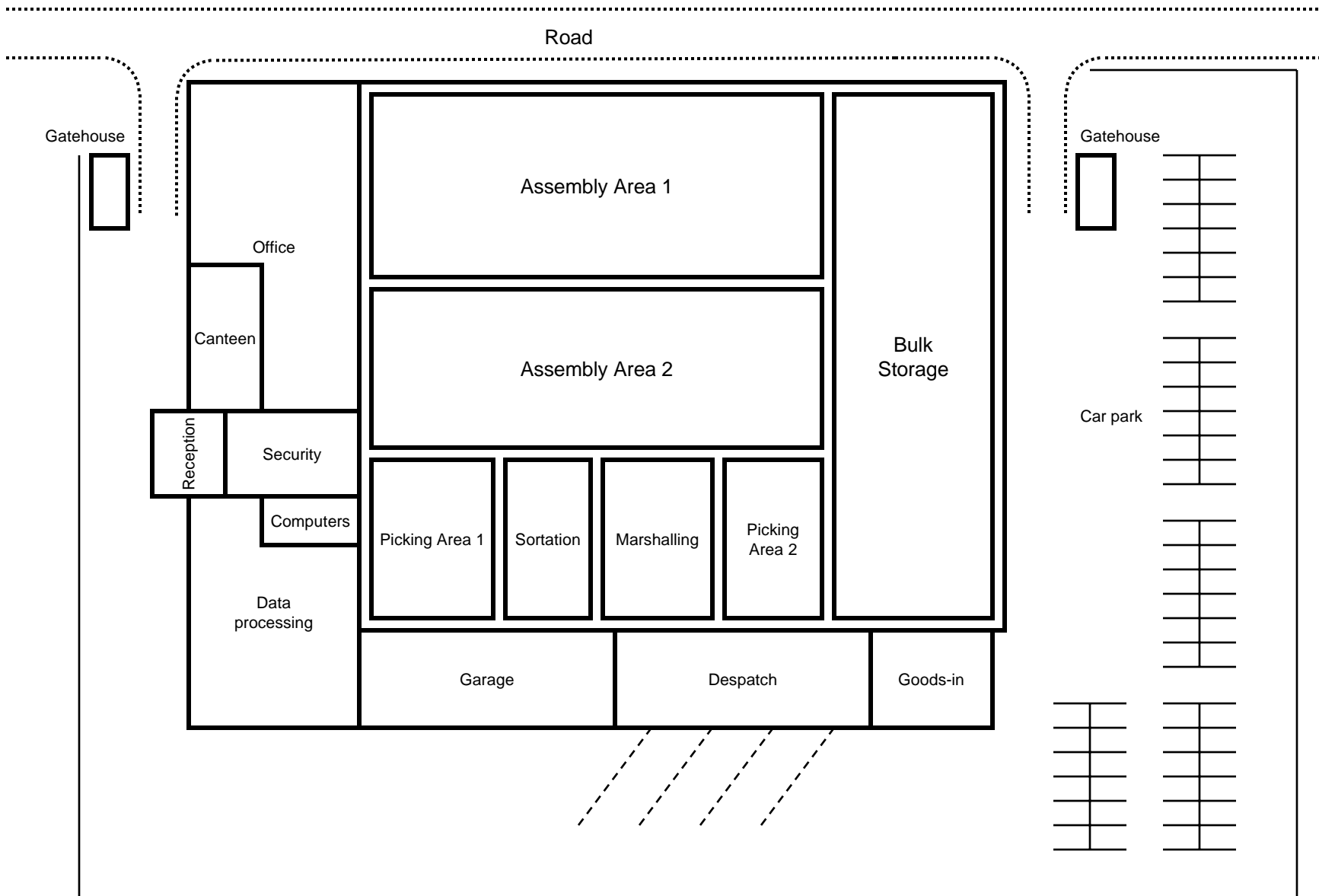
- Ceiling speaker quantity
- Cabinet speaker quantity
- Horn speaker quantity
- Music horn speaker quantity
- Projector speaker quantity
- Explosion proof speaker quantity
- Clean room speaker quantity
- Swimming pool speaker quantity
- Xenon beacon quantity

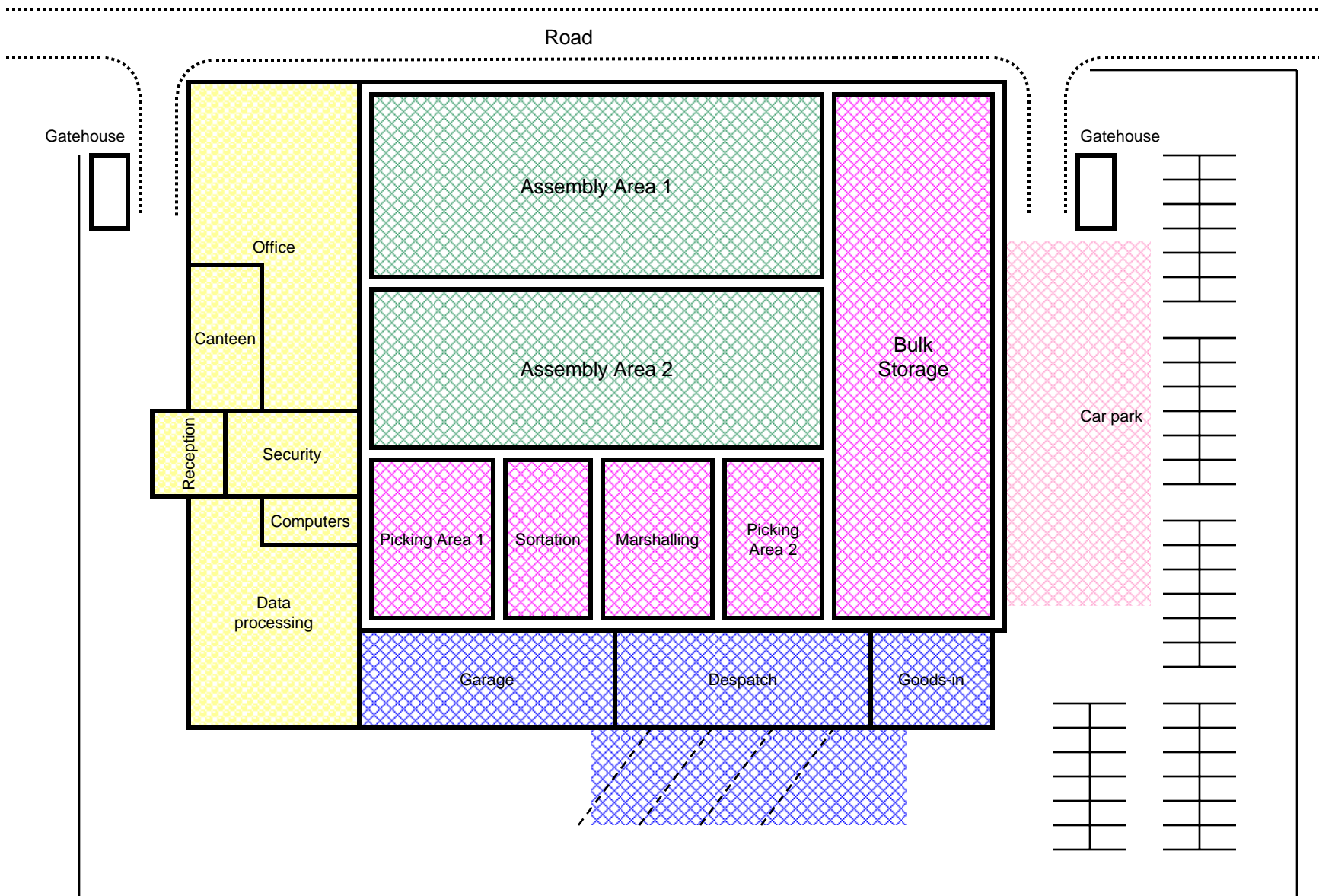
## ■ Other considerations

- BS5839/BSEN60849 compliant
- Battery backup
- Percentage spare capacity
- Percentage future capacity
- Ambient Noise sensing
- Graphic equalisation
- Background noise levels
- Required SPL
- Required RASTI

## ***System example; Factory***

- Requirements;
  - Voice alarm in all internal areas plus some external
  - Fireman's microphone
  - security microphones
  - time signal generator
  - reception microphone
  - background music
  - CCTV Message (“You are on camera”)



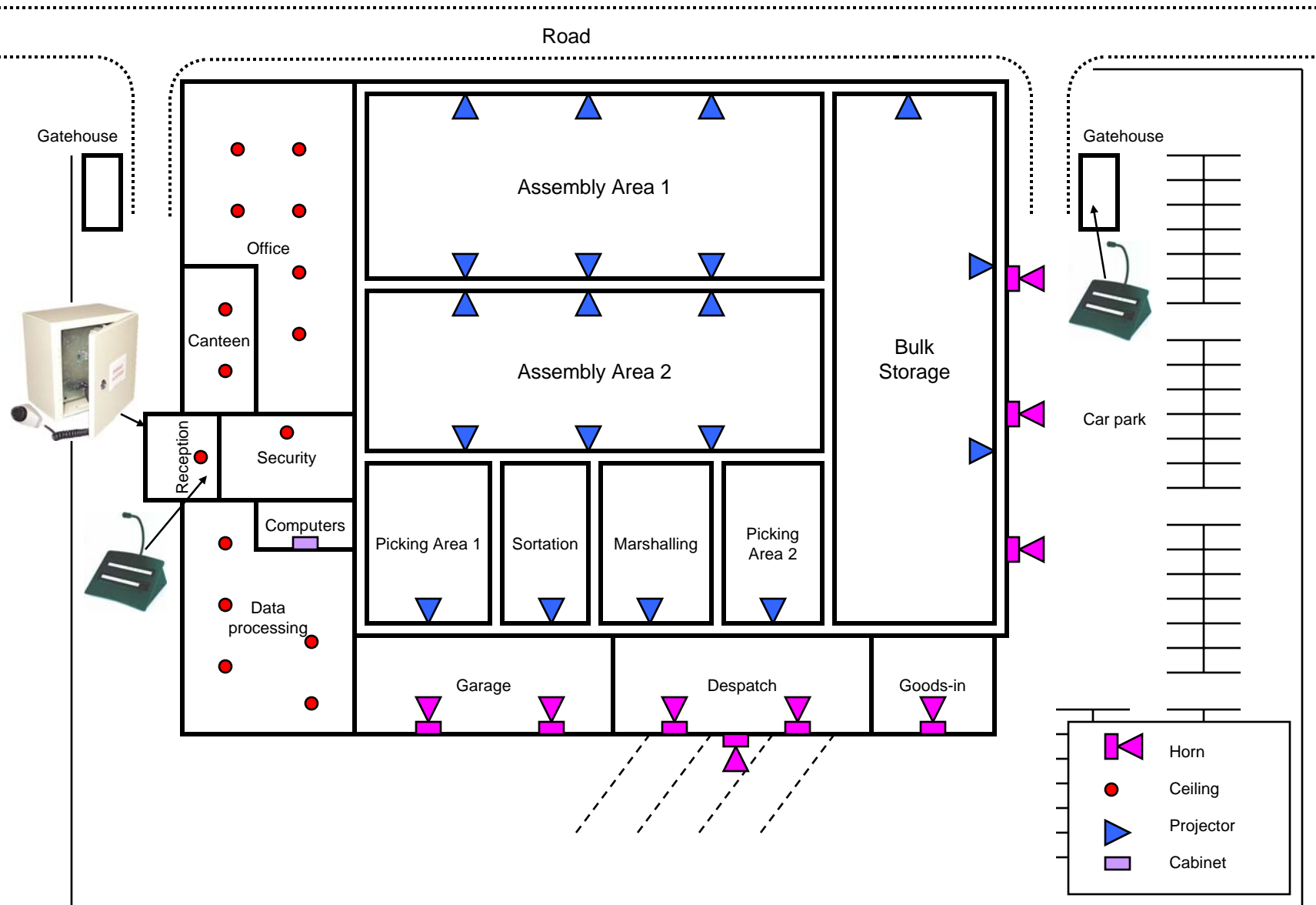


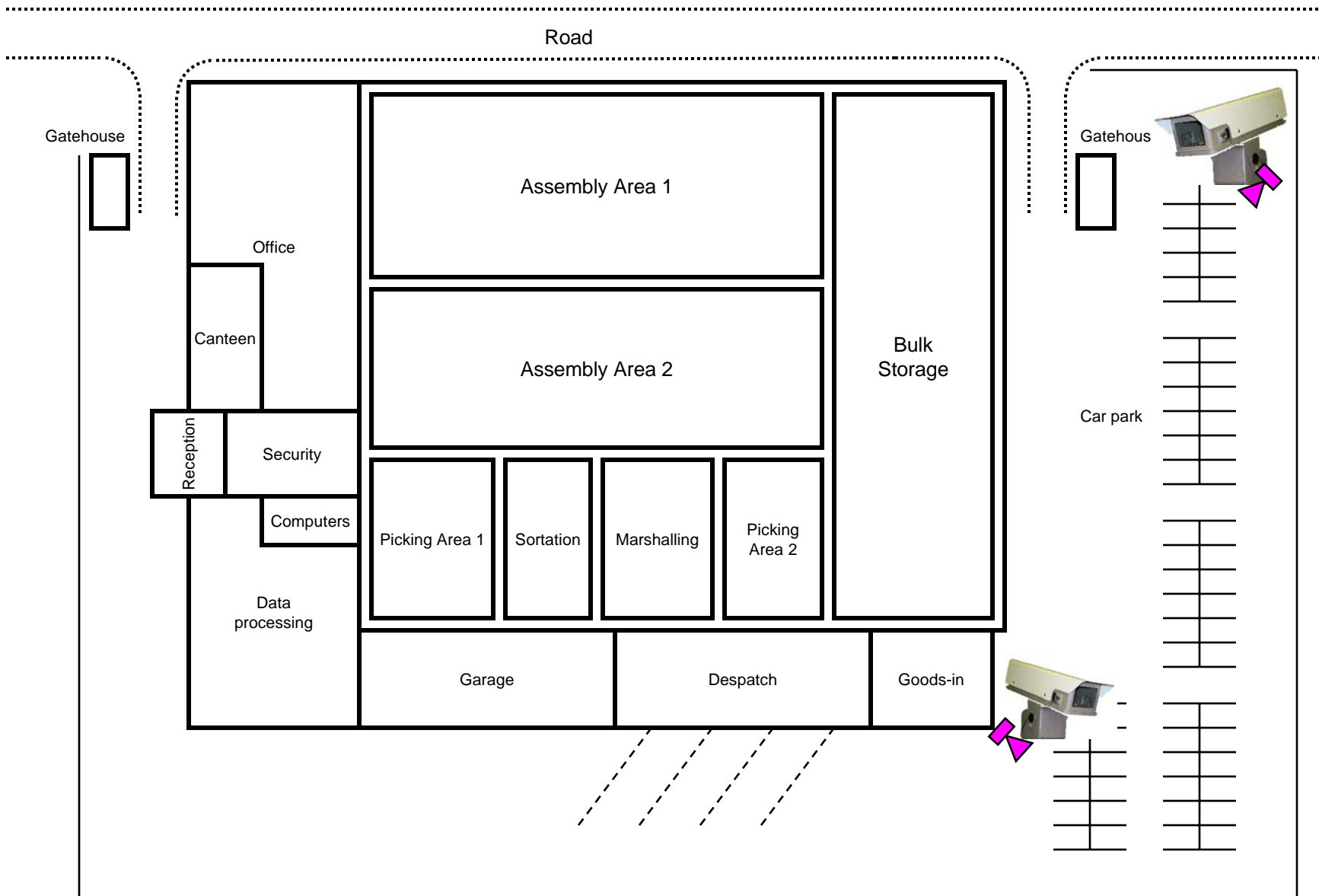
## ***System example***

- Requirements;
  - Warehouse, assembly & picking areas; background music, time alarm calls, fire alarm calls and general paging
  - Offices; fire alarm and general paging
  - Restaurant; background music, time signals, fire alarm and paging
  - Reception; Paging microphone, fire alarm and paging
  - Gatehouses; Paging microphone, fire alarm and paging
  - Entrance; Fireman's microphone

## ***System example***

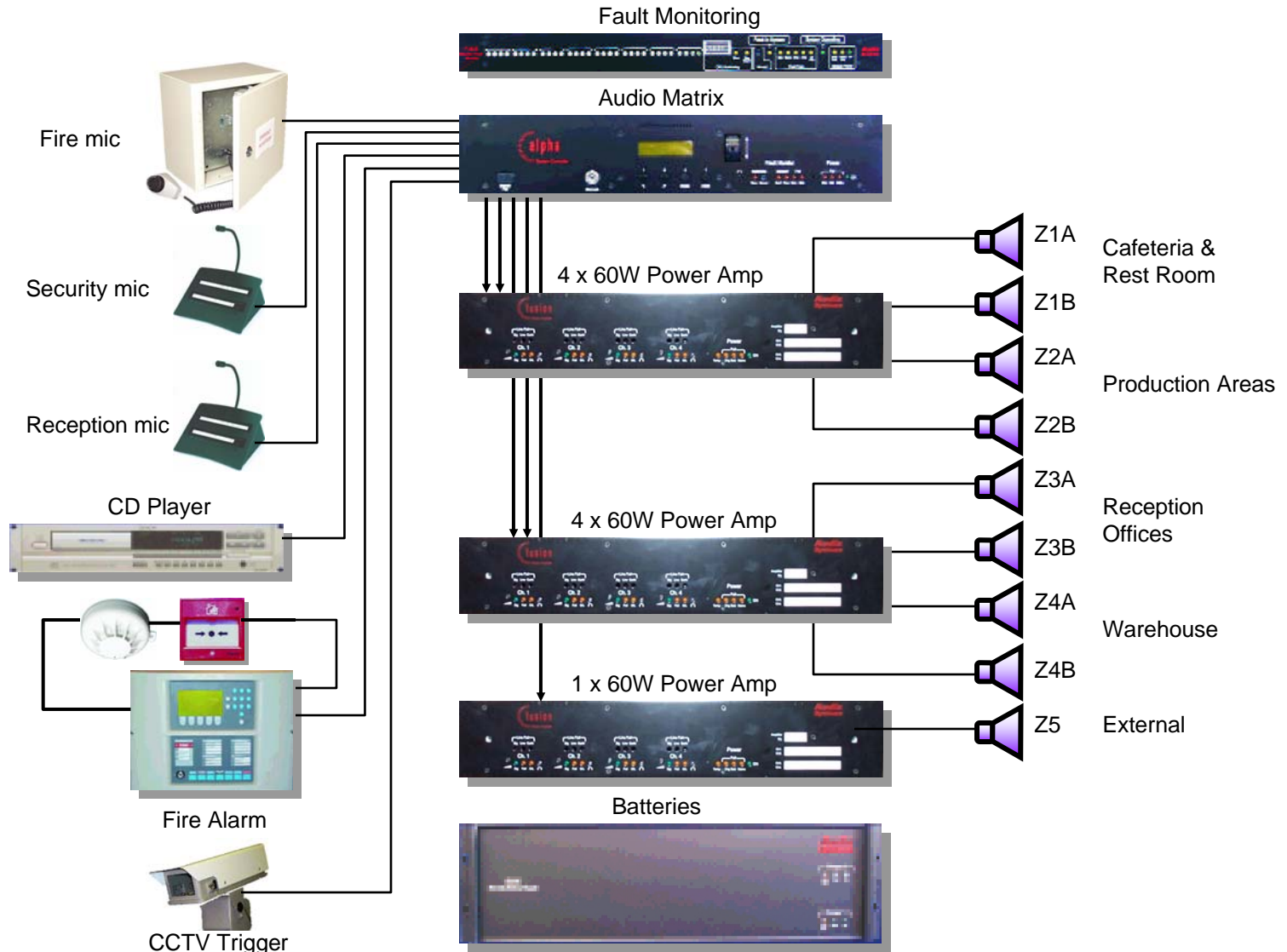
- Offices, reception, canteen; Quiet, suspended ceilings. Ceiling speakers (0.75W)
- Computer room; Noisier, solid roof. Cabinet speaker (1.5W)
- Assembly; Noisy (machines), large spaces, open ceiling. Projector speakers mounted on pillars (7.5W)
- Garage, goods in, despatch; Noisy (vehicles), open ceiling. Horn speakers mounted on walls (7.5W)
- External areas (despatch, car park); Large spaces, weather. Horn speakers on walls and pillars (15W)





## ***Hardware***

- The system requires;
  - Audio matrix with messages
  - Amplifiers
  - Fire alarm interface
  - Batteries
  - Fault monitoring system
  - Speakers
  - Microphones (paging and fireman's)
  - Music source



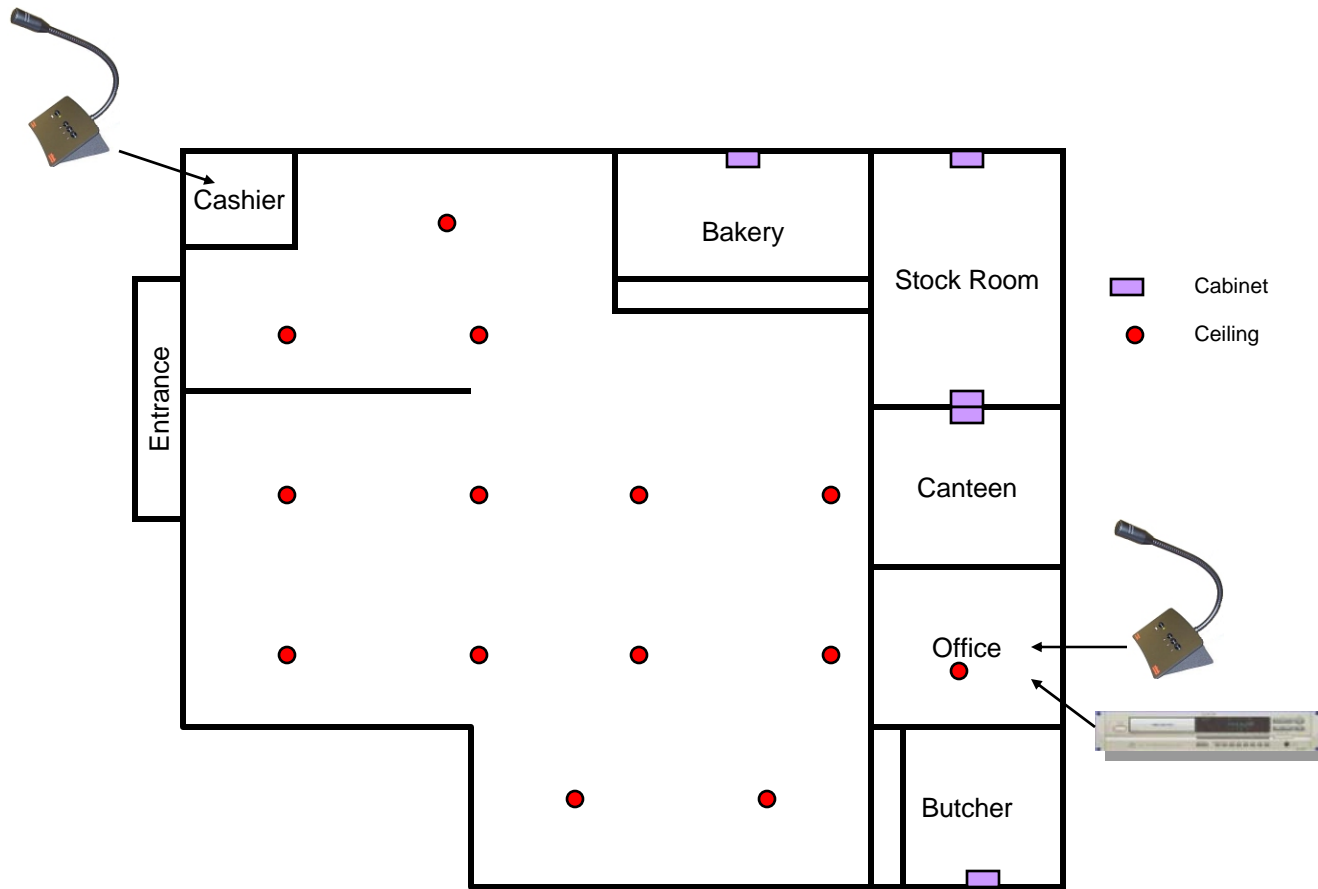
## ***Example; Small supermarket***

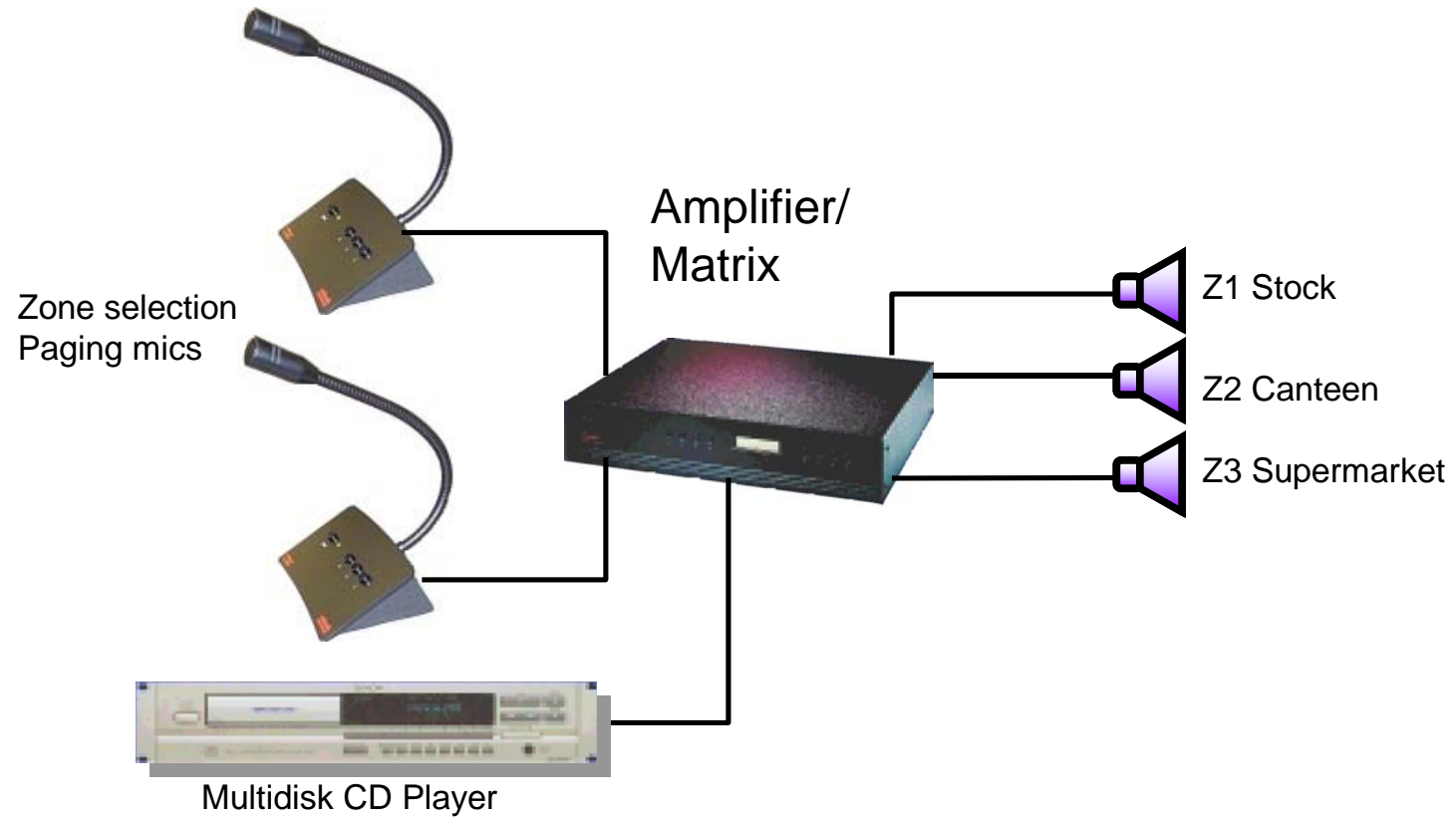
### ■ **SIMILAR APPLICATIONS**

- Small department stores.
- Works canteens

### ■ **REQUIREMENTS**

- Speech and music installation.
- Background music with interrupt for announcements and advertisements.
- Calls must have priority.
- Selectable live announcement routing.
- Mic in office must have priority over cashier.





## ***Example; Department Store***

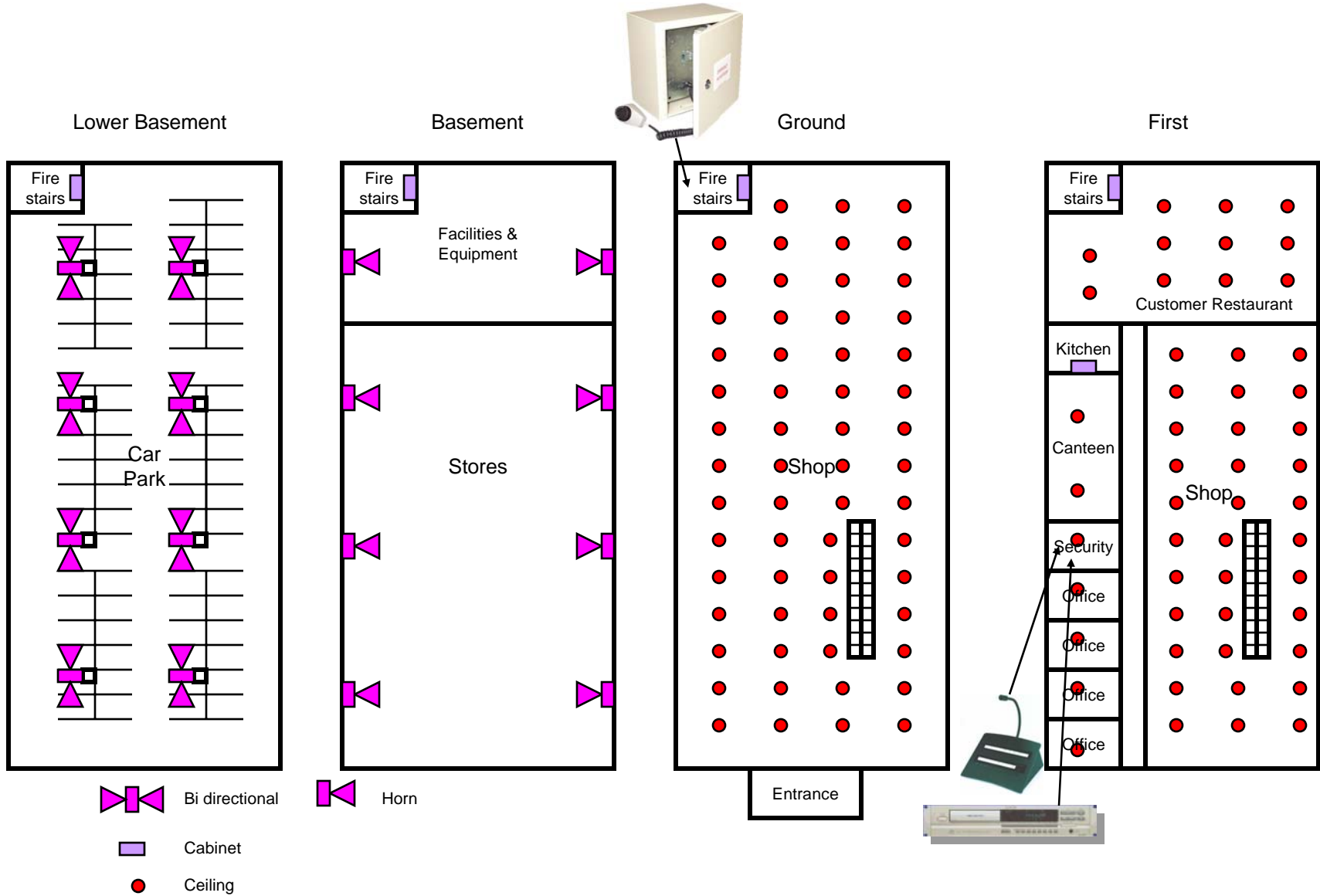
### ■ **SIMILAR APPLICATIONS**

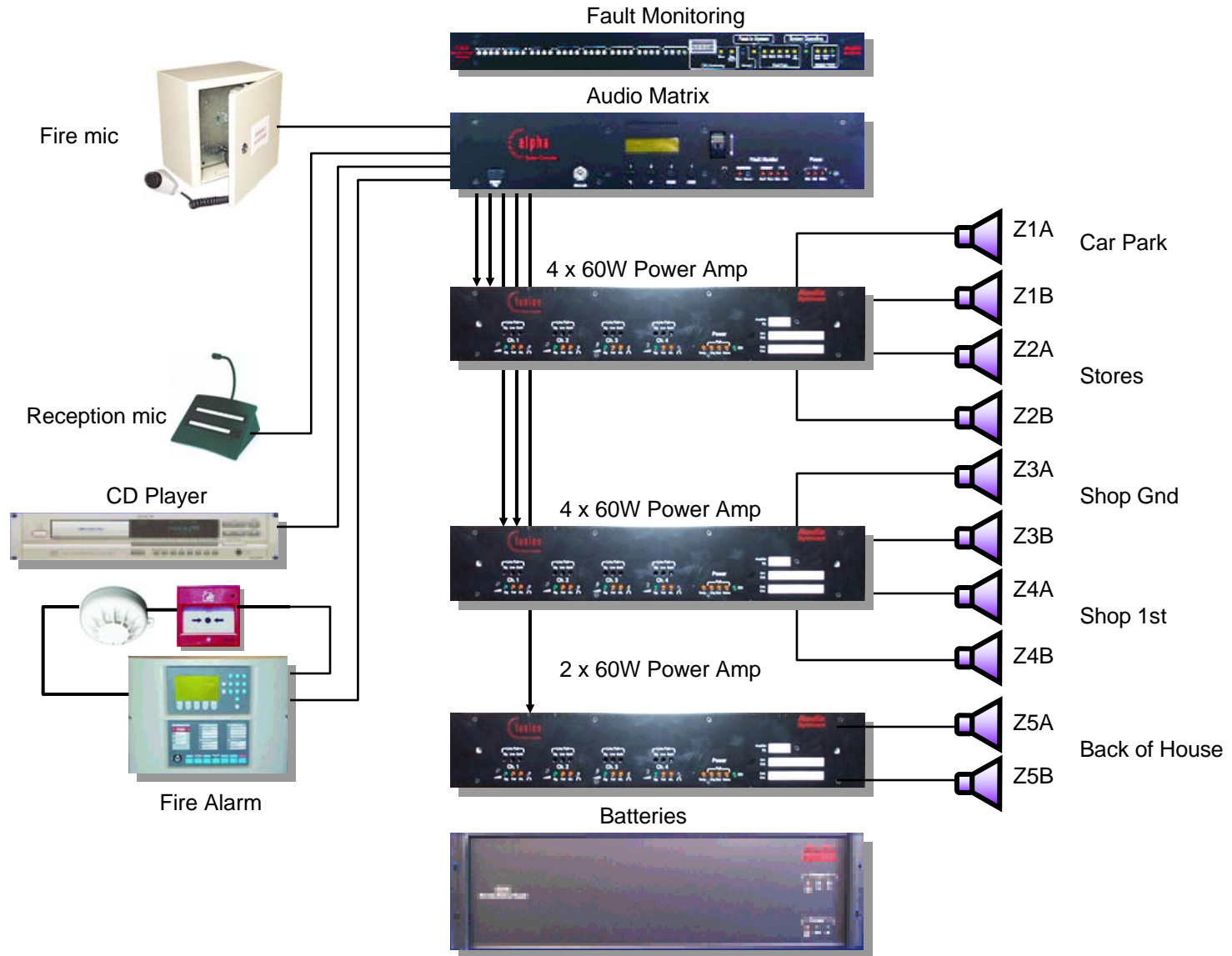
- **Factories.**
- **Industrial sites**
- **Sport complexes**
- **Hotels**
- **Museums**
- **Small airports**
- **Mic in office must have priority over cashier.**

## ***Example; Department Store***

### ■ **REQUIREMENTS**

- Voice alarm
- Speech and music installation.
- Background music with interrupt for announcements and advertisements.
- Calls must have priority.
- Selectable live announcement routing.
- Mic in office must have priority over cashier.





## ***Example; Research campus***

### ■ **REQUIREMENTS**

- Voice alarm over a large site
- Paging between buildings
- Networked matrices providing coverage over all site
- All microphones able to call any building and any zone

