EVAC **Emergency Voice Alarm Communication & Public Address Systems**

Norms & Operational Solutions

2017.03

- Tutti i diritti

FITRE S.p.A.



FITRE S.p.A. • electronics & telecommunications

by C. Frigerio

Scope of Voice Alarm System

The main scope of an Alarm Emergency Evacuation and/or Public Address System is **to broadcast clear information** intended to inform and help the persons operating in the area where an alarm could occur in order to avoid misunderstanding due to the information based on the tones only.



Scope of Voice Alarm System

The Public Address system is one of the primary elements of the security plan related to the working areas.

It is evident that the security and safety of people CANNOT be left to chance and/or to the personal initiative.



3

- All rights

- Tutti i diritti

Scope of Voice Alarm System

Hence the need to introduce standards and norms related to the Voice Alarm and Evacuation System in order to eliminate the proliferation of "self-certification" documents drawn up by individual manufacturers and / or engineers



The standard is a technical specification *adopted by a recognized standards body*.

The standard describes as "doing things right" with respect to safety, the environment and in order to obtain reliable performance.



5

- Tutti i diritti

ISO (International Organization for Standardization) standard is adopted by an international standardization body. Each Country may decide to further reinforce its role by adopting the ISO as their national standards.

For example, an ISO standard adopted also as Italian standard is identified as UNI-ISO (or UNI-EN-ISO whether the standard has also been adopted at European level).



 EN: is a standard adopted by an European standardization.
 The EN standards are drawn up by CEN (<u>Comité Européen de N</u>ormalisation).

The EN standards must be mandatorily implemented by the Countries member of the CEN. In Italy, their reference code is: UNI-EN.

- All rights

- Tutti i diritti ris

FITRE S.p.A.

FITRE S.p.A. • electronics & telecommunications

The EN standards are used to standardize the technical standards across Europe.

So, any national standard that is not in harmony with the CEN standard contents, is not allowed



***UNI:** is a standard adopted by the Italian (local) standardization. **&UNI** is the Italian national standard organization. UNI is a private organization that draws up and publishes technical standards for all industrial, commercial and service sectors.



UNI represents Italy at the European standardization organizations (CEN) and international (ISO).

It features all the Italian national standards. When the standard reference is identified only by UNI prefix then it means that it has been elaborated by the Commissions UNI or by the federated Bodies.



- Tutti i diritti

FITRE S.p.A.

Norms for Voice Evacuation Systems

The norms applied to voice evacuation systems are generated by :

- DECREES, that define where they have to be applied (e.g. hospitals, schools, public buildings, subways, and so on)
- SYSTEM STANDARDS, that define how to design, to install and to commission the system. The system standards define the performance requirements of the entire system
- PRODUCT STANDARDS, that define the technical and functional characteristics of the products to be used in order to realize a Voice Evacuation System



www.fitre.it

11

- All rights

- Tutti i diritti rise

Norms for Voice Evacuation Systems

System: set of elements (components) interconnected between them, which behaves as a single element on the basis of its functional rules.

Product: is one of the elements (component) that defines a system.



12

The history and the process of the norms \$1989: the first edition of the IEC 69849 is released

In 1998, CENELEC transposes the international norm IEC 60849 as European standard: it becomes EN 60849.

In 2002 there is the first revision because the IEC 60849-1998 receives many comments; so on 2003 IEC decides to transfer the revision to the international committee ISO TC21/SC3.



Emergency purposes)



14

- In December 2007, IEC withdraws the IEC 60849, because replaced by the ISO norms.
 - At European level the CLC BT (<u>B</u>ureau <u>Technique of CENELEC</u>) is aware of the situation and decides not to withdraw the EN 60849:1998 (D133/045) until adoption of a new EN standard.

For this reason, CENELEC builds the BTTF133-1 (Bureau Tecnique Task Force 133-1)



- All rights

- Tutti i diritti riser

The BTTF133-1 shall meet the first time on May 19, 2010. The final draft of project named prEN50849 is complited in November 2010 (pr22098)

UNI transposes the ISO 7240-19 and after a few months the UNI ISO 7240-19 is available also in Italian language.



- Tutti i diritti

*2012: the project 22098 of the prEN50849 is submitted for consideration to UAP (Unique Acceptance Procedure) and it is rejected

At the end of 2014: the 22098 project of the prEN50849 is submitted to EQ (Enguiry) that is the first of two Public Inquiry steps laid down by CENELEC)



- All rights

– Tutti i diritti

In July 2015: the BTTF 133-1 shall meet in order to evaluate and discuss the comments received during the EQ job

Meantime the EN 60849 remains in force in order to avoid a legal vacuum



18

- Tutti i diritti rise

FITRE S.p.A.

The CENELEC BT TF 133-1 was established in order to review the EN 60849 standard as well as to eliminate the conflicts with the EN 54-16, EN 54-24 norms and with the respective system norm CEN/TS 54-32 (technical specification)



19

- All rights

- Tutti i diritti riser

July/August 2015: in Italy the UNI CEN/TS 54-32:2015 enters into force –

"Fire detection and fire alarm systems – Part 32: Planning, design, installation, commissioning, use and maintenance of voice alarm systems"

This, in fact, is just an evolution of the ISO 7240-19 norm, even if it follows the basic philosophy (technical specification).



www.fitre.it

20

- All rights

- Tutti i diritti ris

The European Committee has still to vote the new European norm EN 50849 ("Sound systems for emergency purposes which are not part of fire detection and alarm systems"),

Which should replace the EN 60849 and it will include references for designing and manufacturing the Voice Alarm System using components certified EN 54.



The ultimate goal is to include in only one common norm (EN54-32) either the EVAC systems connected to the firefighting systems and to the general emergency systems.

In this way, the current ISO 7240-19, EN 60849 and EN 50849, can be collected in order to finally have a single standard for regulating the entire sector



Currently, CENELEC has to mantein the EN 60849 because it fills some needs in specific applications, such as in some schools where, in addition to the fire alarm systems and the related sirens, it is necessary to provide also additional voice messages (outside the fire system); e.g. in case of an earthquake or flood events.



- Tutti i diritti rise

In this complex regulatory framework, it is evident this could be liable to cast doubts on their interpretation and, in particular, about the applicability of all the norms

To simplify, you can see the next flow chart



Is the EVAC system interfaced to the FIRE system or to the NMS (Mass Notification System)?

Refer to EN 60849 norm for both system and products (components); it is not explicitly required the EN 54 (product certification)

NO

Refer to UNI ISO 7240-19 (and also UNI CEN/TS 54-32); the components must be compliant to the EN 54 norms (product certification).

YES



www.fitre.it

When and where it is necessary to foresee an EVAC system?

*Answer:
It depends on local regulations



The Legislative Decrees define the fileds in which it is necessary the enforcement of the norms (e.g. hospitals, schools, public areas and so on)

The Legislative Decrees can vary from Country to Country – Refer to the following tables for an overview (although reduced) of the Italian Legislative Decrees



The following list is related to the Italian Legislative Decrees

DM 11/01/88	Norme di prevenzione degli incendi nelle metropolitane Nota 1: Alimentazione secondaria almeno 60 minuti di autonomia
DM 20/05/92 n°569	Regolamento contenente norme di sicurezza antincendio per gli edifici storici e artistici destinati a musei, gallerie, esposizioni e mostre Nota 1: Alimentazione secondaria almeno 30 minuti di autonomia
DM 26/08/92	Norme di prevenzione incendi per l'edilizia scolastica Nota 1: Complessi con più di 500 persone Nota 2: Alimentazione secondaria almeno 30 minuti di autonomia
DM 09/04/94	Approvazione della regola tecnica di prevenzione incendi per la costruzione e l'esercizio delle attività ricettive turistico - alberghiere Nota 1: Alimentazione secondaria almeno 30 minuti di autonomia
DPR 30/06/95 n° 418	Regolamento concernente norme di sicurezza antincendio per gli edifici di interesse storico – artistico destinati a biblioteche ed archivi Nota 1: Alimentazione secondaria almeno 30 minuti di autonomia
DM 18/03/96	Norme di sicurezza per la costruzione e l'esercizio degli impianti sportivi Nota 1: Impianti al chiuso con più di 100 spettatori Nota 2: Alimentazione secondaria almeno 30 minuti di autonomia
	A fitro

www.fitre.it

2017.03

FITRE S.p.A. • electronics & telecommunications

DM 19/08/96	Approvazione della regola tecnica di prevenzione incendi per la progettazione, la costruzione e l'esercizio dei locali di intrattenimento e di pubblico spettacolo Nota 1: Alimentazione secondaria almeno 30 minuti di autonomia
DM 10/03/98	Criteri generali di sicurezza antincendio e per la gestione dell'emergenza nei luoghi di lavoro Nota 1: Alimentazione secondaria almeno 30 minuti di autonomia
DM 18/09/2002	Approvazione della regola tecnica di prevenzione incendi per la progettazione, la costruzione e l'esercizio delle strutture sanitarie pubbliche e private Nota 1: Alimentazione secondaria almeno 120 minuti di autonomia
DM 22/02/2006	Approvazione della regola tecnica di prevenzione incendi per la progettazione, la costruzione e l'esercizio di edifici adibiti ad uso uffici con più di 100 persone Nota 1: Esclusi uffici di produzione e magazzino Nota 2: Alimentazione secondaria almeno 60 minuti di autonomia
DM 27/07/2010	Approvazione della regola tecnica di prevenzione incendi per la progettazione, la costruzione e l'esercizio delle attività commerciali con superficie superiore a 400mq Nota 1: Alimentazione secondaria almeno 60 minuti di autonomia Nota 2: Ricarica batterie in massimo 12 ore
DM 28/02/2014	Regola tecnica di prevenzione incendi per la progettazione, la costruzione e l'esercizio delle strutture turistico - ricettive in aria aperta (campeggi, villaggi turistici, ecc.) con capacità ricettiva superiore a 400 persone .

A fitre

www.fitre.it

FITRE S.p.A. • electronics & telecommunications

The design phase of a voice alarm system requires the availability of all data related to the evaluation of the risks in each work environment, from which the project engineer can obtain also the functional requirements of the system itself



- The standard does not exclude that the system can also be used for broadcasting the generic announcements and/or background music (BGM)
- It is evident that the function of the alarm management has the priority to any other function managed by the voice system



- Tutti i diritti ris

The risk assessment

The evaluation is required to analyse the consequences of a possible emergency situation concerning the safety of persons, goods and daily activities.

The information are analysed in order to estimate the probability and severity of each risk in order to decide whether and how to prevent, reduce their impact or if decide to accept the risk itself.



32

2017.03

© FITRE S.p.A. – Tutti i diritti riservati – All rights reserve

The analysis generates the project proposals in order to reduce risk in emergency conditions; in particular : *Identification of zones and areas to be served

The content and the language to be used for broadcasting the voice messages (both microphone and prerecorded)



- All rights

- Tutti i diritti risei

- Type of message: clear (voice) or code (tones) or both
- Alternative broadcasting methods (e.g. inductor loop to support the persons using the hearing aids)
- Visual beacons to be installed in environments with high noise level
- Evaluation of the evacuation carried out on the basis of different phases

Quantity of Emergency microphones

- All rights

- Tutti i diritti rise

In addition, the risk assessment helps to define the integrity level that is necessary to foresee during the design phase of the Voice Evacuation System Two or more loudspeaker lines (loops) Location of the loudspeakers Types of the connections Level of the components redundancy and so on



 In any case, the buyer of the VAS must decide and define the related functional requirements. In order to do it, he has to consult the authorities in charge of security and risk analysis: security responsible, Fire Brigade, Insurance Companies, and so on.
 Following the results of this analysis, it is

Following the results of this analysis, it is possible to generate the functional specifications and the VAS vendor / manufacturer has to meet these



- All rights

- Tutti i diritti rise
Design an Evacuation Voice Alarm System

In **European Area**, the requirements relevant to the Evacuation Voice System are defined in the norms

EN 60849, ISO 7240-19

and in the new

EN 54-16 - EN 54-24 - EN 54-4.

These last specify the requirements, the test methods and the functional criteria of the voice components to be used for designing the detection and fire alarm systems.



Design an Evacuation Voice Alarm System

CPR (Construction Products Regulation)

- The Fire / Voice alarms components can only be installed if CPR-CE certified or whether they have been subjected to tests and verification performed by a certification body
- According to the CPR, the EN54 certification is mandatory for detection and signalling systems in all the EU states.



- Tutti i diritti

Design an Evacuation Voice Alarm System

- The CPR is an European Directive for CE marking; each directive has its own production control requirement.
- E.g, the Low Voltage Directive (LVD) doesn't requires any body survey while the regular inspections (carried out by the Certification body) are necessary for manufacturing the fire safety equipment: according to the FPC (Factory Production Control).

So, the ISO 9000 certify is not enough for manufacturing the Voice Evacuation components

www.fitre.it

- All rights

- Tutti i diritti

FITRE S.p.A. • electronics & telecommunications



summing:

EN 54-16 EN 54-24 EN 54-4



Product Norms (CPR certification)

EN 60849 UNI ISO 7240-19 UNI CEN / TS 54-32



System Norms and Specifications



FITRE S.p.A. • electronics & telecommunications

40

2017.03

UNI ISO 7240: Fire detection and alarm systems

Part 19:

Design, installation, commissioning and service of sound systems for emergency purposes



41

The s.s.e.p. (sound system for emergency purposes) is intended to broadcast clear messages in order to inform the persons about a possible danger that requires a rapid and orderly mobilization of the occupants.

The system must operate (in automatic or manual mode) even after that the alarm event has been detected but the same voice system can be used for broadcasting normal sound messages/information as well as for paging persons

- All rights

- Tutti i diritti risei

The s.s.e.p. is intended to initiate a rapid and orderly mobilization of occupants in an emergency by including systems using loudspeakers to broadcast voice announcements for emergency purposes and alert signals

In order to meet this functional requirement it is necessary a preliminary and very important design phase of the Voice Emergency System



- All rights

- Tutti i diritti rise

FITRE S.p.A.

43

- The project documentation includes at least:
 - Layout of the buildings and areas
 - Acoustic report including the acoustic characteristics of each environment (reverberation, ambient noise, working zones;)
 - Descriptions of the risks and the related plan of the emergency management as well as the related assumptions made about each of the analysed risk
 - Description of the ambient conditions: temperature, humidity, corrosive atmosphere, electromagnetic noise, and so on
 - Description of the environment where the equipment will be located (offices, warehouse, open area, classified area with explosion risk, and so on)



www.fitre.it

2017.03

- Distribution of the proper quantity of loudspeakers in each area / zone / room in order to broadcast intelligible information and to guarantee to the persons to hear clearly the broadcasted messages and to protect the life of the persons themselves
- Analysis of the necessity to inform also hearing impaired persons through alternative sensitive devices (visual beacons, inductor loop)
- Analysis of the evacuation procedures in each area / zone / room in order to define a precise and specific sequence of operations and messages



www.fitre.it

- Tutti i diritti ris

- Messages broadcasting procedure:
 - Automatic inhibition of the sounds and voice messages not related to the emergency event;
 - Proper evacuation management according to the transmission of alarm messages on the basis of the priority between the various zones of the plant;
 - Possibility to activate alternative alarm signalisation in case of fault on the voice system;
 - Possibility to broadcast simultaneously messages on several and different areas of the plant
 - Types and contents of the alarm messages and the related intelligibility during their broadcasting



- All rights

FITRE S.p.A. - Tutti i diritti rise

- The s.s.e.p. cabling must be separate and independent from the power supply and lighting circuits.
- Cables, junctions, terminals and fixing devices must be designed in order to resist to fire at least 30 minutes or to meet higher safety classes according to the national requirements. They must have a mechanical protection adequate to the environment where they are installed



- All rights

– Tutti i diritti

The cabling must be carried out in such a way that a single short-circuit (or open circuit) on a cable of one loudspeaker zone not compromise the normal functioning in any other emergency zone of the plant.

This point contrasts with EN 60849 (CEI 100-55) requiring a double loudspeaker line (loop A/B)



48

2017.03

Example of sound coverage using the double loudspeaker line. In case of fault on one line in the area there is a reduction of 3 dB only)





Each loudspeaker is equipped with ceramic terminals and thermal fuse in order to prevent fault of the line in case of fire or short circuit on the single loudspeaker

2017.03

FITRE S.p.A. - Tutti i diritti riservati - All rights



www.fitre.it

- The loudspeaker cables must be:
 - Twisted type
 - Low capacity
 - Fire resistant (PH min. 30)
 - Fire retardant
 - Outer covering: PURPLE colour
 - Conform to the CEI 20-105 / V1:2013 norm
- The power supply cables must be:
 - Fire resistant
 - Tested according to the EN 50200 norm
 - Outer covering: BLUE colour
 - Conform to the CEI 20-54 norm



www.fitre.it

- All rights

FITRE S.p.A. - Tutti i diritti riser

50

UNI ISO 7240-19 System Specification – INSTALLATION

- The installation of the s.s.e.p. must be carried out by qualified personnel having specific experience (DM 37-2008)
- The cabinet(s) assembled with Control Unit and amplifiers must be installed in secured and protected environment. In any case the access to the Emergency Voice Alarm System is reserved to the qualified personnel only.
- The cabinet(s) must have at least IP30 as mechanical protection
- On the basis of the risk analysis, it could be required also the anti-seismic protection



e

- All rights

– Tutti i diritti

FITRE S.p.A.

51

UNI ISO 7240-19 System Specification – INSTALLATION

- The s.s.e.p. installation shall be in accordance with the project.
- Any modification made to the project and/or to the installation layout must be approved by the owner and by the competent authorities.

The conformity of the installation with the project documentation shall be evaluated at the end of the installation activity



52

- Tutti i diritti

Product Specification EN 54-16

According to the UNI ISO 7240-19 (EN 54-32) System Specifications, the s.s.c.i.e (Sound System Control and Indicating Equipment) shall consist of components (products) certified:

EN 54-16

 Fire detection and fire alarm systems - Part 16: Voice alarm control and indicating equipment – Technical requirements of the products related to the indication and monitoring devices
VACIE (Voice Alarm Control and Indicating Equipment)

Product Specification EN 54-16

- It specifies requirements, methods of test and performance criteria for voice alarm control and indicating equipment for use in fire detection and fire alarm systems installed in buildings, where the alarm signal is in the form of tone(s) or voice message(s), or both.
- It DOESN'T define the complexity level that the voice system has to guarantee (redundancy, zones distribution and classification, and so on). The level of the complexity must be determined by the risk analysis carried out by qualified personnel (responsible for the plant security) as required by the UNI ISO 7240-19 standard



- All rights

- Tutti i diritti risei

FITRE S.p.A.

www.fitre.it

Product Specification EN 54-16

- Example of a simple VACIE system (abstract of EN 54-16 document)
- 1. CIE (EN54-2)
- 2. VACIE (EN54-16)
- Emergency Microphone(s)
- 4. Fire Alarm Interface
- 5. Indicators (LEDs or Display)
- 6. Processing and signal routing
- 7. Messages generation
- 8. Amplification

2017.03

- 9. Voice Alarm Output
- 10.Voice Alarm Zone(s)
- 11.Loudspeaker End of Line (EoL) or other system for checking the status of the loudspeaker lines

www.fitre.it

tre

12. Power Supply equipment (EN 54-4)



© FITRE S.p.A. – Tutti i diritti riservati – All rights

55

The norm requires that the system must be totally and continuously monitored

The eventual failure (including the most serious «System Fault») must be immediately signalled and it must be managed by the operator in accordance to norm requirements

So, also the software developed for managing the functions related to the Alarm Voice System must be verified and approved by the certification body



www.fitre.it

- Tutti i diritti

- The monitoring of the Voice System foresees the continuous checking of:
 - Primary and secondary (back-up) power supply
 - Emergency microphone (including the capsule)
 - Amplifiers (including the spare ones)
 - Message generator and related memories
 - Loudspeaker connection lines (integrity and earth leakage of each cable)
 - CPU and the related software for managing the Voice System
 - Inputs coming from the emergency contacts
 - Integrity of the critical path (from the emergency audio source up to the loudspeakers)



www.fitre.it

2017.03

- In particular, it is necessary to supervise continuously the integrity of the cable connection between the VACIE and the CIE (Fire) systems
- In fact, in the VACIE it is necessary to provide three alarm inputs per each emergency alarm event coming from the CIE:

Emergency Alarm Set

Temporary Alarm Silencing (option)

Emergency Alarm Reset

If only those who caused the alarm has the ability to reset it: CIE (automatic alarm) or operator (manual alarm)

www.fitre.it

- Tutti i diritti ris

- The norm does NOT require that the system is infallible
- The norm requires that each failure (including the "systemfault") is visualized in correct way
- The management of the emergency events MUST BE NOT disturbed by any other sound activity that may be managed by the Emergency Voice system (e.g. paging)
- The norm does NOT define the level of functional complexity (to be defined by the owner)
- The Emergency Voice System must be designed in order to manage at least one alarm input coming from the CIE (Fire), one emergency microphone and one loudspeaker line (with the related amplifier)



- All rights

vati

- Tutti i diritti riser

- The EN 54-16 norm allows that the fault on a loudspeaker line can generate the exclusion of that specific area only
- All other areas and lines should NOT be affected by the event
- According to the EN 7240-19 and EN 54-32), the safety engineers have to foresee and require the safety level according to the operations and working conditions in the plant :



- Level 1: minimum requirement enforced by the 54-16 norm (fault on one speaker zone = exclusion of that specific zone without any effect on the other zones)
- Level 2: speaker distribution over the plant with «A & B» architecture = in case of fault on one speaker line then the sound coverage of the zone is guaranteed by the second line even if with a sound reduction of 3 dB)
- Level 3: speaker distribution over the plant with «A + B» architecture = two cabinets "A" e "B" (including the related amplifiers) installed in different locations and with dual cabling layout (redundancy through «loop A» and «loop B» cabling)



- Tutti i diritti riservati - All rights reserved

Product Specification EN 54-16 EVAC system evaluation

So, two EN 54-16 systems could have different functional levels as well as two different reliability levels due to different architectures adopted by the manufacturer in order to manage the fault conditions

Few examples:

Compact system on which the manufacturer has designed and certified a predetermined solution fixing the quantity of the alarm inputs, of the speaker zones, of the Operator Consoles, of pre-recorded and types of messages. This is the typical vertical application designed for meeting the functional requirement of specific markets (shops, schools, banks and so on)



2017.03

- All rights

- Tutti i diritti risel

Product Specification EN 54-16 EVAC system evaluation

- Distributed system based on «intelligent node» architecture:
 - Each node is managed by its local controller
 - Each local controller manages directly the local resources (amplifiers, operator consoles, alarms, and so on)
 - Typically, each controller manages a quite high quantity of simultaneous calls but the bottle-neck is on the quite limited quantity of simultaneously calls among all the nodes
 - In addition, in case of fault on one controller no other controller can manage the local resources of that node (the interface among the nodes is managed by the controllers)



www.fitre.it

- All rights

FITRE S.p.A. - Tutti i diritti riser

Product Specification EN 54-24 Loudspeakers

Without different national regulations, the loudspeakers used for broadcasting the Emergency Voice Announcements must be certified:

EN 54-24

requirements, test methods and performance criteria for loudspeakers

- The loudspeakers are intended to broadcast a warning of fire to the occupants of the building with a proper Sound Pressure (dB) in order to overlap the ambient noise and to guarantee the proper intelligibility of the messages
- The quantity of the areas /zones is defined on the basis of the risk analysis document (*s.s.e.p.*)



www.fitre.it

- Tutti i diritti

Product Specification EN 54-24 Loudspeakers

The Sound pressure value of the loudspeakers EN 54-24 certified is measured at a distance of 4 m. on its reference axis and it is measured as 1/3 octave from 100 Hz up to 10 kHz. The frequency band must stay inside the following mask



- All rights

- Tutti i diritti riser

FITRE S.p.A.

FITRE S.p.A. • electronics & telecommunications

Product Specification EN 54-24 Loudspeakers

- The EN 54-24 standard foresees two types of loudspeakers:
- Type «A» for indoor installation:
- Minimum protection degree: IP21
- ✤ Temperature: -10°C (+/- 3°) to + 55°C (+/-2°)
- Type «B» for outdoor installation:
- Minimum protection degree: IP33
- ☆ Temperature: -25°C (+/- 3°) to + 70°C (+/-2°)
- NOTE: on classified areas it shall be used ATEX certified loudspeakers (directive 94/9/EC); it is not necessary any additional EN 54-24 certification



www.fitre.it

66

Loudspeaker Network – How to choose the loudspeakers

- Any loudspeaker is characterized by its **«acoustic sensitivity»** which is defined by the dB value measured at a distance of 1 meter and powering the loudspeaker with 1 W – Example:
- A loudspeaker has the SPL value of 120 dB (acoustic pressure) and 20 W (power); this means that, in order to guarantee the sound pressure of 120 dB it is necessary to power the loudspeaker with 20 W (output of the amplifier)
- A loudspeaker has the SPL value of 120 dB (acoustic pressure) and 30 W (power); this means that, in order to guarantee the sound pressure of 120 dB it is necessary to power the loudspeaker with 30 W (output of the amplifier)



www.fitre.it

2017.03

Loudspeaker Network – How to choose the loudspeakers

- Assuming to calculate the quantity of loudspeakers to be installed in an area with dimensions 50 x 20 m, on which the ambient noise is 65 dB, then it is necessary to consider that the sound pressure of the loudspeakers should be at least 75 dB (intelligibility = 10 dB over the ambient noise); now:
- Choosing 20 W loudspeakers with SPL=120 dB/1m then it is enough to consider 2 or 3 loudspeakers; so one amplifier with 40 / 60 W output
- Choosing 20 W loudspeakers with SPL=100 dB/1m then it is necessary to consider about 12 loudspeakers; so one amplifier with 240 W output



- All rights

- Tutti i diritti riser

Loudspeaker Network – How to choose the loudspeakers

- A wrong selection of the loudspeakers entails:
- Over-sizing the amplifier(s) (output power); this means the cost of the system will increase due to:
 - Increasing the power of any amplifier
 - Increasing the quantity of the amplifiers
 - Increasing the space inside each cabinet (in some case, it could be necessary to increase the quantity of the cabinets, too)
 - Increasing the power consumptions; these entail the sizing of the UPS and, when the system is certified EN 54-16, the sizes (power and dimensions) of the battery back-up
- Under-sizing the quantity of the loudspeakers; so, it is not possible to guarantee the intelligibility of the messages



www.fitre.it

- Tutti i diritti ris

Emergency Alarm Voice System INTELLIGIBILITY

- The EVAC system must guarantee the maximum possible level of the intelligibility
- The loudspeakers must be selected and located in such a way that their sound pressure shall overlap the ambient noise (at least 10 dB higher)

The listeners must not receive the messages with sound pressure lower than 65 dBA and not higher than 105 dBA



- Tutti i diritti

FITRE S.p.A. • electronics & telecommunications

Emergency Alarm Voice System INTELLIGIBILITY

- The acoustic signals broadcasted in the sleeping areas must have minimum 75 dBA, measured on the headboard and with all the doors and windows closed.
- These intelligibility values are considered as «minimum and reasonable values»
- Nevertheless, if in some areas/zones the acoustic conditions (reverberation and/or ambient noise) are very high then it could be impossible to meet the sound requirements
- In these cases, it is necessary to agree with the safety engineers the acceptable level of intelligibility.



www.fitre.it

Emergency Alarm Voice System INTELLIGIBILITY

- The intelligibility is the capability that a person or message has of being understood
- The power (W) and the sound pressure (dB) are not enough data to guarantee that the persons receive clearly and they can understand (intelligibility) the content of the alarm voice message
- In order to guarantee the safety of the persons it is necessary that they can well understand the messages; the intelligibility level is measured on the basis of standard methods (STIPA index)



- All rights

– Tutti i diritti
- The measurements of the voice intelligibility has been introduced by the EN 60849
- The INTELLIGIBILITY in an area must be evaluated on the basis of the following parameters:
 - CIS (Common Intelligibility Scale) greater than or equal to 0,7
 - Equivalent to RASTI (Room Acoustic Speech Transmission Index) 0,5 [fast acoustic trasnsmission of the voice]

Equivalent to Alcons index 0.88 (Articulation Loss of Consonants); percentage indication of the loss of speech intelligibility that occurs in difficult acoustic environments



www.fitre.it

- All rights

- Tutti i diritti rise

- The most used method in Public Address application is STIPA (Speech Transmission Index for Public Address). The STIPA value is calculated broadcasting a tone (modulated simultaneously with two modulation frequencies) which is measured by a sound level meter
- It is necessary to know:
 - The average and minimum STIPA values required in each area/zone
 - The acoustic permissible values (dB) in each area/zone
 - The ambient noise level values in each area/zone



www.fitre.it

- All rights

- Tutti i diritti rise

- The ISO7240-19 norm requires that in each a.d.a. (acoustically distinguishable area/s) the acoustic pressure shall be:
 - Min. 10 dB higher than the ambient noise level
 - ✤ Min. >65 dBA and max. <105 dBA</p>
 - ✤ In sleeping areas, min. >75 dBA

The installation height of loudspeakers is limited to 5 m. above floor level



- Tutti i diritti

- The unobstructed distance between a loudspeaker and any occupant of an ADA (Acoustically Different Area) should not be greater than:
 - ✤ 4,5 m for unidirectional loudspeakers (within the 2 kHz coverage) angle of the loudspeaker);
 - ✤ 6,0 m for bi-directional loudspeakers (within the 2 kHz coverage) angle of the loudspeaker);
- the distance between the centres of adjacent loudspeakers Is not greater than:
 - ✤ 6 m for unidirectional loudspeakers;
 - 12 m for bi-directional loudspeakers (on axis);



- All rights

FITRE S.p.A. - Tutti i diritti ris

- When calculating the distance from loudspeakers, the listening height of seated listeners should be taken as being 1,2 m above the floor and the listening height of standing listeners should be taken as being 1,6 m above the floor.
- It is necessary to consider the rules of the acoustic physics:
 - Doubling the power (W) then the sound pressure increases of 3 dB
 - Doubling the distance from the loudspeaker to the listener point then the sound pressure decreases of 6 dB



www.fitre.it

2017.03

- All rights

- Tutti i diritti rise

- In the zones/areas where the ambient noise level is very high then the emergency voice alarm system must be integrated with visual or other devices in order to ensure that persons operating in those zones understand that an alarm event is in progress
- In the zones/areas in which the ambient noise is higher that 95 dB is mandatory to install visual beacons



- The Voice Alarm System must be powered by two sources: primary and secondary (including the related battery backup)
- According to the UNI ISO 7240-19 norm, the power supply must be designed and manufactured according to the

EN 54-4

Fire detection and fire alarm systems - Part 4: Power supply equipment

requirements, methods of test and performance criteria for power supply equipment



www.fitre.it

– Tutti i diritti

FITRE S.p.A.

The power supply unit must be designed in order to power the s.s.e.p. during the voice alarm condition for not less than to the double of the time required for evacuating the area/zone or of the time required by the competent authority (safety engineers)

In the absence of such a time value, the norm requires to consider a secondary power supply source (battery) sized for powering the s.s.e.p. for 24 hours in stand-by conditions and for 30 minutes in voice alarm condition (voice alarm messages)



- All rights

- Tutti i diritti riservati

In any case, even when the system is powered by the secondary power supply (battery):

- It should NOT take place a reduction of the intelligibility level of the message (below the required values)
- It should NOT take place a reduction of the acoustic alarm signal higher of 6 dB below the required value)

The data relevant of the evacuation time has an important effect of the dimensions of the battery and the related space and costs



- In order to size the battery it is necessary to consider the different operational status of the system
- Unlike in the alarm systems used for managing only the sensors and the tones, in the voice alarm systems it is necessary to consider three operational conditions:

Stand-by: none alarm event in progress

Voice Alarm: the system broadcasts a live or prerecorded voice message

Tone Alarm: the system broadcasts a prerecorded alarm tone



- All rights

- Tutti i diritti

- The Alarm system requires the maximum power for broadcasting of the continuous alarm tones while the broadcasting of the voice alarm message requires only about 30% of the maximum power due to the envelope excursion of the waveform
- It is important to consider the types of the alarms (tones and messages) to be broadcasted on the plant during the alarm events
- As common practise, it is good to consider:
 - *24 h in Stand-by conditions
 - * 28-29 minutes (Voice broadcasting conditions)
 - *1-2 minutes (Tone broadcasting conditions)



www.fitre.it

- All rights

- Tutti i diritti ris

Voice Alarm System from theory to PRACTICE

- The knowledge of the norms gives the tools suitable for putting into practice the technical recommendations
- Each working environment (shop, school, production plant and so on) has its own operational needs that the Voice Alarm System has to meet in order to perform the related functional characteristics
- Several EN 54-16 solutions are available on the market; it is necessary to verify that the proposed system meets the functional requirements of the persons which will use the system

- All rights reserved

- Tutti i diritti riservati

FITRE S.p.A.

www.fitre.it

tre

Voice Alarm System from theory to PRACTICE

The industrial environments are characterized by indoor areas (offices, control rooms, corridors, meeting rooms and so on) and outdoor areas (loading zones, process, stock and so on)

The total plant area is very large; so, it is necessary to foresee architectures designed in order to guarantee the maximum level of modularity, the possibility to distribute the intelligence and the amplification as well as to manage several interfaces with other external systems



- All rights

- Tutti i diritti rise

Voice Alarm System from theory to practice - ASTRO

- FITRE has designed ASTRO system with the objective of meeting the functional requirements in industrial and public transport applications
- The modularity is guaranteed by using modules certified EN 54-16 freely assembled inside one node or assembled and distributed in several nodes located in several areas of the plant and interconnected over the LAN backbone



- All rights

- Tutti i diritti ris

Voice Alarm System from theory to practice - ASTRO

There is NOT a real limit in terms of quantity of the modules and/or nodes and/or ASTRO control units that can be installed in a single system (plant)



- All rights

- Tutti i diritti risei



ASTRO control unit (also configurable with 1+1 redundancy).

- Software certified EN54-16 for managing the Emergency Voice Messages as well as the normal Intercom functions (paging).
- Interface with external supervision systems through Web-Service standard software
- Interface with PABX and Radio systems through **Trunk-SIP** standard software





PSDV (Power Supply Distribution and Visualisation) manages the primary and secondary power supply.

It visualizes (LEDs) the events as well as the emergency microphone according to the EN 54-16 norms.

Even in case the cabinet (with or without ASTRO control unit) is not connected to the LAN, then it is possible to broadcast an Emergency announcement on all the loudspeakers connected to its own cabinet.

PSDV manages and supervises also the alarm contacts coming from the Fire system

www.fitre.it

89

IP-DAD (Digital Audio Decoder) converts digital data into analog signal to be connected to the input of the audio amplifier. Up to 4 modules can be assembled in one 19" rack. Each IP-DAD module can be configured as back-up unit (n+1, x+1, 1+1).

- IP-DAD manages the input and the output analog audio signals even from/to other external systems
- Input for connecting an ambient microphone for adjusting automatically the output of the related amplifier on the basis of the ambient noise level



1	mika	0.01	0.012	n la z	
	-199092	1000		-	
Ш.	00000	0000	disto	CISIO	

PMDxxx_AMC: Class D Power amplifier equipped with its own power amplifier (dual input: primary and 24 VDC secondary). Up to 4 modules can be assembled in a 19" rack. Output power: 125 / 250 and 500 W Each IP-DAD module manages also the diagnostic information of the related power amplifier (status and loudspeaker line connection).

Output through 100 V line transformer on «A» and «B» loudspeaker lines; in case of fault of one line, the other one remains active (redundancy)



- All rights

FITRE S.p.A. - Tutti i diritti riservati

www.fitre.it

fitre

ECXI: mother 19" rack configurable with modules for managing the ON/OFF inputs/outputs events:



ECRIO: module equipped with 8 output relays and 8 optocoupled inputs

ECBI: module equipped with circuits for managing the visual beacons. The module switches ON/OFF the power supply as well as manages the diagnostics of the connection line of the visual beacon devices



www.fitre.it

2017.03

DAP-54-16 ASTRO-PAGA Operator Console

DAP Digital Public Address -

- Desk-top Operator Console EN 54-16 certified for ASTRO-PAGA systems
- Continuous monitoring of the microphone
- Status visualization LEDs
- Call, messages and alarm tones management in Emergency PA Systems
- 4 mechanical protected keys for activation of Emergency Announcements and Tones

itre

DAP-54-16 ASTRO-PAGA Operator Console

ASTRO-PAGA architecture including the DAP Operator Consoles



- Tutti i diritti riservati - All rights

FITRE S.p.A.

0

TONO-VoIP_1.3 Intercom Operator Console for ASTRO Systems

- «TONO-VoIP_1.3» Intercom Operator Console is just one of the several models of telephone/intercom sets that can be used in an ASTRO system
- Dual PoE Ethernet port for ring connection and/or redundancy connection (like DAP 54-16 PA Emergency Console)
- 2 rows / 16 characters Display based on OLED (Organic Light Emitting Diode) technology which allows to manufacture colour display emitting its own light



95

- All rights

- Tutti i diritti rise

FITRE S.p.A.

FITRE S.p.A. • electronics & telecommunications

ASTRO/PAGA EN54-16 Architecture

Block diagram drawing: single node and several nodes







- All rights

- Tutti i diritti riservati

FITRE S.p.A.

ASTRO/PAGA EN54-16 Architecture

- FITRE has designed the ASTRO-PAGA system in order to meet the requirement of the EN 54-16 standard. ASTRO-PAGA 54-16 is certified for managing the Emergency announcements and tones as well as for using the LAN backbone (even already existing) for inter-connecting the nodes distributed in the plant. Each node may consist of amplification devices only and/or amplification and local control unit
- It is NOT necessary to provide specific certified switches or network devices
- Each cabinet is a node of the system on which the modules (amplifiers, IP-DAD, PSDV, I/Os) are connected in ring mode (redundancy)
- Each cabinet is connected directly to the existing LAN network



- All rights

- Tutti i diritti riser

Usability of the LAN in the field with ASTRO Systems

- The functional specifications related to the communication systems requires more and more that the systems are digital IP native in order to allow the distribution of the units in the plant using the LAN backbone
- Normally, the LAN specialist designs the network considering the transport of the data related to several systems and services (telephone, data, PLC, CCTV, Scada, Intercom, Hot-Line, PA, Siren and so on)
- The system designed and manufactured by FITRE is one of the user of the LAN and, from the audio band occupation, the PA / Intercom system has not any practical impact



- All rights

FITRE S.p.A. - Tutti i diritti ris

Usability of the LAN in the field with ASTRO Systems

Soth on EN 54-16 (product norms) and on EN54-32 (Planning, design, installation, commissioning, use and maintenance of voice alarm systems) is explicitly foreseen the possibility to implement distributed architectures (EN 54-32 chap. 6.15.1 - page 36) using the third party Ethernet backbone (or any other physical layer)



ASTRO/PAGA EN54-16 Analysis of the fault events

From the point of view of the data transportation, ASTRO-PAGA architecture is a ring typology (including the management of the data-flow direction)



- Tutti i diritti riservati - All rights reserved

FITRE S.p.A.

ASTRO/PAGA EN54-16 Analysis of the fault events

- FITRE has designed ASTRO system in order to guarantee the maximum level of availability even in case of failures (ASTRO supports the single point of failure without any functional limitation)
- Up to 26 type of faults were considered (including simultaneous faults); for every single one of which were described:
 - The type(s) of the fault(s)
 - The behaviour of the system during the fault event
 - The behaviour of the system during the return to the normal operation (at the end of the fault)



- All rights

- Tutti i diritti rise

ASTRO/PAGA EN54-16 Analysis of the fault events

- In particular, ASTRO offers a very robust HW and SW architecture for managing the redundant connection over the LAN. ASTRO supports up to 3 simultaneous faults and under no circumstance ASTRO crashes
- All the information related to the fault analysis together to the high MTBF & MTTR values of the modules are the elements used by the safety engineers for calculating the

RAM(S) value

- Reliability,
- Availability,
- Maintainability
- ✤ Security



www.fitre.it

102

FITRE S.p.A. - Tutti i diritti riservati - All rights reserved

ASTRO/PAGA Diagnostic

- ASTRO is configured for managing all the diagnostic information that can occur on any module (IP-DAD, PSDV, Amplifier, ECBI, ECRIO) and including the operator consoles, the digital telephone and intercom set for which ASTRO performs also the speech-test in order to check of the complete audio path (microphone, pre-amplifier, amplifier and loudspeaker)
- The third party supervision systems can access to all the diagnostic information of ASTRO, through

WEB-SERVICE standard software



www.fitre.it

103

- All rights

- Tutti i diritti rise

ASTRO/PAGA Diagnostic

- Through WEB-Service, ASTRO makes available to the external third party supervision system also a set of commands in order to get the possibility to access to its own resources
- The operator of the supervision system can use the supervision GUI (Graphic User Interface) in order to:
 - Set calls
 - Check the status of the calls
 - Configure ASTRO system
 - Send command for activating functions in ASTRO
 - Receive commands activated by ASTRO system
 - Access to the recorded audio files (intercom conversations and PA announcements)

- All rights

- Tutti i diritti rise

FITRE S.p.A.

0

www.fitre.it

ASTRO/PAGA Diagnostic

- Using the supervision GUI interface, the operator doesn't need a special training on a specific ASTRO GUI.
- The alarm events are visualized on the basis of the supervision GUI interface (common for all the supervised systems) including the visualization through maps and priority levels related to any supervised system
- For example, the major alarms are visualized on the general graphic map, then the supervisor operator can access to the second level of the map in order to visualize more details of a specific alarm



FITRE S.p.A. - Tutti i diritti ris

ASTRO System Voice Recorder

- ASTRO, independently if configured as PA, Intercom, Emergency system can record automatically all the conversations and/or PA announcements
- All the recorded audio files are stored into the mass static memory of ASTRO and the operators can access to them through ASTRO Client and, through Web-Service
- ASTRO offers a set of easy-to-use tools in order to search the files (date/hour, user data, event).



www.fitre.it

- All rights

- Tutti i diritti

ASTRO System Voice Recorder

- ASTRO records automatically al the conversations and PA announcements, provided that these are managed by ASTRO itself. For example, if the configuration foresees that all the conversations are peer-to-peer type, then they are NOT recorded
- When it is required the recording of all the communications existing in the plant (e.g. radio, telephone) managed by the related systems, then it is necessary to provide a general voice recorder that will record also the ASTRO conversation through the SIP sniffing function



- All rights

- Tutti i diritti rise

ASTRO System Voice Recorder

- ASTRO guarantees minimum 32 Gbyte of its memory space (typical is about 40 Gbyte) for recording the audio files
- The audio recording occupies maximum 32 Mbyte/hour
- Even considering the stricter data, it is possible to guarantee that ASTRO can record audio files in continuous mode (h 24) for 1.000 hours (about 42 days / 24 h/day)



- Tutti i diritti ris
- The PAGA system has the scope to broadcast messages / Announcements. It is designed for managing a mono-directional flow of information: from the system toward the field (loudspeakers) in automatic or manual mode (by the operator)
- In industrial environment, it is also important to guarantee the communication among the field personnel as well as from the field to the control room

INTERCOM function

- All rights

- Tutti i diritti rise

FITRE S.p.A.

- The INTERCOM function doesn't require any certification
- The loudspeaker network can used for broadcasting both the Emergency Announcements and the «paging» messages (during the normal working activity)
- In the field are installed telephone / intercom sets in order to allow the bi-directional communication among the persons as well as among personnel and the operators in the control room(s)
- In any case, the INTERCOM functions NEVER disturb the EMERGENCY functions



- All rights

FITRE S.p.A. - Tutti i diritti rise

PAGA 54-16 & INTERCOM ASTRO SW Architecture



- Thanks to this fully integrated architecture, the Client benefits in significant cost saving because he:
 - Uses industrial and civil Intercom / Telephone sets (even connected and managed by the PABX system) in order to access to the paging functions but using the same full controlled loudspeaker network already designed and available for the Emergency announcements

Uses the same LAN backbone already designed and available for all the other communication of the plant



www.fitre.it

- All rights

FITRE S.p.A. - Tutti i diritti risel

FITRE S.p.A. • electronics & telecommunications

- It is NOT necessary to foresee dedicated and separate cabling network per each service: PA, Intercom, Telephone and so on.
- All the communication services use the same LAN backbone.
- The system uses only one loudspeaker network for different services for managing:

Emergency Voice Announcements

Paging voice massages

Intercom / Telephone bidirectional communications



www.fitre.it

- All rights

- Tutti i diritti rise

FITRE S.p.A.

FITRE S.p.A. • electronics & telecommunications

- It is possible to access to the PA, paging and bidirectional functions just using the type of the station already available in the plant (analog, digital IP, indoor or outdoor industrial weatherproof / explosion-proof type). So, there is a significant cost saving; in terms of reduction of:
 - Cables and the related installation accessories
 - Time for installation and cabling activities
 - Installation documentation
 - Several Trainings (time), necessary when there is one network per each system
 - Equipment (it is not necessary to provide in the same location, the intercom and the telephone sets with the related acoustic box)



www.fitre.it

114



All the industrial stations are configurable in order to be used as telephone and/or intercom

The intercom station is characterized by the possibility to activate automatically the selfanswering when the station receives a call. In order to increase the sound around the location where the intercom station is located, it is possible to connect an additional amplified loudspeaker (weatherproof or explosion-proof type). The intercom station and the related amplifier loudspeaker(s) could be considered as «small paging zone».



- All rights

FITRE S.p.A. - Tutti i diritti riser

In areas where the ambient noise may vary on the basis of the working conditions (e.g. fans area) then it is possible to use the self-adjustable amplified loudspeakers. In rest condition, the loudspeaker operates as ambient microphone adjusting its own output about 1 time/second; when it receives the call then it adjusts automatically its output on the basis of the last output volume

The amplified and self-adjustable amplified loudspeakers can be used for managing PA areas/zones (only when the EN 54-16 certification is not required)

2017.03

www.fitre.it

- Independently by the type of the available station, the user can:
- Access to the loudspeaker network for broadcasting the «Paging» announcements
- Inform the paged person on which bidirectional communication line the initiator is waiting for the answer (Page & Talk function)

The paged person can use any intercom or telephone station for answering to the paging announcement



- All rights reserved

vati

FITRE S.p.A. - Tutti i diritti riser

- Such full Paga & Intercom integration guarantees also the redundancy of the «Telephone» and «Intercom» functions:
 - In case of fault of the PABX, then ASTRO manages all the Intercom and Paging functions on the digital IP and analog stations (these last managed by the GFX gateway)

In case of fault on the GFX or ASTRO, then it is activated automatically the switching of the telephone lines: the cables are connected to the related subscriber ports of the PABX and the intercom stations become normal telephone users of the PABX



www.fitre.it

119



- Elimination of the acoustic feed-back (larsen effect):
- Very often, the working activities require that all the users of the plants (intercom, telephone, radio) can access to the loudspeakers network
- In order to avoid the acoustic feed-back risk (when the initiator is located close to one or more loudspeakers), ASTRO records automatically the paging announcement
- When the initiator hung-up his station, then ASTRO broadcasts automatically the recorded paging announcement



- All rights

- Tutti i diritti rise

FITRE S.p.A.

- FITRE has designed the architecture of ASTRO system on the basis of the HW and SW "building-blocks" (modularity) in order to meet the Customer's requirements avoiding special and proprietary solutions to be invented time by time
- The set of HW modules (ASTRO, PSDV, IP-DAD / amplifiers, ECBI, ECRIO, ReteMatic) as well as of SW (SIP, FastPA, Web-Service, SNMP) provide the capability to implement systems based on different levels of complexity:

Management with or without redundancy

- Local or remote redundancy
- Distribution of the intelligent nodes or only amplification nodes
- Management of any type of station (digital IP, analog or mixed analog & digital IP)



www.fitre.it

- All rights

FITRE S.p.A. - Tutti i diritti riservati

FITRE has developed ASTRO architecture in order to meet the multitude of functional specifications adopted in many different industrial applications where the integration with different communication systems is one of the most important factor in order to manage the plant

Intercom, Emergency, Paging, radio and telephone users must communicate in fast and reliable way; this increases the safety and reduces the costs



123

- At present, the concept of digital IP system operating through the LAN backbone is nowadays well established and it is universally well recognized as a benefit in terms of saving costs as well as in terms of increasing of the availability and safety
- The management of a plant requires several communication systems; the old concept to design and install a dedicated cabling per each system is today obsolete
- Currently, the market requires that the LAN has been designed and sized in order to guarantee the maximum level of availability as well as to guarantee the transport of high quantity of data through secure methods avoiding interferences among the different services transported over the LAN



- All rights reserved

vati

FITRE S.p.A. - Tutti i diritti riser

- By adopting the VLAN (Virtual LAN) it is possible to dedicate «channels of data flow» mutually independent and using only a fibre optic cable with significant advantages:
 - The fibre is cheaper than the copper
 - The installation time is limited to lay only one cable instead of «n» cables (one network per each system of the plant)
 - Ease of modification of the connections because they are just virtual connections and they don't require any cabling modification and/or additional cabling
 - Real time management of the network including very precise information about the causes and the location of the fault. This reduces at minimum the costs of the maintenance activity



125

- Unlike many other systems, ASTRO uses the digital IP technology to 100% (all the modules of ASTRO are native IP)
- In some systems available on the market, the term «digital» is utilized to indicate an ISDN connection or proprietary solutions used for transforming the analog signals into digital ones; so:
 - The system controller manages the its own resources through pointto-point connections (ISDN or proprietary protocols)
 - The controller is connected to the LAN through an its own interface (not IP native)
 - Almost always it is necessary to provide one controller in each node
 - The communication among the several nodes is typically limited to few channels (predefined by the manufacturer)
 - All the resources of the nodes (Operator Consoles, alarm inputs, actuators and so on) are connected directly to the cabinet through cables with limitations in terms of distance



www.fitre.it

© FITRE S.p.A. – Tutti i diritti riservati – All rights reserved

2017.03

 Basic architecture in other systems Basic architecture in ASTRO systems





- In case of fault of oneIn case ofcontroller then the other onethen the sCANNOT manage themanage aresources of the faulty oneresources
 - In case of fault of one ASTRO, then the second ASTRO can manage automatically all the resources of plant

2017.03

•••

- All rights reserved

- Tutti i diritti riservati

© FITRE S.p.A.

FITRE S.p.A. • electronics & telecommunications

re

www.fitre.it

- In the proprietary and quite old systems, the architecture based on one controller unit per each node has been used for meeting the redundancy requirement of the system «A & B»
- The redundant «A & B» system was born of the need to guarantee the broadcasting of the announcements even in case of failure on one controller and accepting, as inevitable consequence, the reduction of 50% the sound pressure (- 3 dB)
- In case the reduction of -3 dB is not acceptable then it is necessary to double the amplification power (and the quantity of loudspeakers) in each node: 100% on line «A» and 100% on line «B»



- All rights

- Tutti i diritti riser

FITRE S.p.A.

- Traditional «A&B» architecture with
 50% of the power on "A"
 - ✤ 50% of the power on "B"

 Full-Power «A&B» architecture with

- ✤ 100% of the power on "A"
- ✤ 100% of the power on "B"



Equivalent Architecture in ASTRO systems **



In case of fault on one ASTRO then the second one becomes automatically the server of the whole system and it manages 100% of the sound power on the plant tre

www.fitre.it

2017.03

- All rights

- Tutti i diritti

FITRE S.p.A.

FITRE S.p.A. • electronics & telecommunications

130

- The equivalent architecture of ASTRO foresees:
- Three controlled communication channels between the two ASTRO units in order to guarantee the continuous automatic data alignment as well as the PA and Intercom functions even in case of fault on one ASTRO
- Support up to two simultaneous faults on the LAN without any functional limitation on the system
- In case of three simultaneous faults on the LAN, then each ASTRO becomes the server of its area managing the local resources
- Thanks to the full redundant LAN interface available on the Operator Console, the operator can access always simultaneously to VLAN A and to VLAN B (and consequently to ASTRO A and ASTRO B) in order to broadcast the announcements simultaneously on loudspeakers «A» and «B»



2017.03

Standard «A & B» architecture of ASTRO Systems



- Like the previous block diagram drawing but considering the case of 3 simultaneous faults on the communication between the two ASTRO units
- In this case the system is split in two functional sections, each controlled by its own ASTRO which manages the local resources (operator consoles, amplifiers, all call, selective call and so on)
- In any case each loudspeaker zone is still based on line «A» and line «B» managed by its own amplifier



www.fitre.it

- All rights

- Tutti i diritti risel

© FITRE S.p.A.

- All the above PAGA architectures (shown on the block diagram drawings) support also the INTERCOM function
- In fact, the loudspeakers network is the common element (media) for broadcasting:
 - EMERGENCY announcements and messages (through the equipment certified EN 54-16)

PAGING and INFORMATION announcements and messages in order to increase the normal working operation of the personnel

> Bi-directional voice communications (intercom)



www.fitre.it

- All rights

- Tutti i diritti rise

FITRE S.p.A.

- It is clear the great economic benefit of using the same resources for managing different functions:
 Same LAN network (used also for the data transport related to other services)
 - Same amplification architecture (distribution of the amplifiers in the plant in order to reduce at minimum the length and the size of the loudspeaker cables)
 - Elimination of dedicated cables for connecting the intercom stations (each intercom is native IP and it is directly connected to the existing LAN through its own integrated Ethernet interface)



- All rights

FITRE S.p.A. - Tutti i diritti riser



The certifications (standards) give a set of rules to be considered during the designing, the implementation and installation of an Emergency Voice System but **only the Customer can define the functional requirements on the basis of his working methods**



Conclusions

The most important quality to be evaluated and to be recognised in a supplier/manufactures is his ability to understand correctly the functional requirements that the system has to guarantee in order to get the «Customer Satisfaction».

It doesn't exist any "good' or "bad" system; only the system fulfilling the client's needs can be defined as «ideal system». The vendor/manufacturer must be able to incorporate the needs of the customer in order to supply

«the ideal system that satisfies his customer»



– Tutti i diritti

FITRE S.p.A.



Thanks for Your attention





© FITRE S.p.A. - Tutti i diritti riservati - All rights reserved

2017.03

Abbreviations

	a.d.a.	Acoustically Distinguishable Area(s)	1	ISO 9000	
	Alcons	Percentage Articulation Loss of Consonants	LAN		
	BTTF	Bureau Tecnique Task Force	ſ	MNS	
	c.i.e.	Control and Indicating Equipment	ſ	MTBF	
	CEI	Comitato Elettrotecnico Italiano	I	MTTR	
	CEN	Comité Euroéen de Normalisation	(OLED	
	CENELE	C Comité Européen de Normalisation en Électronique et en Électrotechnique	F		
	CIS	Common Intelligibilty Scale			
	CLC BT	Cenelec Bureau Technique		PAGA	
	CPR	Construction Products Regulation			
	dB	decibel		XASTI NG G L G	
	DM	Decreto Ministeriale		s.s.c.i.e.	
	EoL	End of Line		s.s.e.p.	
/ati – All rights reserved	EQ	EnQuiry			
	EVAC	Emergency Voice Alarm Communication systems	9	STIPA	
	FPC	Factory Production Control			
	GUI	Graphic User Interface	l	JAP	
	IEC	International Electrotechnical Commission	\	VACIE	
ti riser	ISDN	Integrated Services Digital Network	\	VAS	
i diritt	ISO	International Standardization Organization	\	VLAN	
RE S.p.A. – Tutti		Â	f	itr	
© FITI		2017.03	vw.	fitre.it	

ISO 9000	Gestione della Qualità
LAN	Local Area Network
MNS	Mass Notification System
MTBF	Mean Time Between Failures
MTTR	Mean Time To Restore
OLED	Organic Light Emitting Diode
PA	Public Address
PABX	Private Branch Exchange
PAGA	Public Address and General Alarm
RAMS	Reliability Availability Maintainability Security
RASTI	Room Acoustic Speech Transmission Index
s.s.c.i.e.	Sound System Control and Indicating Equipment
s.s.e.p.	Sound System for Emergency Purposes
SIP	Session Initiation Protocol
STI	Speech Transmission Index
STIPA	Speech Transmission Index for Public Address system
UAP	Unique Acceptance Procedure
VACIE	Voice Alarm Control & Iindicating Equipment
VAS	Voice Alarm System
VLAN	Virtual LAN

