

Think Safe, Use SafetyNet

A Wireless Sensor Network for Fire Protection and Emergency Responses



If you are a member of fire and rescue services (FRS) related personnel, then this Newsletter contains vital information to support you when discharging your duties.

If you are a Group Fire Control Officer, Gold Command, Silver Command, Incident Command, Sector Command Officer or even a firefighter, would it be useful to obtain real-time, dynamic information from inside an incident building before entry? Would it be helpful for decision making and firefighting?

If any of your answers to the above questions is positive, then SafetyNet is able to accomplish your needs. SafetyNet is an integrated first-responder support system providing real-time data about building and hazard conditions, including monitoring of responder location through mobile nodes, floor-plan provision and hydrant locations. This newsletter describes what SafetyNet offers.

Benefits from SafetyNet

Life Protection

Firefighters command the greatest respect because they save lives and protect property. There is no question that protecting firefighters should be of paramount importance in fire and rescue situations. Firefighting is tough and is made more so by uncertain situations. SafetyNet can provide FRS with the support to protect firefighters' lives in such situations. SafetyNet turns uncertain situations into certain by obtaining and providing information about on-site environment and hazards. Firefighters will be sure that it is safe to enter a building, and advised how to most efficiently tackle the hazards.

Real-time dynamic on-site information

SafetyNet wireless sensors deployed in buildings provides real-time information about temperature, humidity, smoke level, flame level, toxic gas existence (e.g. carbon monoxide) and more as desired to on-site fire engines, fire command and even the control centre. Together with the information about the building, occupants and hazards available in the FRS database, front line firefighters have excellent support for fire fighting and rescue.



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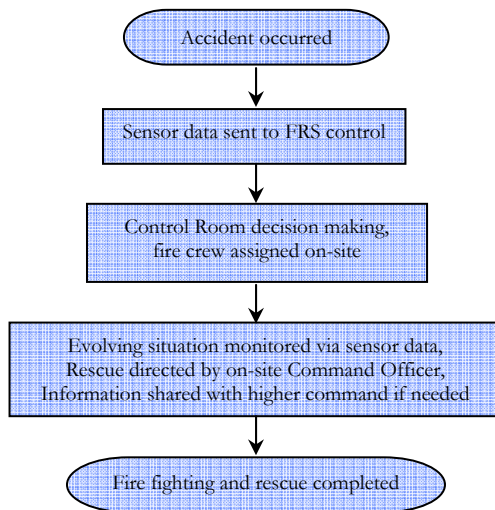
Accident Identification before 999

Abnormal environment parameters (temperature, humidity, smoke, flame, toxic gas) detected by SafetyNet building wireless sensors will trigger accident alarm and be sent to control centre even before a manual 999 call. The combination of various parameter results from different sensors within the network and the information crosschecked between every single sensor node will ensure each alarm is reporting a real accident!

Support decision making

FRS emergency duties normally begin as a 999 call rings, in the mean time decision making starts in the control room. Is it a real or false fire alarm? How severe is the fire? What are the environment parameters? Are there any chemical materials involved? Currently the answers to these questions have to be worked out from the 999 calls but information is always limited. So officers in the control room have to use their experience and decide “the number of fire engines needs to be sent on-site”, “any special equipment required” and so on. As long as control room continues updating accident information after receiving a latter call or feedback from fire crew’s on-site inspection, control room has to keep changing decision.

With SafetyNet, as the building wireless sensor network will provide various environment parameters, all the answers to the above questions can be completely obtained at the first instance even before the 999 call from a victim or witness, and hence more efficient and effective decisions can be made at the beginning of the accident. During the event, command officers either on-site or off-site may benefit from dynamic information together with their experience to direct the firefighting and rescue.



SafetyNet supported FRS procedure

Support fire fighting and rescue

A robust sensor mote mounted on the firefighter’s uniform forms part of a firefighter guidance system, which will detect the surrounding environment and help direct firefighters to rescue the people inside a building and to safe ways. Via the system, building hotspots and dynamic evolving hazards will be realized between the fire crew.



Uniform photograph courtesy of reddingfirefighters.org

A sensor mote mounted on firefighter uniform

Save time, save life

Time is critical in emergency. Transferring information about hotspots and dynamic hazards to on-site fire vehicles and control centre in real time will speed up the whole fire fighting and rescue procedure. Of course, the more time saved the more lives saved.

Extend Firelink and FiReControl service

Communities and Local Government have recently awarded O2 Airwave (TETRA technology) the contract to replace the legacy mobile communications systems used by FRS throughout England, Scotland and Wales. As police and ambulance services already joined Airwave, all of the emergency services across Great Britain will be on one national network, making it the biggest public safety network of its kind in the world.

Airwave is part of the UK Government’s Critical National Infrastructure and is designed to stay working even during major incidents (9/11, 7/7) when conventional mobile and fixed telephony networks may overload and fail. Firelink and FiReControl are the main projects of Airwave fire service.

SafetyNet is able to cooperate with Airwave and its Mobile Data Terminals on fire engines. SafetyNet Wi-Fi/ZigBee networks may be supplements to Airwave Firelink and FiReControl with support information GUI integrated into FRS data terminals, due to the convenient installation and maintenance of SafetyNet.

Convenient Installation and Maintenance

Simple hardware on fire vehicle

As Mobile Data Terminal will be basic equipment and available in each fire engine and command unit because of the Firelink and FiReControl project, only one SafetyNet USB adapter (dongle) is required on each fire vehicle for accessing dynamic information. The plug and play design means users can handle it easily.



SafetyNet USB adapter

Easy software integration

The SafetyNet real-time information support system is a web-based application and only a web browser is needed to display the GUI and access the information, hence the system can be simply integrated into the existing FRS (Airwave) Mobile Data Terminal used on fire engines. Everything is under the control of fingertip touch.

Low cost small robust sensor

Robust low-power sensor-node (mote) technology ensures the tiny sensors are capable of operating in extreme high temperatures, communicating over a wide range and capable of supporting occupancy, heat, smoke or integrity sensors. The sensor encapsulation is robust in the tough environments of fire accidents, e.g. can sustain continuous direct fire for

tens of minutes. Due to the network design, even with sensors damaged in part of the network, the function of the remaining network will not be affected. In large scale production, the price of a single mote will be small.



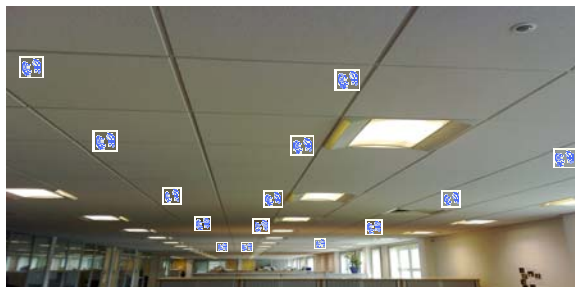
Sensor module

Wireless sensor network (WSN) in building

Wireless sensors may be installed during the construction of a building or afterwards, as there is no cable involved. The sensor network built in SafetyNet will be mesh network, which is reliable, fast-transmitting, self-organizing and easy to deploy. In the event of sensors being damaged, the remaining sensors will keep on working, and find a suitable network route to transfer the information to the outside of the building.

Integration with building management system

The management of WSN may be integrated into the existing building management system. As similarly to the existing fire alarm or smoke detection system, there is no need to install new cable for integrating SafetyNet with building management system.



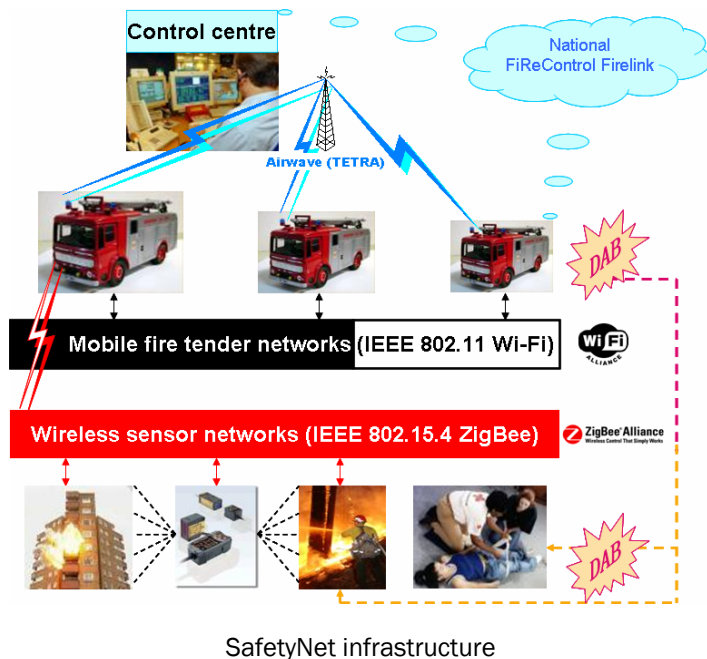
AutomatedBuildings.com
Building Management System



WSN in a building with building management system

SafetyNet Architecture

SafetyNet is an integrated first-responder support system providing real-time data about building and hazard conditions, including monitoring of responder location through mobile motes, floor-plan provision and hydrant location. With a communications protocol to allow up to 10,000 sensor nodes to be connected in a self-healing ad-hoc network, SafetyNet information infrastructure enables buildings, firefighters, fire tenders, and their control centre to efficiently communicate during natural or manmade disasters. SafetyNet infrastructure contains three layers of networks.

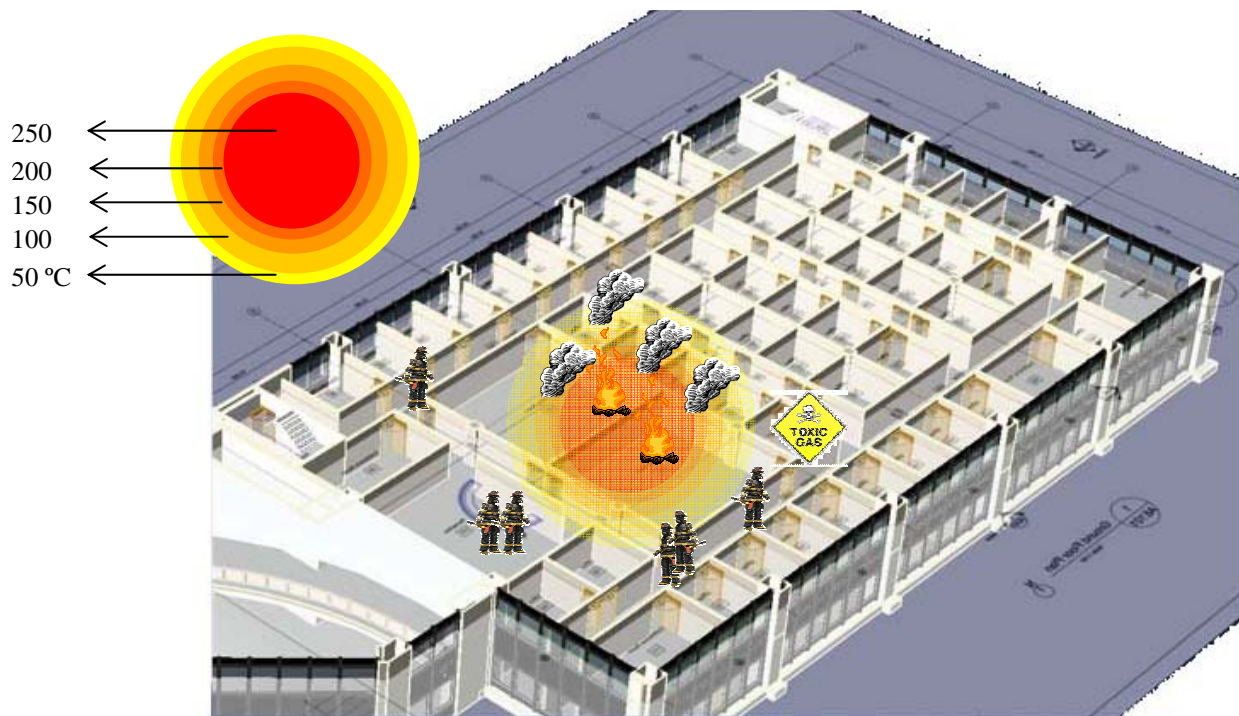


ZigBee - The bottom layer comprises a robust wireless sensor network installed in and around the building. The sensor network utilises sensor 'motes' to detect any changes in the environment at any specified locations. The sensor network can take the place of existing fire alarm networks, meaning no previous installations are required. Information collected flows over the sensor network and is transmitted to the fire tender network.

Wi-Fi + DAB - The middle layer consists of a vehicle-mounted mobile network installed on the fire tenders. It is achieved by upgrading the newly introduced Firelink Mobile Data Terminal and adding not only the up-link with the control centre but also the down-link with the sensor network. The real-time information about the building, occupants, and locations of the fire fighters is collected from the sensor network and presented at the fire tender network. Data over Digital Audio Broadcasting (DAB) technology is employed between the bottom and middle layers in order to maintain a time-critical one-way communication channel between the fire tenders (e.g. on-site commander) and emergency personnel.

Airwave - The top layer is the central facility located at the control centre and linked with the on-site fire tender network through Airwave communication network. The SafetyNet emergency response management system at the control centre will provide up-to-date critical information for decision making and remotely monitor the latest development of incidents.

Dynamic information about hotspots and other hazards collected from WSN or downloaded from control centre will be displayed along with 3D floor plans on the fire engine Mobile Data Terminals or even firefighter personal devices and command officer handheld devices if desired. Data mining technologies have been used to retrieve the information from mass sensor data and present it to right people at right time in right formats.



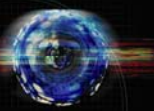
SafetyNet dynamic information presentation (thanks to Bentley Systems for 3D building design)

Visiting News

On 10th August 2007, some of SafetyNet Research Team from Loughborough University visited Derbyshire Fire and Rescue Services (DFRS). The first-hand information on emergency response of FRS has been collected from fire service officers. The comments on SafetyNet made by DFRS officers have been integrated into the outputs of the SafetyNet project.

Sponsor

Technology Strategy Board



SafetyNet project is sponsored by Technology Strategy Board, which was previously known as Department of Trade & Industry (DTI).



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