



### B.R.A.I.N.S.— Building Redundant, Automated, Intelligent Networks System

Why BRAINS?

BRAINs adds brain to the building and converts a normal passive building into a SMART building—SAFE, MANAGED, AUTOMATED, RESOURCEFUL & TRAINED. A smart building is the building block for a SMART community/complex/society/area/township or a SMART CITY. The more intelligence we build into the things or IOT (Internet of things) the SMARTer we get. The decision making, management and disaster recovery becomes easier. So let's build SMARTer world with BRAINS.





# BRAINS—

As the name suggests, is an integrated system for all the buildings with an in-built artificial intelligence based on the principles & technology of IP (Internet Protocol) as the communication backbone and SCADA (Supervisory Control & Data Acquisition) using PLCs (Programmable Logic Controllers), various kind of analogue sensors, RTUs (Remote Terminal Units) and DCSs (Distributed Control Systems). It is like the concept of IOTs (Internet of Things).

The idea of BRAINS is to work out of sight with no impact on the occupant of the building. When a person, be it man, woman or child enters a building with BRAINS control they will encounter a comfortable environment at the correct temperature and clean air as he or she moves through the building space. These individuals will probably never consider how this environment is maintained.

The BRAINS as we call it, is the same thing but with great emphasis now being place on the energy "E" component due to the current economic climate and commercial energy costs.

The modern age buildings are no more just a civil construction jobs. Today the buildings have to be green, eco-friendly, energy efficient and working towards reducing the carbon footprints of the organisation.

Today's buildings need a lot of management, supervision, facilities and controls. With the advent of technology, today we have a possibility of integrating the following functions in the same network; turning the buildings into a SMART buildings;

- 1. Fire safety, alarm systems
- 2. Heating Ventilating and Air Conditioning (HVAC)
- 3. Elevators and escalators
- 4. Access control systems
- 5. Lighting management as per occupancy & timings
- 6. Energy & utility management & smart metering systems
- 7. Security & surveillance system
- 8. Water & pump management system
- 9. Public announcement system
- 10. Paging system
- 11. Power backup system, maintenance & management
- 12. Parking system
- 13. IT, TV & Telecom system





When all the above functionalities are terminated on one single network, which is;

- 1. Scalable
- 2. Highly available
- 3. Redundant
- 4. Easily manageable
- 5. Secured
- 6. Converged with Penta-Play capabilities (voice, video\*, data, wireless & automation)
- 7. Interoperable & Intelligent
- \*: Video Communication, Television & Video Surveillance

The building turns into a SMART building—SAFE, MANAGED, AUTOMATED, RESOURCEFUL & TRAINED.



#### Fire safety, alarm systems

Fire Safety has now becoming one of the basic features for any new building. In fact it has even been on top priorities for the older buildings to adapt the fire safety measures for the welfare of occupants.

Be it a School, college, hospital, Mall, cinema hall, recreation centre, club house, sports complex, stadium, railways station, airport, bus depot or any other public building, fire safety system has become one of the most basic needs. But typically, it is handled in a very unprofessional manner, wherein everything is manual. There are pipelines, firefighting extinguishers, sand buckets and notifications, across the buildings "don't use lift, during fire". This means, everything is manual. When the disaster happens, everyone should get into fighting with fire.

A little better one will also have smoke detectors & sprinklers installed.

But for real safe buildings, we need to have the following in place;

- 1. A separate storage tank for firefighting pipeline, in which the water is kept running periodically, so that leakage and effectivity is kept checked on a regular basis.
- 2. A smoke detector & alarm network linked to the firefighting pipeline system & public announcement system, so that adequate time could be given to the people for evacuation of the premise in case of any emergency/mishap.
- 3. An interlinked surveillance system, with a facility of head count & face recognition, so that life safety could be ensures.
- 4. Efficiency check for the water tank and water pumps for the firefighting systems, so that no last minute surprises are faced.

With BRAINS all the above becomes possible on a clink of a button. We are able to see the occupancy of the building, and also sense the presence of any life form within the building at the time of emergency or otherwise, enabling us to take precautions and corrective measures, before any disaster. As the Russian proverb goes "A stitch in time, saves nine".

## Heating Ventilating and Air Conditioning (HVAC)

HVAC (heating, ventilation, and air conditioning) is the technology of indoor and environmental comfort. Its goal is to provide thermal comfort and acceptable indoor air quality. HVAC system design is a sub-discipline of mechanical engineering, based on the principles of thermodynamics, fluid mechanics, and heat transfer. Refrigeration is sometimes added to the field's abbreviation as HVAC&R or HVACR, or ventilating is dropped as in HACR (such as the designation of HACRrated circuit breakers). HVAC is important in the design of medium to large industrial and office buildings such as skyscrapers and in marine environments such as walk-in aquariums, where safe and healthy building conditions are regulated with respect to temperature and humidity, using fresh air from outdoors.

Early control systems were pneumatic or air-based and were generally restricted to controlling various aspects of the HVAC system. Common pneumatic devices include controllers, sensors, actuators, valves, positioners, and regulators. Due to their large base of installation throughout the 1960s and 1970s, pneumatic control systems are still in place in a majority of existing buildings, especially in established metropolitan areas. Analogue electronic control devices became popular throughout the 1980s. They provided faster response and higher precision than pneumatics.

However, it was not until digital control or DDC devices came on the scene in the 1990s that a true automation system was possible. However, as there were no established standards for this digital communication, various manufacturers, created their own (proprietary) communication methods. However, today we can do it all on a single IP network, which is anyways laid in all the buildings for LAN, Voice, Video & internet.

The concept of HVAC at the most preliminary stage, started with the industrial revolution itself, but today's HVAC systems have come of ages from what it used to be in those days. The figure below shows the earliest signs of HVAC systems during early 18th century.

Today our systems are smart enough to understand the number of occupants in the room and maintain the temperature & ventilation accordingly. For example, for a conference hall having 25 people would need more air for breathing and subsequently more heating/ cooling compared to an office chamber of just 2-3 people.



The present HVAC systems using

IP network & SCADA systems are able to work on these intelligence and adjust the environment accordingly. Atypical heating system for building is shown in the above figure, like wise we also have cooling systems and pumps for air ventilation.



In totality the system above shows how a separate system for heating and a separate system of cooling are linked in together for a smart environment control management.



#### **Elevators and escalators**

Usually people keep elevators & escalators separate from the building management systems, but the moment you think of the green environment or energy conservation, it becomes quite imperative that you take elevators & escalators also under smart management systems. These are one of the most abuse facilities in any building.

Typically when somebody has to go up, he/she would press down button, as he/ she is on a lower floor or vice-versa. If there are 5 lifts, typically an individual would call all five of them and use, whichever comes first.

Every time the lifts moves or lift stops, it consumes energy. So we need to curb the energy wastage.

So if we give just one button to request for a lift and let the system plan which lift is the nearest or which one has the least energy consumption to reach that floor should be used, that solves everyone's problem.

Secondly now a days surveillance inside the lift has also become a mandatory requirement. And that also can be done on the basis of the same network which is deployed for adding intelligence to the elevator system.

Similarly, we find escalators & walkalators in malls, railways stations & airports. Here also if the machine is able to sense the traffic and then move or stay stationery, it contributes to energy conservation.

#### **Access control systems**

I think this is the most commonly used technology, which is associated primarily with the attendance system of an organisation these days. Even a lot of government offices have started using biometry based access control linked to the payroll management system.

But here, we are talking of the access control for building, not the attendance system which means, if a visitor is there to meet an official on 5th floor, the system wouldn't allow him on 8th floor. The visitor pass issue to him from reception would allow him access only to a certain area, which is earmarked on the basis of his/her information and the official he is going to meet.

No single system is good for all, the system needs to be designed and defined as per the need of the building. For example a mall's need would be different from a hotel or a school. A hospital would be dissimilar from a public/government office.

### Lighting management as per occupancy & timings

Lighting, as we see is the key contributor toward the energy wastage, after the air-conditioning. To conserve or to optimise this, we need to have light sensors & occupancy sensors within the building, a collective data of which would decide, how much lighting is necessary and how to avoid wastage.

We can set the parameters in SCADA system on lux/lumen and the nature of job being conducted in the said premise. Like for presentation we need lesser lights, but for studies we need a lot of it.

A library should be well-lit, but for developing photos, we need dark rooms.



Moreover there are work environments and there are schedule days. Like for an office working five days a week, there is no need of public area lightings on a Saturday or a Sunday.

All those kind of planning and implementation could be done in BRAINS.

### Energy & utility management & smart metering systems

We have all kinds of system in a building and we need to manage them smartly to reduce the carbon footprint and identify the building as green.

Depending upon the type of building and the needs of the environment, the management & conservation of energy can be planned in BRAINs.

#### Security & surveillance system



Firstly, we want to build a better system than human intensive security, so we also need to understand the human limitations. As per a study at Harvard University, human limitations in surveillance can be categorised under three limitations listed as under;

- A human observer cannot focus on more than 1-2 things at a time.
- A human eye cannot observe plenty of changes, if done in symmetry in a crowded place. This is called change blindness.
- A consistent watch on a particular area make human eye blind to unusual objects, phenomena known as "intentional blindness".



Secondly, in the new age world, we are susceptible to various security threats like terror attacks, which we see all around us now days. Every property has now become vulnerable. But is simply putting up the cameras sufficient?

#### Absolutely NO.

What we get by putting up the cameras, is multiplying the number of hours with number of cameras. If we install, 50 cameras, in one hour, we are generating 50 hours of surveillance videos. Security agencies will go bonkers in analysing such huge video database.

Here again, technology comes as a saviour. There is no use of capturing videos, unless there is a mechanism to add intelligence into it.

And this comes out simply on the basis of the human behavioural reaction to an eventuality. When we have a security guard; it's all dependent on the element of suspicion which security guard will have on a stranger/trespasser/unauthorised visitor, due to his actions. If the same suspicion could be generated in the surveillance system, which could generate an alarm/alert to the security guards, it would be a fruitful system to complement the security.

Following are the suspicious activities which lead to some kind of threat:

- 1. Loitering/Unattended stuff or baggage
- 2. Trespassing
- 3. Person starts running
- 4. Vehicle driving in wrong direction
- 5. Vehicle entering in unauthorized area
- 6. Vehicle over speeding
- 7. Wrong parking

We can tap and trap the iffy activity by the surveillance systems by putting in the whole city under camera. The system will do the snap/ audio video capture and also raise an alarm on the basis of pre-defined dubious activity. Following are some examples of slotted devious activities that we can define, in order to achieve a better threat/crowd/ traffic management:

- 1. Human activity & management can trigger a video capture & alarm
- 2. Man leaves an object and moves on/loitering
- 3. Somebody starts moving in the wrong direction
- 4. Somebody stops moving in the wrong direction
- 5. A person starts running
- 6. A person stops running
- 7. Man entering restricted area
- 8. Man exiting restricted area
- 9. People count of enter/exit a particular area

All that is possible in the new surveillance systems, which gets latched on the same network and make things happen from one single Control room.

#### Water & pump management system

Water is the most important ingredient of human body. 70% of our body is water and therefore anything related to human habitation needs a lot of water. If we see all the ancient and modern cities are built around the water bodies, be it lakes or ponds or rivers, water bodies are must for human habitation.

Coming on to building, our subject, we need water for drinking, heating, cooling, firefighting, almost everything. In a typical building we have separate water tanks for all these purposes. And we have pumps for maintaining the adequate pressure level to serve the desired purpose.

The figure below gives an idea of how the network would look like for a water management system inside a building. We can see a pump house, from where the pipeline goes into the four water tanks shown in the figure, from where it connects to the boilers/turbines, and at the same time the pump house is also reaching the SCADA control room.



#### **Public Announcement (PA) system**

PA system is the public communication backbone for all public buildings, be it a metro station, mall, railways station, airport, office complex or any other public/government building.

It's the only method to broadcast to all. And its role becomes pivotal in case of an emergency.

Therefore bringing the PA system on to the same network is an imperative function of BRAINs.

#### **Paging system**

This is a limited function, which may or may not be applicable to all buildings, but is surely an unavoidable feature when planning for a SMART building.

Typically this is used in education/healthcare organisation, when a particular operation/lecture is held for want of a specific personnel and the same is desired to be reached.



### Power backup system, maintenance & management

Power backup is again one of the most desired and important functions, especially for a country like India, wherein the power cuts are a part of everyday life routine. But today we are in the era, wherein and simple power cut can't be a reason for delay.

Time has become very important aspect of life, and power contributes to almost everything we do in our routine. Starting from our mobiles to computer, to AC, to water pumps to ventilation pumps to any kind of machinery or scientific apparatus, everything runs on power. Thus power backup is a mandate today.

Backup could be from a generator or a battery. It could be from and energy stored in battery via renewable energy or a generator which runs on conventional energy.

Now when we say power backup, it simply translates into supply and running efficiency of the battery bank or the Gensets.

So we need to monitor, the fuel levels in Genset, fuel consumption, working efficiency, service requirements, and of course replacement time and parameters. And all this should be generated out of system proactively and periodically.

#### **Parking system**



Parking can be managed on the basis of certain information, else it could be a chaos. One needs to know what the capacity of a parking area is and what is the occupancy, depending on which a new entry would be permissible or denied.

The above is achieved through sensors/RFID tags or using the surveillance system for parking management too.

#### IT, TV & Telecom system

When Planning a Local Area Network (LAN), the system administrator or the IT team, needs to pay attention on various aspects. First, they must stay up-to-date technologically, in terms of network speed, capacity and functionality.



At the same time, they have to control both upfront and long-term LAN costs. Finally, they have to figure out a way to achieve those objectives while also complying with a global mandate to trim energy consumption. To list it down briefly, they need to keep the following things in mind while planning out the network:

- Scalability
- Availability
- Redundancy
- Manageability
- Security
- Convergence
- Interoperability
- Intelligence
- Future safe investment
- Green technology
- Penta-play capable Data, Voice, Video (Cable-TV, IPTV, Surveillance & Video Communication), Building-Automation & Wireless
- Low CAPEX and low OPEX

That's a tall order. But customers can now achieve these goals by deploying an advanced GEPON solution, based on Gigabit Ethernet Passive Optical Network (GEPON) technology. The solution delivers a "70-80-90" set of benefits: reduce capital costs by up to 70%, reduced power consumption by up to 80%, and shrink the required floor, rack and closet space by up to 90%.

In the past, all GEPON solutions were created for the residential market for FTTH networks by service providers. However, now ZyXEL's R&D and customization of the technology to suite the need of of campus network, today we are using the same technology not just for FTTH, but for FTTB (Fiber-to-the-building), FTTF (Fiber-to-the-Floor) and even FTTN (Fiber-to-the-node). The ZyXEL GEPON solution is being widely used to today in BRAINs & even in the campus wide networks, which was conventionally deployed purely on a switching solution.



An GEPON is a Layer-2 transport medium, built with PON technology and fiber-optic cabling, which provides converged video, data and voice services at gigabit speeds over a single strand of fiber to endusers. Compared with legacy active-Ethernet solutions, a GEPON dramatically reduces electronics and cabling requirements. The PON cabling infrastructure supports bandwidth of more than 50 terabits per second (Tbps), and the single-mode fiber extends the LAN reach up to 20 kilometers without Signal Regeneration. (no intermediate distributed or access switches required).

It is the same network which would give wired & wireless connectivity to mobile users for the LAN services, internet & intranet, apart from voice, video, building management/SCADA like premium services. A typical BRAINs network looks like the below figure.





#### GREEN

Make the connection of renewable energy sources easy, reliable and cost-effective

#### PRODUCTIVE

Manage processes, make all the utilities of any infrastructure more efficient

#### **EFFICIENT**

Measure and control energy, automate, provide relevant diagnosis

#### RELIABLE

Prevent power outages and energy quality variances

#### SAFE

Transform and distribute power safely

#### About ZyXEL Communications

ZyXEL Communications Corp., founded in 1989 and headquartered in Taiwan, is the leading provider of complete broadband access solutions. As one of the early modem manufacturers, ZyXEL has undergone many transformations in the fast-paced networking industry. Today, ZyXEL is one of the few companies in the world capable of offering complete networking solutions of Telco, SME/Enterprise, and Digital Home for a wide range of deployment scenarios. Telco solutions include wired and wireless access network equipments, networking customer premises equipments, and Carrier Switches. SME and Enterprise solutions include Unified Security Gateway, LAN Switches and WLAN. Digital Home solutions include network connectivity devices and multimedia solutions.

The company has 3200 employees and distributors in 70 countries, reaching more than 150 regional markets. The ZyXEL Communications Corp. includes 33 subsidiaries and sales offices and two research and development centers worldwide. For more information, visit the company's Website, http://www.zyxel.com.

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