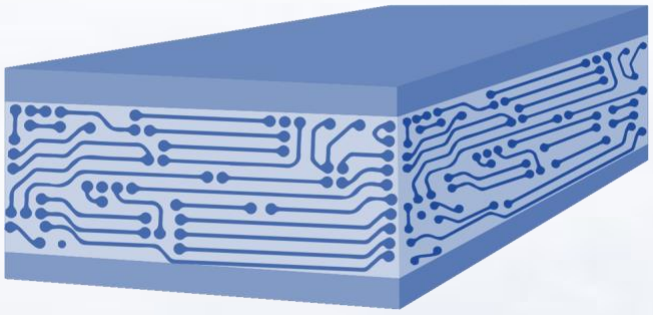


INTELLIGENT STRUCTURAL PANEL

QUASAR CONSULTING GROUP
WZMH Architects
C3Po3
Stephenson Engineering

CANADIAN CONSULTING ENGINEERING AWARDS
2019 SUBMISSION

PROJECT INFORMATION

Project Name:
Intelligent Structural Panel (ISP)

Firm Names:
Quasar Consulting Group
WZMH Architects
C3Po3 and Stephenson Engineering

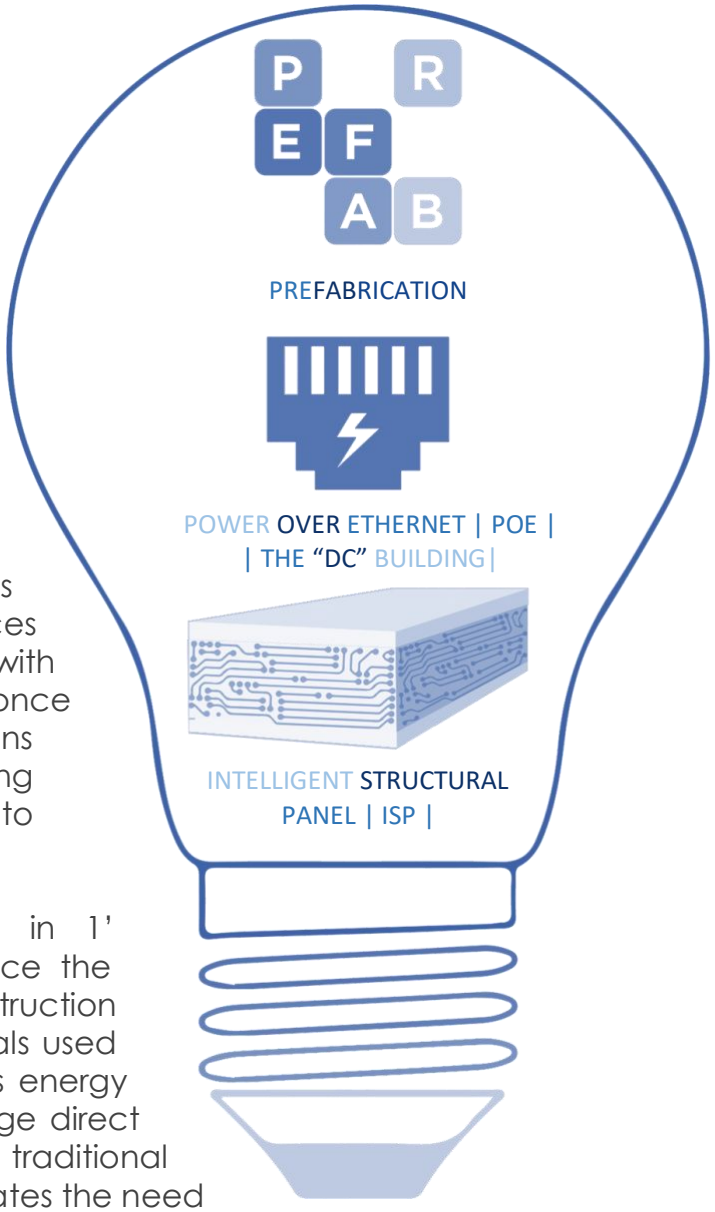
To be Entered in Category:
Technical Category F – Special Projects

Role in the Project:
Mechanical and Electrical Engineer Partner

PROJECT SUMMARY

The Intelligent Structural Panel (ISP) was developed by WZMH Architects, Quasar Consulting Group, Stephenson Engineering and C3PoE in response to a need for the next generation of smart building systems. The ISP is a smart building component that is prefabricated, modular, energy-efficient, and includes the infrastructure to power, monitor and control most key building systems including Mechanical, Electrical, IT, etc. The ISP is fabricated off-site, installed on-site with minimal labour, and 100% complete once 'plugged-in'.

Q1. INNOVATION

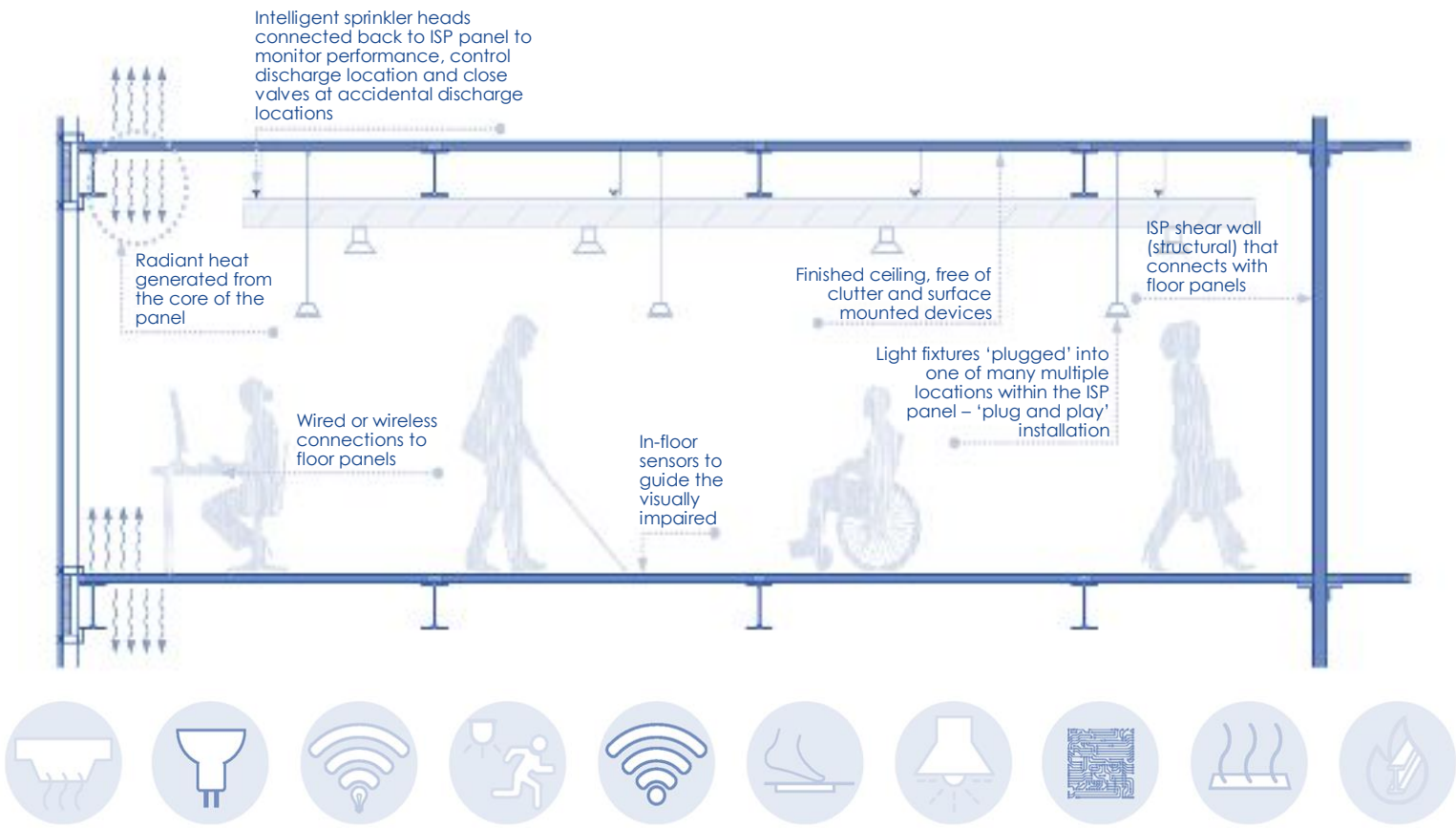


Building construction materials and techniques have largely remained unchanged in the last 50 years. The vision for the Intelligent Structural Panel (ISP) was simple: take all the components and processes that go into constructing a floor and shear wall in a building and combine it into one product – but with a 'brain'. The ISP panel is fabricated off-site with skilled labour, reduces construction waste, installed on-site with minimal labour and is 100% complete once 'plugged' in. Once installed, the ISP contains an intelligent highway to allow key building mechanical, electrical and IT components to be plugged in and operated.

The significance of the ISP is a '10 in 1' prefabricated component that will reduce the time it takes to build, provide safer construction sites and substantially reduces the materials used in buildings by as much as 25%. The ISP is energy efficient by means of utilizing a low-voltage direct current system that is not only safer than traditional higher voltage AC systems, but also eliminates the need for inverters or transformation typical in AC designs. The ISP is a concept that combines two very different components – sandwich plate system and an internal layer of technology for all connected devices. These two components result in an intelligent building system that can be used for floors and walls in lieu of traditional structural elements (i.e. concrete/steel decking) but with the added benefit of containing the infrastructure to operate the building.

The ISP works by incorporating an intelligent highway within the panel that allows the connection of an unlimited amount of both 'smart' and 'dumb' devices: low-voltage (DC) or PoE (Power over Ethernet). These devices are connected with an industry accepted international connector (RJ45) that plugs and snaps in place without the need for electrical junction boxes – making the ISP extremely flexible, versatile and allowing virtually anyone to connect/disconnect and relocate devices.

All connected devices are controlled and monitored from a secure network (similar to devices that are connected via data cables). The fact that the ISP contains an intelligent highway, all connected devices can communicate to each other via the network (i.e. laptop, mobile phone, etc.) Connected devices can be easily programmed to 'talk' to each other and make the building and spaces user-friendly, barrier-free, smart and energy efficient (i.e. lights interact with daylight sensors, fans will turn on/off with connected air quality sensors, roller shades will open/close based on natural daylight, etc.).

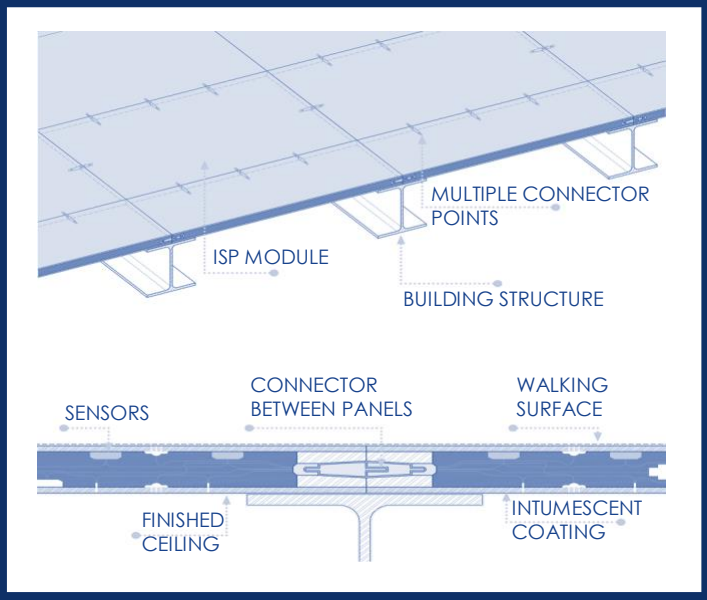


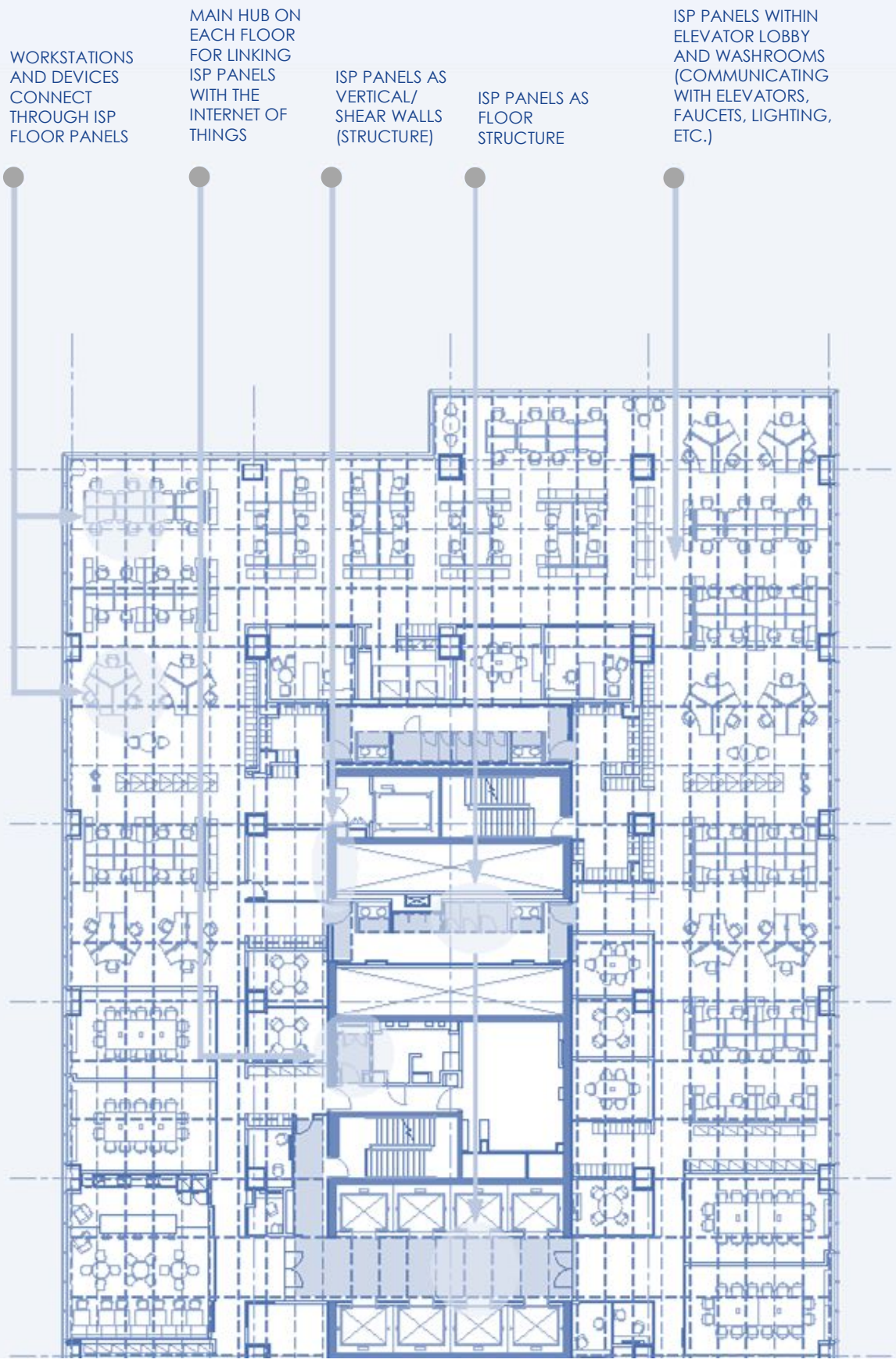
Q2. COMPLEXITY

The vision for the Intelligent Structural Panel (ISP) was to take all the components and processes required for constructing a building, and combine them into one prefabricated modular product – but with a 'brain'. The structural component was well understood since the steel sandwich panel was well established, however the key challenge of the ISP is the intelligent infrastructure which incorporates both technology and structure into one component, resulting in a building where the 'skeleton' or frame is 'smart', and provides the occupants with an environment that has access to the Internet of Things, is safer, more efficient, user-friendly, mobile, barrier-free, flexible and enjoyable. The team evaluated a number of technologies but settled on a solution with electronics-based 48 volts DC, and ethernet protocol based on the universal acceptance of both.

Another key challenge was to offer complete flexibility in the design and configuration of workspaces; whether the building is an office, hospital, hotel or other usage. The solution was to allow panels to include a multitude of ports, based on user needs, to connect both power and data to all devices within the space; lights, HVAC, IT, sensors, blinds, IT, security and AV devices.

The final challenge was integrating the Internet of Things and sensor technology into the ISP. Again, the simple ethernet based protocol and RJ-45 standardization of physical connection points allowed the ISP team to work with Microsoft and their Azure platform to integrate all sensors onto a common platform.




WORKSTATIONS AND DEVICES CONNECT THROUGH ISP FLOOR PANELS
MAIN HUB ON EACH FLOOR FOR LINKING ISP PANELS WITH THE INTERNET OF THINGS
ISP PANELS AS VERTICAL/ SHEAR WALLS (STRUCTURE)
ISP PANELS AS FLOOR STRUCTURE
ISP PANELS WITHIN ELEVATOR LOBBY AND WASHROOMS (COMMUNICATING WITH ELEVATORS, FAUCETS, LIGHTING, ETC.)

Q3. SOCIAL AND ECONOMIC BENEFITS

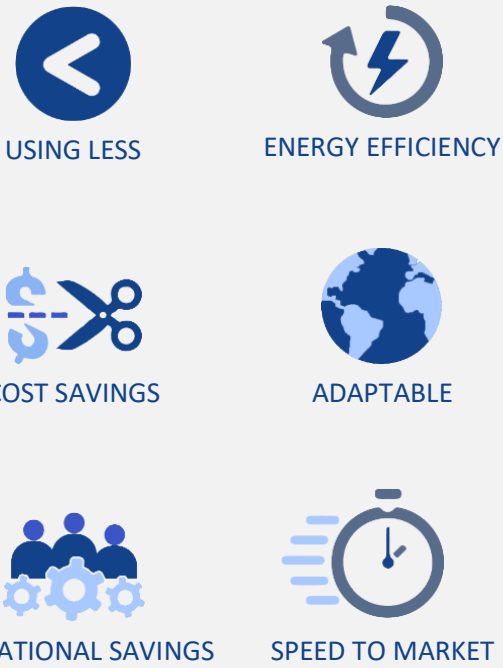
There are three main benefits to the ISP:

1. Reduced Construction Materials: A preliminary study prepared by the team has shown that the ISP uses 25% less materials than traditional buildings. These savings are primarily achieved by the prefabricated modular components. A reduction in materials used means that there are fewer natural resources used in construction, which has obvious long-term benefits.

2. Energy Savings: Based on preliminary energy modeling, the ISP saves an additional 15% compared to the exact same building if constructed with traditional techniques. These energy savings are achieved in two ways: a) Base building voltage within the user space is Direct Current which eliminates the need for inverters (AC to DC) for LED lighting, personal computers, AV equipment, HVAC control equipment, etc., b) The ISP leverages IOT sensor technology to truly monitor and control spaces based on occupancy and AI. Lights and HVAC are fully integrated, and fresh air rates, illumination levels, temperature and humidity are optimized in real time.

3. Shortened Construction Schedule: The improvement in schedule has economic benefits to owners and tenants.

The ISP Team is currently collaborating with Microsoft through their IoT & AI Insider Labs to further develop the ISP and manage the potential for millions of connected devices through the Azure Cloud. This ISP initiative will revolutionize the way buildings, transportation, and public infrastructure is designed and utilized well into the future, improving the way we all live, work and play.

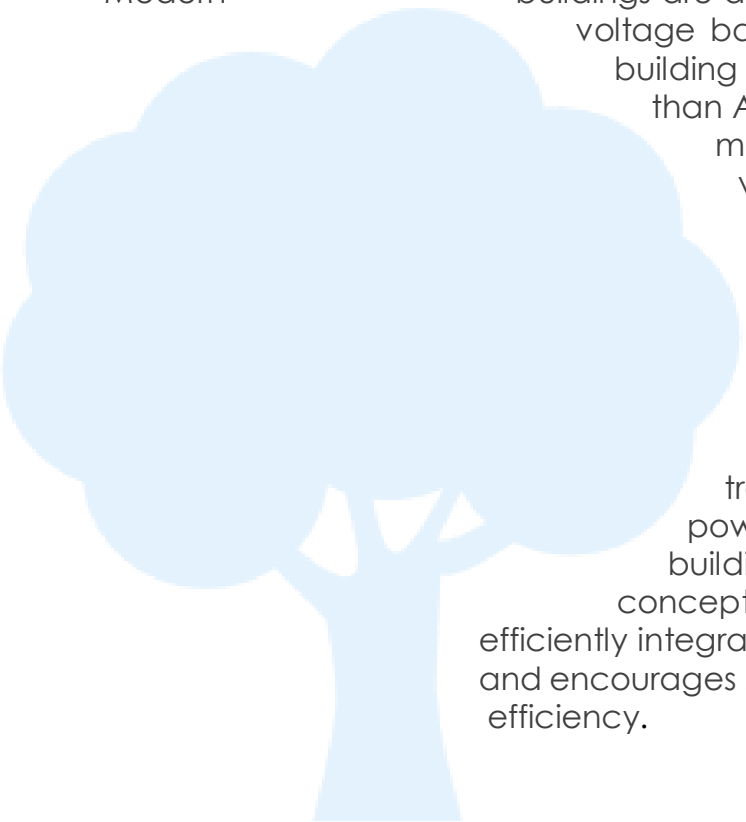


Q4. ENVIRONMENTAL BENEFITS

The ISP Panel utilizes low-voltage (DC) and PoE (Power over Ethernet) as the highway for all connected devices. This results in a building that will be 90% low-voltage based, versus traditional AC solutions with numerous transformers to allow for the operation of DC or low-voltage components.

The ISP panel results in a building design that reduces construction materials, compared to a conventional solution, by as much as 25% (pending recognition by 'green standards' in building design). The structure is akin to a 'prefabricated sandwich', containing most of the building's electrical and IT infrastructure, and eliminates the need for items such as metal junction boxes, electrical connectors, conduit, transformers, mechanical enclosures, electrical panels, etc.

The energy efficient component of the ISP is mainly driven using the low-voltage (DC) backbone or highway that provides a direct connection for all devices. Modern buildings are designed with devices that are 75% low-voltage based; thus, it only makes sense for the building infrastructure to be DC based rather than AC. Computers, mobile phones, tablets, monitors, roller shades, etc., are all low-voltage devices that do not require AC power.



The ISP panel eliminates approximately 50% of the electrical transformation and inverters in a typical building by means of providing a low-voltage highway. The elimination of the transformation results in a reduction of power losses, and thus makes the overall building more energy efficient. The ISP concept provides Designers with the means of efficiently integrating technology within an environment and encourages new and innovative solutions for energy efficiency.

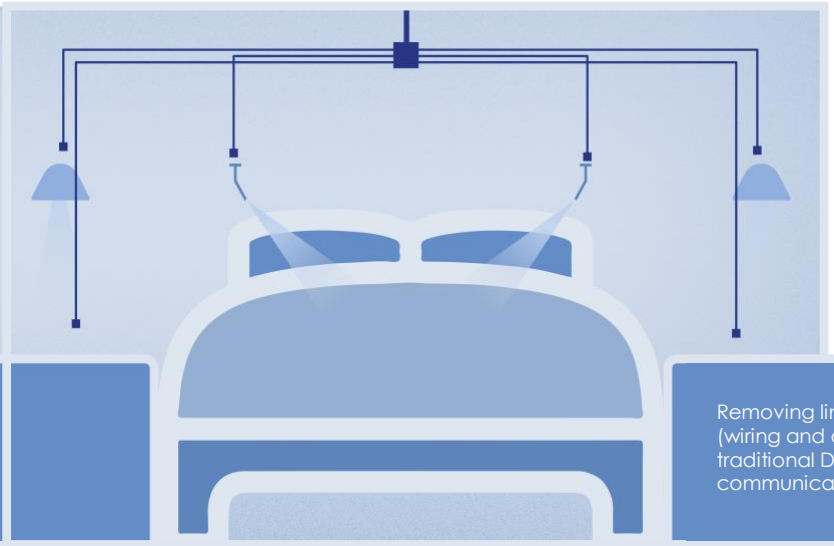
Q5. MEETING CLIENTS NEEDS

The ISP panel was initially designed for implementation and use in typical buildings; however, this concept is also being developed for use in other specialty industries such as healthcare, transportation, retail, and traffic/parking management, just to name a few.

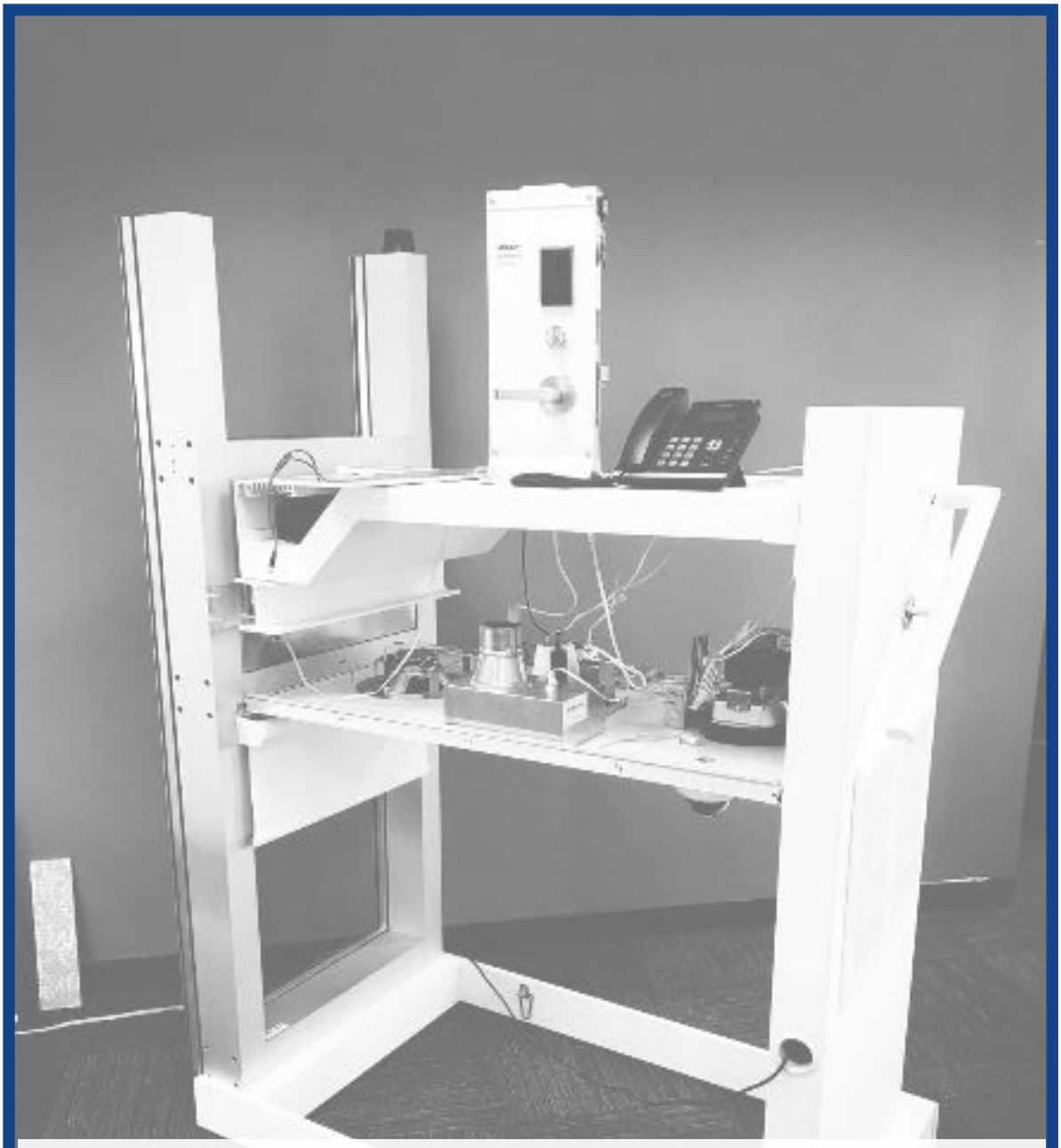
In cruise ships, as in typical buildings, the ISP can be used to allow connectivity of devices via floor, ceiling, and wall panels. For transportation, the ISP can be utilized as the floor for rail cars or subways, in which sensors are installed to monitor people movement, weight, seat availability, etc. The subways can then communicate to the people within the station, and inform them of areas with available seats, standing room, etc.

In the retail sector, the ISP can provide accurate and guided customer monitoring, targeted advertisements and coupons based on location, personalized 'Apps', and increased security monitoring. Occupants that circulate within spaces which include the ISP will interact with intelligent infrastructure through sensors that are triggered by touch, sound, and other interactive devices such as canes, mobile devices, etc.

The technology and concept developed for the ISP is also well suited for other areas, such as the healthcare field, with improved 'headwalls' and patient monitoring within hospitals. Hotel suites can additionally be designed with fewer electrical outlets in the partitions by locating all the wiring and low-voltage connections within the headboard of the bed (lighting, charging stations, laptops, etc.), which offers more flexibility for future design upgrades.



Removing line voltage from the walls and installing low voltage (wiring and outlets) in the furniture systems powered by traditional DC or PoE – making them smart and capable of communicating with other components



The photograph shows the working mock-up of the ISP which is shown in a typical installation with a dropped ceiling such as in traditional commercial office spaces. The ISP in the mock up contains an integrated offset in the structural panel to contain the flush floor HVAC unit and the dropped ceiling contains lighting, AV speakers, CCTV camera, exhaust fan, telephone, door lock and roller blinds all connected via unshielded twisted pair (UTP) cables to the ISP which delivers all power and controls to the devices.

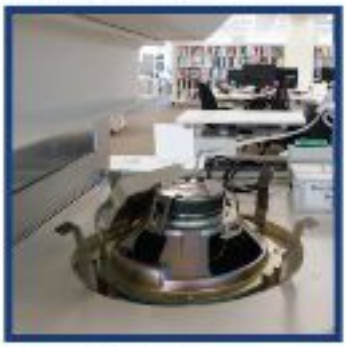
Example COMPONENTS

Motorized Photovoltaic Panel

Low Voltage in Floor Heating/Cooling

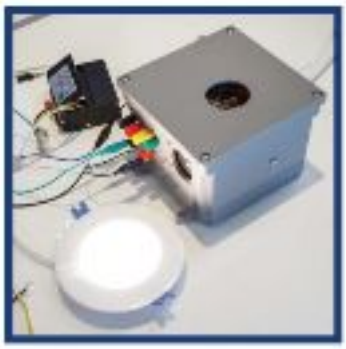
Smart Roller Shade

Smart Camera



Smart Speaker

Smart Light Fixtures



Smart PoE Splitter ("Black Box")

Temperature Control

Stair Exit Lighting

EVOLUTION OF THE ISP

1. Conceptual Model (Foam Core)
2. Conceptual Model (Plexiglass)
3. First Working Mockup
4. Second Working Mockup