

## **KWP Proposal for Maseeh College of Engineering and Computer Science Innovation Program grant 2013-04-22**

**PROJECT TITLE:** PoE-LPI48 (Power-Over-Ethernet Local Power Infrastructure 48VDC nominal)

**TEAM MEMBERS:** Keith W. Parker, BS programs: Computer Engineering and Architecture (Built Environment) mechanical engineering student collaborator to be actively sought, others (computer science, civil/environmental etc.)

**POINT OF CONTACT:** Keith W. Parker <kwp@pdx.edu> 503-449-7379, ECE-401 Prof. Raj Solanki

**WORK TO BE DONE (grand scale):** Implement all steps of the “grand plan” described at the end of this handout.

**WORK TO BE DONE (this proposal):** Implement step 1 of the “grand plan” described at the end of this handout.

**END PRODUCT: (this proposal):** A documented, functional set of POC prototype PoE-LPI48 connectors

**MILESTONES:** 1.) learning necessary 3D printing skills; 2.) fabricating set of POC prototype connectors

**ULTIMATE OBJECTIVE:** Portland State University precipitating an ISO-IEC international standard for a PoE-LPI48 (Local Power Infrastructure 48VDC nominal).

**REQUESTED RESOURCES:** Continuation of my 84-Lab space, assistance finding a mechanical engineering student collaborator, 3D printing support.

**BRIEF BUDGET SUMMARY:** \$1000. **First priority** is components and tooling for full set of prototype PoE-LPI48 connectors. **Second priority** is upgrading my equipment rack in 84-Lab to function as both an engineering/test system for PoE-LPI48 system components (and their AC mains powered equivalents) and as a fully operational PoE-LPI48 local infrastructure application (completely operational using its internal sealed lead-acid batteries that can be recharged by both AC-mains power and low voltage DC alternate energy sources; solar, exercise machines, etc.).

My proposal for a poster on this subject has been accepted for presentation in **Portland State University's 1st Annual Student Research Symposium** (Wednesday, 2013-05-08).

**Title:** PoE-LPI48 (Power Over Ethernet Local Power Infrastructure 48VDC nominal)

### **Abstract:**

**HYPOTHESIS:** Globally, the quality of life for hundreds of millions of people can/will be substantially improved if there is an ISO/IEC international standard for

PoE-LPI48 (Power Over Ethernet-Local Power Infrastructure 48 VDC nominal).

**OBJECTIVES:** Precipitating the establishment of an official ISO/IEC standard for PoE-LPI48.

**METHODS:** Collaboration between the Maseeh College of Engineering & Computer Science and the School of Architecture to precipitate an ISO/IEC standard for PoE-LPI48. The departments from the Maseeh CECS will include: Electrical & Computer Engineering, Mechanical/Engineering, Computer Science, and Civil & Environmental Engineering. Use shells, pins, and sockets from existing ISO/IEC standard connectors.

Only new components (insulating inserts) will be produced with 3-D printer.

Create a “strawman” ISO/IEC standard for PoE-LPI48, following to the letter, the ISO protocol.

Create a set of functional prototype conversion, from AC mains to PoE-LPI48, architectural plug loads.

Create a set of functional prototype, totally new and unique, PoE-LPI48 built environment devices.

Provide these devices, with student engineering support, to the School of Architecture for evaluation.

School of Architecture will develop additional ideas, not thought of by engineering, for significant quality of life improvement with PoE-LPI48.

**RESULTS:** Hard data on the usefulness of the strawman standard towards the objective.

**CONCLUSIONS:** It is imperative, to be fully effective, that PoE-LPI48 be implemented as an international standard.

To initiate an ISO/IEC Technical Committee (TC) for PoE-LPI48 it will require pull from Architects on every continent publishing peer-reviewed works concurring with the hypothesis.

**SIGNIFICANCE:** Mind boggling! (see hypothesis)

I currently am working on a “by arrangement” class (ECE-401, Prof. Raj Solanki) on the subject:  
COURSE TITLE: [ RES:POE-LPI48 CONCPT ]  
COURSE NAME: PoE-LPI48 Concept/Draft Standard  
COURSE DESCRIPTION: Define PoE-LPI48 (Local Power Infrastructure 48 VDC nominal) and interdisciplinary project for ISO-IEC “strawman” standard including prototypes for Dept. of Architecture

***“The Innovation Review Council has the following feedback which you may find helpful:”***

***“- Explain the practical problem you are solving and the state of the art in much clearer terms ”***

Due to the intrinsic low-voltage DC nature of modern electronic devices, there are many advantages (efficiency, sustainability, global standardization, safety, catalyst for innovation) to having a local power infrastructure based low-voltage DC instead of life/death/safety/comfort dependency on an easily disrupted high-voltage AC-mains infrastructure.

There are various proposals **partially** addressing the subject but they have various problems (such as being based on 24 VDC (doubling conductor sizes) and/or not including Ethernet for management/control or insufficient power levels.

***“- Isn't 1A+ in the wiring almost as much of a problem as in the connector? Seems like entering fire hazard territory... Maybe PoEoRomex? ”***

I am addressing the limitations of the plastic RJ-45 connector.  
I am in no way implying that CAT5/6 cabling would be used for high current circuits.  
The wiring for the high-current would, of course, follow standard engineering practices.

***“- The bulk of the proposal describes a grand plan that is not to be implemented in the scope of the proposal. The small amount of documentation on the actual plan (Step 1) gives this reviewer the impression that the actual work proposed for the project has not be adequately defined. ”***

“A journey of a thousand miles begins with a single step. ”  
Lao-tzu, The Way of Lao-tzu , Chinese philosopher (604 BC - 531 BC)

Without an being aware of the overall application and its significance it can be difficult to see the value of the first step.

The actual work proposed for this, initial, project is to

- 1.) Acquire the necessary resources, skills, and collaboration for 3-D printing
- 2.) Implement a functional PoC (Proof of Concept) set of PoE-LPI48 connectors
- 3.) Upgrading my equipment rack in 84-Lab to function as both an engineering/test system for PoE-LPI48 system components (and their AC mains powered equivalents) and as a fully operational PoE- LPI48 local infrastructure application (completely operational using its internal sealed lead-acid batteries that can be recharged by both AC-mains power and low voltage DC alternate energy sources; solar, exercise machines, etc.).

*“- Not clear what the 'innovation' is, ... ”*

An international standard for PoE-LPI48 is, like all well defined standards, is a catalyst that enables many other innovations.

As referenced in “step 5” of the “Grand Plan”

“5.) develop a set of prototype original devices that become practical with the existence of a PoE-LPI48 international standard; ”

To pick “**the**” innovation, I would say that it is, in recognition that virtually all modern devices (due to solid state physics) run on low-voltage DC, moving to the many advantages of a local power infrastructure based on 48 VDC nominal (**LPI48**).

Another innovation, not of the technology but of how to get an international standard implemented, is that it will take “pull” from the global community of Built Environment Architects publishing papers and giving lectures on how they will be able to significantly improve the quality of life for hundreds of millions of people, if an international standard for PoE-LPI48 exists.

Whether, in its self, a set of connectors that extend PoE (Power Over Ethernet, IEEE-802.3.af(.at)) to handle multiple kilowatts of power is “innovative” may be in the eye of the beholder. The fact that international standard for PoE-LPI48 would precipitate many major innovations is not (IMHO).

*“... also not clear how it would improve the 'quality of life for 100's millions of people' (short of the electrical hazard potential) ”*

PoE-LPI48 can provide many of the significant quality of life improvements of modern technology, to hundreds of millions of people, where a traditional high-voltage AC-mains infrastructure is either non-operational or non-existent. This is particularly true for developing countries, in addition to developed countries that have their AC-mains infrastructure disabled due to natural or man made disasters.

ALL emergency services, including all medical services, need to be able to operate without AC-mains.

**PoE-LPI48 is intrinsically capable of off-grid operation**

using simple, well-understood, easily recycled, lead-acid battery technology.

LPI-48 is much more efficiently interfaced to many alternate energy sources, particularly small-scale sources found in developing countries or remote locations.

**LPI-48 Microwave Ovens** - How many trees per person-year of microwave cooking will be saved? What will the health improvements be from reducing/eliminating wood/dung cooking fire smoke?

**LPI-48 Refrigerators/Freezers** - What are the advantages of refrigerators and freezers that are not dependent on an operational AC mains power grid for food preservation?  
...for medicine storage?

**LPI-48 Washing Machines and All Other Household Appliances** - Also, gadgets of all kinds.

**LPI-48 and Bio/Natural Gas** - can be used for the highest thermal loads (water, HVAC). LPI-48 will provide air/water handling and automation in addition to energy management. Common shaft gas powered turbo-alternators can be used for both primary and emergency charging. Bio/natural gas can be stored/distributed using the existing global natural gas infrastructure.

**More applications (a very partial listing, use your imagination):**

On or Off Grid Operation,  
Emergency Services,  
Medical Devices (clinic/home),  
Exercise/Physical Therapy (clinic/home),  
Eldercare/Monitoring/Assistance,  
LED Lighting,  
Home Appliances/Furnishings,  
Hotel/Airline/Train/Ship/Bus/RV/Boat interface for power and wired networking,  
HMI (Human Machine Interface),  
Sensors/Actuators,  
Research and Industrial Instruments,  
EPICS (Experimental Physics and Industrial Control System R3.14.12),

**The “Grand Plan” (note: steps 2-7 can/will be largely parallel and iterative)**

- 1.) design/fabricate a POC (Proof of Concept) prototype set of PoE-LPI48 connectors;
- 2.) develop a “strawman” draft standard for PoE-LPI48, following the ISO-IEC standard creation protocol to the letter;
- 3.) design/fabricate an Alpha prototype set of PoE-LPI48 connectors, following the “strawman” draft standard;
- 4.) develop a set of prototype conversions of AC-mains powered architectural plug loads into PoE-LPI48 devices;
- 5.) develop a set of prototype original devices that become practical with the existence of a PoE-LPI48 international standard;
- 6.) School of Architecture uses prototypes to furnish **BEES (Built Environment Embedded Systems)** living laboratory/studios (as alternative/adjunct student housing) in order to evaluate the viability of the PoE-LPI48 concept;
- 7.) based on the experimental results of the BEES living laboratory/studio student housing experiments, Architects will be able to publish papers and lecture on the value of the existence of an official ISO-IEC standard for PoE-LPI48;
- 8.) with enough “pull” from Architects around the world, publishing papers and lecturing on the advantages of an ISO-IEC standard, the appropriate authorities will form an ISO-IEC Technical Committee (TC), beginning the official standard development process, using the PSU “strawman” draft standard as a starting point.