DERri
Distributed Energy Resources
Research Infrastructures

PROPOSAL UNDER DERRI
User-Project Proposal:

User-Project Acronym	ADART-EMM
User-Project Title	**A**utomated **DA**ta **R**eading and **T**ransmission via **E**nergy **M**anagement **M**odule
Main-scientific field	Energy Management Applications
Specific-Discipline	Automated Meter Reading

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Position in Organization	Partner - Services Director

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Re-submission	YES_____ NO_____
Proposed Host TA Facility	Ricerca sul Sistema Energetico SpA (RSE)
Starting date (proposed)	April 2nd, 2012

Summary of proposed research (about ½ page)

Managing a facility today, from a small household up to geographically dispersed large installations, is a demanding job. Especially with Energy becoming a substancial cost it is paramount to have the right energy data and to be able to act upon them.
Moreover, investing in renewable energy is a clever move on the financial rewards as well as on helping the environment. It still remains an investment though. As a result, monitoring its performance as well as calculating its financial rewards is essential.
The Energy Management Module (EMM), designed and produced by Ether Applications, is intended to be used for automated data reading of energy meters and also for data transmision to central servers for further analysis and processing.
EMM can easily monitor energy consumption or production, either via an existing (electricity, gas or water) meter or, in case of electricity only, directly from the energy supply cables using current transformers. The end user can have instant information from the LCD screen of the EMM-200 regarding instant power, daily or monthly consumption/production and the active tariff or even through Mobile Apps. The energy information is also transmitted to the ePortal via an existing WiFi/Ethernet connection or through 3G/GPRS, if Internet access is not available.
The overall goal of this project is to test in depth the whole operation of EMM under various real conditions in order to evaluate its performance in several areas e.g. precide data recording, transmision in various data rates etc.

State-of-the-Art (about 1 ½ page)

It is widely known that fossil fuels resources worldwide are decreasing and in the future there is going to be an increasingly growing demand for them. As a result, it is absolutely necessary to take appropriate measures to reduce energy consumption on one hand (energy saving) and to substantially increase energy production from renewable energy sources (like photovoltaic systems and wind generators) on the other hand.
Today, energy management applications are gaining worldwide acceptance as a holistic approach to energy saving and resources management. The main reason for that is that just by implementing energy saving measures to a building or installation, it is not guaranteed that maximum energy efficiency has been achieved and will be sustained. An energy management application enables the constant monitoring of energy use and ensures maximum efficiency and minimum costs.
In the area of renewables, more and more investors and end users are getting involved with the production of green energy. Green energy power plants (PV, wind turbines or biomass units) are usually located in a distributed manner according to the availability of the natural resources involved and the availability of the electricity network. It is therefore difficult for the end user/investor to have a concentrated overview of their production and operation, unless there is a system that can universally monitor their output and efficiency.
From the above, it is clear that collecting timely and accurate energy (consumption or production) data is very crucial for such applications.
The first step in using energy management to realize operational savings and monitor a renewable production system is to install a system which will gather detailed energy data. The system is comprised of energy meters installed at energy surveillance points that communicate their readings through an appropriate network to a central database, where the data are

stored,processed and analysed .The user can have access to the database content through a web application that produces custom reports and graphs, but also can generate alarms for increased energy consumption, high peak power etc.

Detailed Description of proposed project : Objectives – Expected Outcome – Fundamental Scientific and Technical value and interest (2-3 pages)

EMM is a new product that has not entered the market yet. During this project, we intend to run analytical and in-detail tests on EMM regarding its whole performance and operation under various conditions. In particular we are going to test

- the accuracy in reading and collecting energy data and transmitting them to our online server by a single EMM under a constant load
- the accuracy in reading and collecting energy data and transmitting them to our online server by a single EMM while rapid and sudden load variations (in various levels of Watts and KWatts) take place
- what happens in both above testing procedures in case that multiple EMMs are being tested at the same time
- the impact of environmental conditions (especially temperature) on the energy recording
- in which way, different types of loads (inductive, capacitive) and generators (active, reactive power) affect the accuracy of recording by EMM
- if the communication between EMM-200 and the central database is constant and accurate at various recording rates (no dropped packets)

EMM can record energy data with two ways; either by connecting EMM on existing meters (making use of EMM's digital inputs) or, in case of electricity only, directly from the energy supply cables using current transformers (on EMM's analog inputs). We will start our project by connecting EMM to electricity meters' digital output (in cases there exist no such meters, we will install our own ones) in order to check the accuracy of EMM200 in collecting and recording energy data under real circumstances. To achieve this, we will compare the data written on the LCD of EMM with the data measured by the meter. We will also test analog inputs of EMM by using current transformers to electricity cables (where this is technically feasible) and connect the transformers to the EMM. Moreover, by switching on and/or off some loads, we are going to test the capability of EMM to record energy with accuracy while load changes take place. In both above cases we are also going to test the precise data transmission from EMM to our central online server, by comparing its results to the equivalent obtained by a local data monitoring and acquisition system.
Next step to our project would be to test EMM while recording energy data from distributed energy resources, both conventional and renewables. For this purpose, we are going to connect EMM to existing utility meters, PV plants meters, or even install our own meters to suitable surveillance points. The data recorded in this phase are obviously going to be in a greater level regarding KWs than in the previous tests, so we want to see how our product reacts while recording much higher energy (consumption or production). Again in this case, it is crucial for us

to test that the data transmission is being conducted with accuracy and in almost real-time for higher recording rates.
In case of recording energy from PV systems, it is essential that we also measure the temperature through suitable sensors (of our own) that we will connect to the analog inputs of EMM. By this way, we will test whether the EMM recording capability is influenced somehow by temperature variation.
Obviously, there is the possibility that RSE expertized staff will suggest us to make some additional tests, something that we are definitely going to do.

Originality and Innovation of proposed research – Broader Impact (1-2 pages)

EMM is designed to be used in smart-metering systems for automated data reading and processing of electricity, gas and heat meters and optionally data transmission to energy portals or/and smartphone applications. As a product it differentiates from the competition on its **open architecture** (been able to easily adapt to specific customer requirements) and its **price/quality ratio**.
The electricity bill of a household can sometimes be an unpleasant experience. The rising energy prices as well as the complex billing tariffs that modern utilities follow may lead to increased energy bills. So, energy saving applications via energy monitorinig must be followed. Moreover, renewable energy sources are usually distributed and dispersed over large areas. Both investors and technical administrators need to have a **clear and total picture** of the production and efficiency of their power plants, irrespective of place or time.
In the area of utilities, it is often a difficult task to handle and collect data from so many meters in so **different and dispersed environments**. Utilities need to collect data in a **fast, reliable and inexpensive manner**. Utilities and Energy Suppliers/Traders that fight to survive in this business environment need to **know how much energy is consumed by their customers and when**, in order to quickly adapt to market trends and offer the best possible deal to their consumers, in almost real-time conditions. At the same time, it is vital for them to **differentiate their offerings** and **improve the company image** towards the end customer.
EMM200 is designed to meet all the above requirements. It collects energy data from the **meter**, (household meter, utility meter, any other meter installed at the power plant) or through Current Transformers and transmits this information through any **available internet connection** (3G/GPRS, WiFi present etc.) or standard Ethernet cable to a central database. ePortal then takes over, by collecting and presenting the data in a **simple, uniform and easy to understand way**. It will also be capable of notifying the user via email or SMS regarding the daily consumption or production of each system or in the case that a production plant does not produce as much energy as expected.
A utility can achieve its goals in a robust and cost effective way by implementing EMM. EMM can easily monitor the energy consumption of each customer, as already enabling the end user to have instant information from the LCD screen of the EMM regarding instant power, daily or monthly consumption and the active tariff. The energy information is also transmitted to the central database which will then make appropriate calculations and then enable the utility to have a full picture of the consumption of their customers.
In conclusion, after the successful ending of this project, and by using its results to improve it further, we hopefully believe that EMM will be widely used by

- **integrators** that build their own S/W solutions
- **energy suppliers** that need access to their customers data quickly and efficiently
- **facility managers** that need to track their customers infrastructure
- **renewable investors** that need to monitor their production
- and **utilities** that need another approach to traditional smart metering solutions.

Proposed Host TA Infrastructure/Installation – Justification (about one page)

After extensive research and communication with many of the 13 TA Infrastructures, we have decided that the most suitable Infrastructure for our project would be the RSE. We have already been in contact with them and they agree on this.
RSE's Demand side Management Experimental House (DSM-EH) constitutes an ideal environment for testing EMM under real household circumstances. We are going to install EMM in several points inside the House (heating system, common appliances, PV generator) (also energy meters where they are not available) and record both consumption and production energy data. Its commercial home automation system will enable us in testing our device while load changes regarding KW take place. Moreover, we will have the opportunity to compare, in terms of consistency, the data EMM is recording with the House's monitoring, acquisition and data storage system (Home energy manager & gateway – GED).
Next, in the RSE DER Test Facility, we are going to test our product while recording energy data from distributed energy resources, both conventional and renewables. The data recorded in this phase are going to be more than in the DSM, so we want to see how our product reacts while recording much greater energy consumption or production data. The variety of distributed power plants that are available in the DER Test Facility constitute an ideal test environment for us, regarding both the variety of different energy sources (PV plants, solar thermal plant, biomass system, battery system etc) and the different size of these systems as well .
The Communication system that is available with different technologies in RSE (LAN Ethernet, Wireless and Power Line) along with the supervision and control infrastructure will help us test extensively and at different rates and speeds the communication between EMM and central server.
For the further development of our product, we reckon that the results of such tests will be very important.

Dissemination – Exploitation of results (about ½ page)

We are going to publish a detailed report including a description of all tests made in RSE and their results in the following means:

- in our webpage www.ether.gr
- in EMM dedicated web page www.clevermetering.com
- in the greek magazine regarding economy-ecology-construction ECON3 (www.econ3.gr)
- in the greek magazine regarding renewable energy ANEMOLOGIA (www.eletaen.gr/anemologia)

Time schedule (about ½ page)

We are planning to visit RSE in the first week of April. In particular, we arrive in Milano on Sunday 1st of April. On Monday the 2nd we will install our meters (where needed) and the EMMs, set up our Laptops to connect to the existing W-LAN and our online server and in general, prepare the whole test set-up. In the next 2 days, we will run the actual tests. On Thursday the 5th of April, we are going to analyze and evaluate the results of the commited tests.

Description of the proposing team (as long as needed)

Ether Applications Ltd is one of the leading Greek companies, active in Energy Management applications. Numerous applications have already been setup for various types of customers such as renewables producers, chain retail stores, banks, public buildings, airports, sports centers etc. with impressive results.

Athanasios Vamvakas is a graduate of the Economic University of Athens, holds a distinction in an MSc degree of Information Security from the University of London and a Professional MBA from the Hellenic American University. Athanasios has been working for the last 13 years prior cofounding Ether for organizations such as Microsoft and Hewlett Packard, providing solutions for the top organizations in the Hellenic and European market. He created a patent for HP Labs (HPL-2002-185) and has participated in a series of publications including a Trusted Biometric System (2002). During his work for Microsoft his role was in performance testing for all major software rollouts. His role in the project will be regarding the software aspects of the solution, data processing performance and visualization.

Dr. Kostas Tsirbas holds a Mechanical Engineering degree and a PhD degree from the Mechanical & Aeronautics Engineering Dept. of the University of Patras, Greece. During his PhD research work, he has had extended R&D experience during his work in EU-funded research projects between 1998 and 2002. He was involved in both theoretical and experimental activities in laboratories from all over Europe. He has participated in the publication of more than 10 scientific papers in international journals and conferences. His role in the proposed project will be to define the right tests conditions so that we get useful and exploitable results, analyze the performance of EMM under various types and sizes of loads and evaluate the final results.

Alexandros Panagiotopoulos holds an Electrical Engineering degree from the Electrical Engineering department of the University of Patras, Greece and a Master of Science in Electrical Power Engineering from the department of “Electrical Engineering and Information Technology” of Technical University of Darmstadt (TUD), Germany. He has worked in Siemens, Germany as a commissioning engineer running commissioning tests on high-voltage substations instruments, like circuit breakers, switchgears etc. In the proposed project, he will be in collaboration with RSE staff for the general set-up test preparation (installation of meters, EMMs etc.), the unhampered operation of all devices of the user team during tests as well as the documentation of the results and the reports of the tests for dissemination purposes.