Application Note # 2

Tenant Sub-metering

Description of application: Tenant sub-metering is a broad term applied to the use of hardware and software to bill tenants in commercial facilities for their actual usage of energy. The goals of tenant sub-metering are: 1) to ensure that the owner recovers the cost of energy from tenants, and 2) to make sure that tenants with high energy usage are not subsidized by those with lower usage.

Background: Many buildings are equipped with only a primary metering system for measuring and billing energy consumption for the entire building. In buildings with this configuration, the tenants are typically billed for energy usage on either a fixed rate (cost per square foot) that is built into the lease, or the bill is allocated to tenants based on their square footage. Each of these methods have inherent flaws, but both share the common problem that energy costs are unlikely to be accurately charged to the tenants. Under a cost per square foot arrangement, the owner will almost certainly collect more or less than the actual bill, and the discrepancy will be even greater during times of energy volatility or low occupancy rates. If the bill is simply divided amongst the tenants on a per square foot basis, tenants with lower energy density (BTU per square foot) will subsidize the space costs for those with higher energy density (e.g., data centers).

These errors become particularly acute when there is a wide variance in occupancy schedules (retail vs. office space) and the building provides central services such as chilled water or conditioned air. Additional complexity is added when the building owner must make decisions in advance on the cost to add when the rate structures for commercial buildings are taken into account.

Residential electrical customers typically pay a flat rate for electrical consumption in the form of cost per kilowatt-hour ($/kWH) which makes calculating a bill relatively simple: read the kWH from the meter and multiply by the $/kWH to get a cost. Commercial rate structures are much more complex. Commercial rate structures typically have the following components:

- Consumption (kWH) charge – this part of the bill is basically the same as the residential charge, but usually has multiple tiers so there is not a single fixed cost. The owner pays at different rates for the amount consumed (e.g., the first 100,000 kWH is billed at $0.07, the next 100,000 kWH is billed at $0.065). These costs will also generally vary by season, so there will commonly be a winter rate and summer rate depending on the supply and demand for electricity that the utility experiences. For purposes of sub-metering, these costs can generally be blended into an average cost per kWH.
- Demand (kW) charge – since the utility has to be certain that adequate supplies of power are available, large customers such as commercial properties are billed not only for the total energy consumed during the month, but also for the maximum

power used during a short interval (typically 15 minutes). The demand charge is used to help pay for the costs associated with having generating capacity to meet the highest period of demand (hot summer days, for example) that is not required during lower periods of demand. The demand charge is also applied because the utility will typically have to bring on less-efficient generating plants to meet the peak loads and thus the cost of generating goes up.

- Power factor charge – In a perfect world, the electrical energy provided to a device (e.g., a motor) would be converted to mechanical energy with 100% efficiency. Unfortunately, with very rare exceptions, this is not the case and the inefficiencies associated with this energy transfer mean that the utility must provide more power than it can actually bill for (the actual math is quite complicated and beyond the scope of this paper, but it's true). This inefficiency is usually just bundled into the other charges along with things like line loss, etc., but many utilities will bill customers with a power factor penalty if the power factor (the measure of efficiency) falls below a certain level (commonly 92% to 95%).
- Other charges – In addition to things like taxes and surcharges, most utilities are studying or have implemented rate structures that are intended to more directly reflect the actual cost of generation and have large users bear more of the burden during peak times. Things such as time of use metering, load curtailment penalties, etc. will only serve to complicate the average commercial electrical bill even more as time goes on.

How does it work?: In the simplest sense, the owner installs meters to monitor the consumption of electricity, gas, water and steam by individual tenants. These meters are connected to a data acquisition server (DAS) like the AcquiSuite from Obvius. The DAS gathers data from the meters on the same schedule as the utility supplying the building and then communicates this data to a local or remote database such as http://www.buildingmanageronline.com (BMO). The tenant is then billed at the end of the month at the same rate the building owner pays for the building as a whole and thus the owner recovers the cost of energy from each tenant.

While this process seems very straightforward, as with most things, the devil is in the details. Using the Obvius hardware and BMO service, the gathering, storing and reporting of the data is relatively simple and in most cases the information can be available with just a few hours of installation time. Analyzing the data and producing accurate billings for tenants can be considerably more challenging due to the different rate structures and billing components in a typical commercial setting as outline above. Options for allocating these costs will be considered in the "Actions" section below.

Benefits: The most obvious benefit is that tenants pay their fair share of the energy costs and the owner does not get stuck with unrecoverable costs. An often overlooked, but extremely important benefit is that the building owner is not placed at a competitive disadvantage in the marketplace. If the costs of serving high energy density tenants is

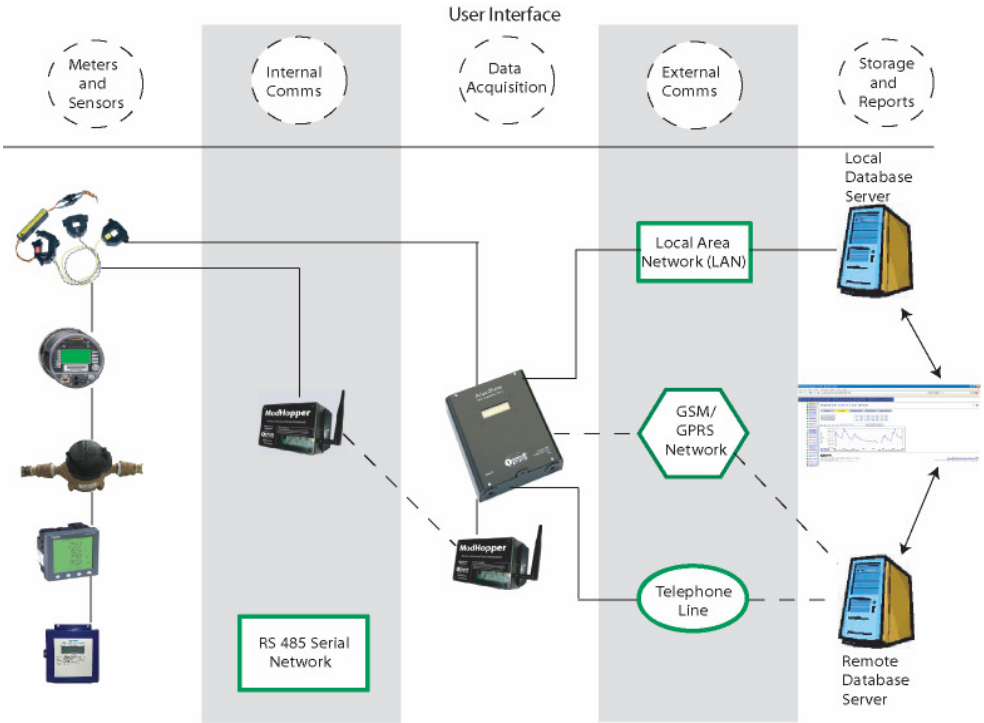
spread over all the tenants, the total cost per square foot of leased space goes up and the owner may lose new or existing tenants to lower cost competition.

Drawbacks: There are two key issues to consider before implementing a tenant sub-metering program:

- Costs – depending on the layout of the services in the building, the cost of sub-metering may be high, particularly for utilities like water and gas where pipe cutting and threading may be involved.
- Regulatory agencies – in many jurisdictions, the state Public Utilities Commission (PUC) regulates the ability of building owners to charge tenants for energy consumption to prevent the owners from overcharging "captive" users. It may be difficult for owners to implement tenant sub-metering programs and to recover the costs of setting up and managing these programs.

Installation requirements: Details and costs of installation will naturally be heavily dependent on the layout of the building and utility services, but in general most applications can be met with the following hardware:

- AcquiSuite data acquisition server (DAS)– a standalone web server located on the building site that communicates with the sensor(s), stores interval information and communicates with the remote server



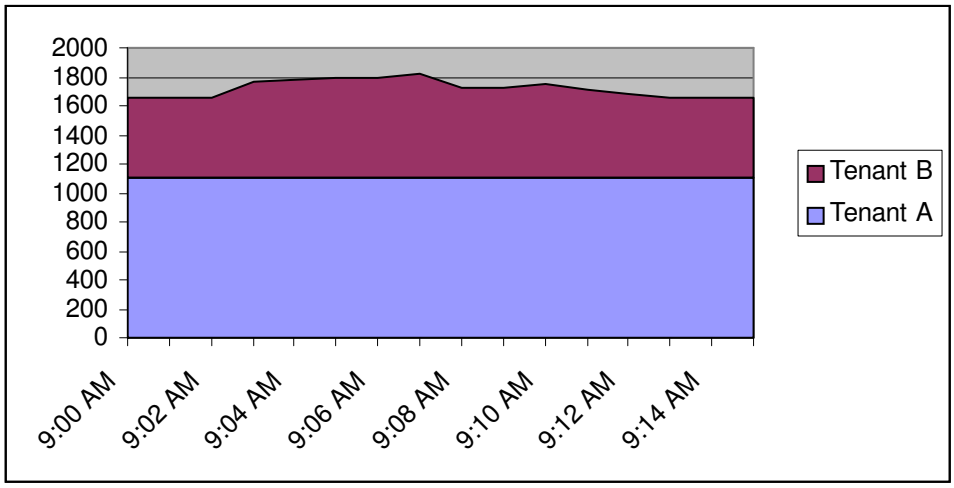
- Electrical sub-meter(s) – several companies (including Power Measurement, Ltd. and Veris Industries) produce electrical meters designed for sub-metering applications. These meters can be simple pulse output devices or can provide information using serial communications to provide additional information such as power factor, current and harmonics.
- Flow meter(s) – flow meters are used to measure the volume of flow of gas, water and steam. There are a variety of technologies that can be employed, but typically these meters produce either pulse or analog signals that can be read by the AcquiSuite and converted to billable units of measure (gallons, therms, etc.)
- Btu meter(s) – Btu meters combine flow meters with temperature sensors to measure the actual energy usage for chilled or hot water. These meters can be useful in cases where a central chilled or hot water plant serves multiple tenants as the tenant is billed not only for the water consumed, but also for the input energy required to produce the conditioned water. These meters can provide simple pulse or analog output to the AcquiSuite or can provide more sophisticated analysis via serial connections

Reports: The level of complexity of reports depends on the method chosen for the tenant billing. The data from the BMO site provides all the information necessary for calculating tenant bills except for the rate structure information. In the simplest scenario, the owner simply downloads the consumption data from BMO for each tenant and allocates the total bill cost to each tenant based on his or her proportionate consumption (kWH). For most applications, this simple process provides the most cost-effective solution that distributes the cost fairly without creating a complex and expensive process for administration.

The standard reports from BMO provide all the information necessary to do a more thorough allocation that incorporates the demand (kW) charge and power factor penalty (if applicable). The back end processing required to accurately allocate demand charges can be significant as the owner and tenants (and potentially the PUC and utility) must agree on the mechanism used for allocating demand costs. While it is relatively simple to determine the peak interval for the billing period and compare the demand for each tenant for that same interval, the actual allocation of this cost (known as coincident demand) can be very difficult and time-consuming (see "Analysis/Actions" section below).

Analysis/Actions: In the case of simple allocation based on consumption outlined above, the owner imports data from BMO into a spreadsheet (or other cost allocation software) and the software generates a bill for the tenant that is added to the monthly rent.

Billing for coincident demand and time or use charges becomes more complex because there are judgment issues involved as well as simple quantitative analysis. Does the tenant with a flat constant demand (e.g., data center) have to absorb the additional penalties for tenants with highly variable rates? Does the tenant whose use is relatively low, but has incremental demand that pushes the total building into a higher demand charge have to absorb all the additional costs or are those costs spread among all tenants?



Notes/miscellaneous: Simple tenant sub-metering is a relatively easy process that can be implemented by the building owner with the assistance of the providers of the hardware and software. More complex analysis is best left to consultants and resellers who specialize in rate engines and billing analysis.

Summary: Tenant sub-metering is a valuable tool for commercial property owners who want to accurately allocate the costs of energy to tenants and occupants, but it is extremely important to define the scope of the program upfront and to do the homework necessary to ensure compliance with leases and regulatory agencies such as the PUC.

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