Badger Meter

How the Cloud is Revolutionizing the Future of Water Utility Management

Understanding the Differences Between Managed Cloud-based Software Solutions and Traditional In-house Solutions for Water Meter Data Management

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White Paper

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Introduction

Web-based software services, more commonly called cloud computing or Software as a Service (SaaS), are being implemented globally by users in virtually all types of organizations, including manufacturing, government, services, retail, and water utilities. Cloud software services are bringing about rapid and diverse changes to how a water utility operates and how data is used. As new systems often require new technology resources to operate and support, utilities are finding cloud computing to be a viable alternative to investing in additional hardware. Cloud-based or SaaS platforms share several major characteristics:

- Quick to deploy
- No hardware to purchase
- Experts maintain the system so utilities can focus on their core competency
- Automatically implemented software updates
- Rapid elasticity or expansion as utility's needs change
- Subscription pricing provides a pay-as-you go option

These characteristics allow organizations to rapidly build IT resources through cloud-based software services, making it easier and less costly to adapt to changing utility requirements. The emergence of cloud-based services, however, has been met by a lack of thorough understanding of how this new model compares to the traditional in-house IT model, and how a utility might rationalize its costs and benefits. To assist utilities in evaluating this new solution for managing their operations, a brief overview of both of these topics is presented, along with information on the benefits of Advanced Metering Analytics (AMA) and planning for a transition to the cloud.

Traditional Meter Reading

Trend towards AMR, AMI and AMA

Over the last two decades, an increasing number of water utilities have been adopting technology platforms in their operations. Trends in the industry have demonstrated that utilities are moving past the manual and touch read devices in exchange for Automatic Meter Reading (AMR), Advanced Metering Infrastructure (AMI) and most recently Advanced Metering Analytics. This transition has allowed utilities to

move from capturing a monthly or quarterly meter reading for billing purposes to capturing hourly meter reading data that can be used to improve customer service, increase operational efficiency and provide the end-water user with an understanding of their water consumption.

Shifting to an AMI fixed network system yields a dramatic decrease in labor requirements specific to meter reading, reductions in meter reader injury-related costs and can often increase the accuracy of the recording of meter readings. AMI systems also provide reductions in vehicle expense and fuel, and very often provide a faster resolution of consumer calls and complaints about high bills, because more detailed information is readily available to the utility staff.

AMI reduces labor costs and injuries while increasing accuracy and customer service

In recent years, the concept of AMI has evolved. Data collectors or gateways are now permanently installed on building roofs, light poles, water towers, or other structures and communicate with the meter endpoints on a regular basis. At selected intervals, the gateways then communicate with the utility head-end software which then receives the stream of meter data. Utilities have typically been responsible for the installation and maintenance of these data collectors, along with the ongoing fees for powering the device and the backhaul communications.

Regardless of the method of meter reading, a software system stores and manages the meter readings and transfers them to the utility billing system. Early on, this software resided on the utility mainframe computer, but over time, it has transitioned to client/server architecture. However, both approaches require utility-based hardware and software, as well as system maintenance and data backup by utility personnel. In addition to this added complexity, over time, hardware and software improvements have necessitated upgrades or replacement that require management by skilled utility personnel, who are not always readily available.

A software system is always needed to store and manage meter readings

The Latest Innovations in Meter Reading Technologies

The newest fixed network technologies have changed the paradigm for utility meter data management in a number of ways. First, solutions are now offered by vendors that include a hands-off approach for the utility in regards to the data collection equipment, computer hardware and software applications. This new approach, referred to as a "managed solution" includes several aspects. The solutions provider installs and maintains the data collection equipment, allowing the utility to remove itself from the responsibility of installation and maintenance of everything except the meters and endpoints. The software applications are "hosted" by the solutions provider, eliminating the need to install and maintain computer hardware and software at the utility. This means the utility simply has to provide a personal computer with a web browser to access the application software and data via the Internet.

Evolution to a cloud-based, vendor-managed solution

This evolution from a utility-centric system to a cloud-based, provider-managed solution, means utilities can enhance their entire meter reading operation, including staffing and skills requirements, to drive decisions on how to best allocate staff and use the additional data to proactively manage their operations and customer relationships.

Who Manages the System?

In the traditional approach, the utility usually assumes responsibility for implementing and managing the system. In contrast, in a provider-managed, cloud-based system, the solutions provider assumes the responsibility for operation and maintenance of the system beyond the meters and meter communication endpoints. This approach provides a flexible solution that reduces the number of resources required to operate and maintain the meter reading system, freeing personnel to support other critical areas of the utility operation.

The solutions provider assumes responsibility for operation and maintenance in a cloud-based, managed solutuion approach

FUNCTIONS/ACTIVITY	TRADITIONAL CLIENT/ SERVER SYSTEM	CLOUD-BASED/SOFTWARE as a SERVICE (SaaS)
Application	Utility	Solutions Provider
Data	Utility	Solutions Provider
Runtime	Utility	Solutions Provider
Middleware	Utility	Solutions Provider
Operating System	Utility	Solutions Provider
Virtualization	Utility	Solutions Provider
Servers	Utility	Solutions Provider
Data Storage/Backup	Utility	Solutions Provider
Networking	Utility	Solutions Provider
Administrative Control/ Access	Utility	Utility

Table 1. Who Manages the System?

While solutions providers of cloud-based services assume virtually all the IT responsibility, it remains a joint responsibility between the solutions provider and the utility to protect the privacy and security of the data. The provider has a responsibility to meet stringent security standards for the physical environment and data center, the network and the applications. The utility continues to be responsible for maintaining administrative control and defining who has permission to access the various portions of the system.

Joint responsibility between the solutions provider and the utility to protect privacy and security

Typical Utility Costs of Ownership

Traditional fixed network AMI systems include a wide variety of capital expenditures, as well as both direct and indirect operating costs that are incurred over the life of the system. However, in a cloud-based software solution that typically utilizes a monthly subscription payment option, the cost elements and timing of those costs are vastly different.

Cost elements and timing of a cloud-based software solution are vastly different than a traditional fixed network system

COST ELEMENTS	TRADITIONAL CLIENT/ SERVER SYSTEM	CLOUD-BASED/SOFTWARE as a SERVICE (SaaS)
HARDWARE		
Meter Endpoints (initial+replacements)	Y	Y
Data Collectors (initial+replacements)	Y	
Servers (initial+replacements)	Y	
Data Storage (initial+replacements)	Y	
SOFTWARE		
Applications/licenses	Y	
Operating System/licenses	Y	
Database/licenses	Y	
Software enhancements/ new versions	Y	
INSTALLATION/START-UP		
Meter Endpoints	Y	Y
Data Collectors	Y	
Servers	Y	
Staff training	Y	Y*
Engineering/IT/Install project mgmt. services	Y	
Software integration into legacy systems	Y	Y
OPERATIONS/MAINTENANCE		
Communications for collector backhaul	Y	
Energy for collectors, servers	Y	
Hardware service contracts	Y	
Software maintenance contracts	Y	
Location leases for collectors	Y	
Staff to operate/maintain hardware, software	Y	Y*
Other repair/support costs	Y	
SaaS SUBSCRIPTION FEES		Y

Table 2. Typical Utility Costs of Ownership
*Training and staffing requirements are much simpler with SaaS than with a traditional system.

What follows is a more detailed look at each cost element:

Hardware

Meters and endpoints, often called MTUs, are required in all the various forms of automated meter reading, regardless of the type of system being deployed.

MTU's are required in all forms of AMR

In the traditional forms of meter reading, the utility also has to own and maintain the necessary data collection equipment, including handheld units, mobile reading equipment or permanently mounted data collectors. However, if the endpoints utilize cellular communications technology for all or a portion of the deployment, the requirement for gateways might be reduced or eliminated completely.

Within utilities that have traditional systems, some type of computer hardware is required, often a server and associated capabilities to store and back up large amounts of data. With such sophisticated equipment, hardware replacements may be needed during the project life due to technological obsolescence or product failure or damage (excluding warranty replacements).

However, with a managed services approach, the utility no longer has to manage hardware beyond the meter and endpoint. Instead, the solutions provider is now responsible for providing the functionality and therefore must maintain all the necessary hardware. For the cloud-based analytics software, the utility is only required to simply provide its users with a personal computer, web access and a web browser. Generally, these already exist within the utility so systems may be deployed rapidly and with little to no additional expense to the utility.

With a managed services approach, the utility no longer has to manage hardware beyond the meter and endpoint

Software

As meter reading has evolved from capturing a reading every quarter to the fixed network systems of today that collect hourly readings, the sophistication of the head-end meter data management systems and the requirement to manage the large

amount of data has increased dramatically. These systems often require software updates, and on occasion, a completely new version of software to be purchased and installed. With increased functionality, more users within the utility may require access, often requiring the purchase of additional licenses.

With a cloud-based system, software improvements are automatically updated by the solutions provider

However, with cloud-based systems, software improvements are automatically updated by the solutions provider, eliminating any work required within the utility. Also, the costs of these software improvements are included in the base subscription, so the utility can always be current with the most advanced software features without additional cost or effort.

Installation and Startup

In most AMR/AMI rollouts, the installation of the meter and endpoint comprises a large part of the effort and expense. Generally, this expense is incurred regardless of the type of system being deployed. If a traditional fixed network is deployed, the installation of the gateways or data collectors is also necessary. This potentially includes the need for bucket trucks and crews trained and certified to work above ground. It might also include costs for installing new infrastructure on which to mount the gateways, such as poles, special mounting brackets for use on water towers, tripod mounts for rooftops, construction of new towers, and electrical connections or solar panels. Utilities also need to work with local officials to get zoning permits and general permission to deploy gateways throughout a service territory.

Cellular endpoints eliminate the expense, complication and expertise needed to deploy a fixed network system

Endpoints with built-in cellular communication technology eliminate the expense, complication and expertise needed to deploy a fixed network system by eliminating the need for data collectors.

Training and project management are also major cost elements of any AMI system, especially since most utilities are employing AMI for the first time and do not have the required expertise on staff. Training of everyone in the utility is critical for enterprise-wide

success of the project. Training includes the field staff who will work with the endpoints and meters, those responsible for installation and maintenance of the data collectors, the IT staff who will be responsible for the servers and software, the staff responsible for billing, and the customer service and engineering staff who will use the data. Also included is the administrative staff, responsible for the overall system.

With cloud-based, managed systems, the solutions provider is typically responsible for the infrastructure installation, if any is used, and startup of that infrastructure, thus eliminating the need for installation training. Since the software applications are cloud-based, training in software maintenance and data backup is not required. Certainly, with any system that has less hardware and software to manage, the easier and less costly the training requirement.

Solutions providers are responsible for the infrasturctre installation in a cloud-based, managed system

Operations and Maintenance

As with just about any system, there are ongoing operating costs that need to be considered. With traditional fixed networks, the data collectors typically utilize a public backhaul, such as the cellular network, to get the data to the utility. If a public network is used, there are regular monthly communications charges that must be paid by the utility to operate the system.

The data collectors also require electrical power to operate, either line-powered connections or solar panels. Sometimes leases are required to rent space on poles, buildings or other infrastructure owned by others for locating the data collectors.

Since system uptime and ongoing support are usually critical to the utility, most AMI systems utilize both hardware and software maintenance or service contracts to minimize risk and downtime. With cloud-based managed solutions, most operations and maintenance costs are not incurred by the utility, as they are part of the solution provider's costs.

Most operations and maintenance costs are not incurred by the utility with a cloud-based managed solution

Staff to operate and maintain the system, as noted previously in the training discussion, is a key to the success of the AMI system. With a cloud-based managed solution, staff requirements are less than with a traditional system, allowing IT resources to provide support to other key areas of the utility.

Subscription Fees

For managed solutions, a subscription fee is charged to the utility. This fee is typically charged on a monthly basis and replaces the upfront capital and long-term operating expense associated with a traditional fixed network system. Another advantage to the subscription fee model is that the fees are based on the actual number of meter endpoints in the system for each particular month (pay-as-you-go). In comparison, the traditional fixed network often requires the full investment in hardware and software early in the project in anticipation of the eventual full-system deployment. Predictable subscription fees paid over the life of the system provide a dramatic difference to the traditional model, where a very large portion of the costs are paid up front, and where there are more unknown costs that may occur during the life of the system.

Monthly subscription fees are based on actual number of meter endpoints in the system (pay-as-you-go)

Implications

Traditional AMI systems bring with them the difficulty of predicting total costs due to additional hardware and software that may be needed to accommodate uncertain growth and technology changes. However, with cloud-based services, scaling-up for growth is easily accomplished and on-premise management costs are virtually eliminated.

With cloud-based services, scaling up for growth is easily accomplished

When utilizing cloud-based services, there is an obvious shifting of many costs, particularly IT, from paying with capital expenditures (CAPEX), to accounting for it as an operational expenditure (OPEX) in the form of the subscription fee. This requires some change in thinking and planning since there may be implications in utility budgeting and accounting. However, some vendors do offer a

front-end lump sum payment in lieu of a monthly subscription fee if the utility determines that to be preferable.

Summary

Web-based software services, or cloud services, offered in a managed solution model are making access to AMI software systems, infrastructure and hardware platforms available in a low-cost, effective way that was not imagined just a few years ago. Using this approach, utilities can benefit from the expertise and economies of scale that a large solution provider can offer compared to what is typically available within a utility, and without the need for the utility to manage the system internally.

Utilities can take advantage of these new services with minimal up-front costs and with minimal involvement of in-house personnel to start up and maintain the system. Once a decision is made to move forward, the costs are incurred only on an ongoing basis over the life of the system, rather than having to purchase the entire system up front.

Cloud services and a managed solution model is making access to AMI software systems, infrastructure and hardware platforms available in a low-cost, effective way

Present Value Calculations and Comparisons

In capital budgeting, determining the value of a proposed project, or comparing two different competing projects, requires estimating all the costs and all the revenues for each year of the project life. The analytical tool used to combine all the costs and revenues is called "Net Present Value" (NPV). To account for the fact that the value of a dollar is worth less in the future than it is today, a "discount rate" is used in the NPV formula to adjust the costs and revenues in each year. The discount rate is typically the utility's weighted average cost of capital. While each utility will have its own specific discount rate and method of calculating NPV, the NPV is a common tool in discounted cash flow analysis and is a standard method for using the time value of money to appraise long-term projects.

To use the NPV tool, the following data is needed:

- All the capital and operating costs for each year of the project life
- All the relevant revenue gains and savings benefits for each year of the project
- The utility's discount rate or cost of capital

There are many NPV tools on the web and financial and budget analysts work with these tools regularly, so there is no need for a detailed review of NVP in this paper.

However, a basic understanding of the role of the typical costs and how the discount rate can affect analysis of projects is important. Consider two different project alternatives:

- In a "Traditional" AMI Project much of the expense is incurred at the start. This includes the hardware, software and installation with ongoing costs incurred over the life of the project for maintenance, hardware and software upgrades, and other expenses.

- With cloud-based, managed solutions, a "SaaS Project", the initial costs are primarily for the meter endpoints. An ongoing

subscription fee is incurred over the life of the project and covers all the systems, applications, data storage, and communications.

Obviously, a major benefit to the utility in using the managed solution model is delaying the incurring of costs so that cheaper dollars are used. To illustrate in simple terms, assume a Traditional AMI Project and a SaaS Project are to be compared with hypothetical costs over an assumed five year life, and assume revenues will be the same in both cases. If a discount rate of 3% is used, a Present Value of Costs table can be constructed (displayed below). If both costs and revenues are to be analyzed, then a Net Present Value can be calculated that combines the Present Values of Costs and the Present Value of Revenues.

Net Present Value (NPV) = (Present Value of all the Revenues) – (Present Value of all the Costs)

But, for simplicity, only costs will be examined here. The Traditional Project has an initial capital cost of $500, with operating expenses of $20 occurring annually. The SaaS Project has a lower initial capital cost with a value of $200, but considerably higher operating expenses every year of $95. Both projects have total costs of $580 before applying the discount factor.

Year	Discount Factor at 3%	Traditional Project Expenses - Unadjusted	Traditional Project Expenses - PV	Cloud-Based/ SaaS Project Expenses - Unadjusted	Cloud-Based/ Saas Project Expenses - PV
0	0	500	500	200	200
1	1.0300	20	19.42	95	92.23
2	1.0609	20	18.85	95	89.54
3	1.0927	20	18.30	95	86.94
4	1.1255	20	17.77	95	84.40
		Total = 580	PV = 574.34	Total = 580	PV = 553.11

Table 3. Example of Present Value of Costs of Two Alternative Projects

Several observations are important to note:

First, costs in future years will be made with dollars that are worth less than today, so it is beneficial to push out costs into future years when possible. The Present Value of both projects is less than the apparent total cost of each, when simply adding up all the payments, due to a portion of the expenses occurring in later years and being paid for with cheaper dollars.

Second, while both alternative projects appear to have the same total cost before considering the discount factor, there is a clear difference when the discount factor is applied. The SaaS Project with lower initial costs but higher costs in later years has a clear financial advantage with a lower overall Present Value, because more of the cash payments are made in future years. All other factors being equal, the project with the lower Present Value of Costs is generally preferable.

Implications of Present Value for Advanced Metering Analytics

Traditional AMI systems are much like the Traditional Project above in that much of the expense is incurred at the start of the project, meaning Net Present Value reflects the entire system investment at the current value of the money. However, cloud-based, managed solutions push more of the payments out over the life of the contract. Obviously, there is a major financial benefit to the utility in delaying the future payments so that cheaper dollars are used.

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www.badgermeter.com

The Americas | Badger Meter | 4545 West Brown Deer Rd | PO Box 245036 | Milwaukee, WI 53224-9536 | 800-876-3837 | 414-355-0400
México | Badger Meter de las Americas, S.A. de C.V. | Pedro Luis Ogazón N°32 | Esq. Angelina N°24 | Colonia Guadalupe Inn | CP 01050 | México, DF | México | +52-55-5662-0882
Europe, Middle East and Africa | Badger Meter Europa GmbH | Nurtinger Str 76 | 72639 Neuffen | Germany | +49-7025-9208-0
Europe, Middle East Branch Office | Badger Meter Europe | PO Box 341442 | Dubai Silicon Oasis, Head Quarter Building, Wing C, Office #C209 | Dubai / UAE | +971-4-371 2503
Czech Republic | Badger Meter Czech Republic s.r.o. | Maříkova 2082/26 | 621 00 Brno, Czech Republic | +420-5-41420411
Slovakia | Badger Meter Slovakia s.r.o. | Racianska 109/B | 831 02 Bratislava, Slovakia | +421-2-44 63 83 01
Asia Pacific | Badger Meter | 80 Marine Parade Rd | 21-06 Parkway Parade | Singapore 449269 | +65-63464836
China | Badger Meter | 7-1202 | 99 Hangzhong Road | Minhang District | Shanghai | China 201101 | +86-21-5763 5412