Power

White Paper

FTTx ONT Battery Backup

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Installation and Replacement Options
November 7, 2007

With network providers continually adding bandwidth intensive programming the latest revenue-generating services including streaming media, voice over Internet Protocol (VoIP), IP based television and other services, fiber to the home (FTTx) has emerged as the media of choice.

Historically many FTTx networks providing video and data services have not been provisioned with battery backup at the home. Today's networks providing triple play services including voice, video and data, are always provisioned with battery backup either at the home or the MDU subscriber.

Implementing the most cost effective and reliable battery backup at the subscriber's home while balancing future battery management and replacement challenges is becoming a growing concern for both service providers and homeowners. Educating both the service provider and customer will be crucial to a positive battery experience.

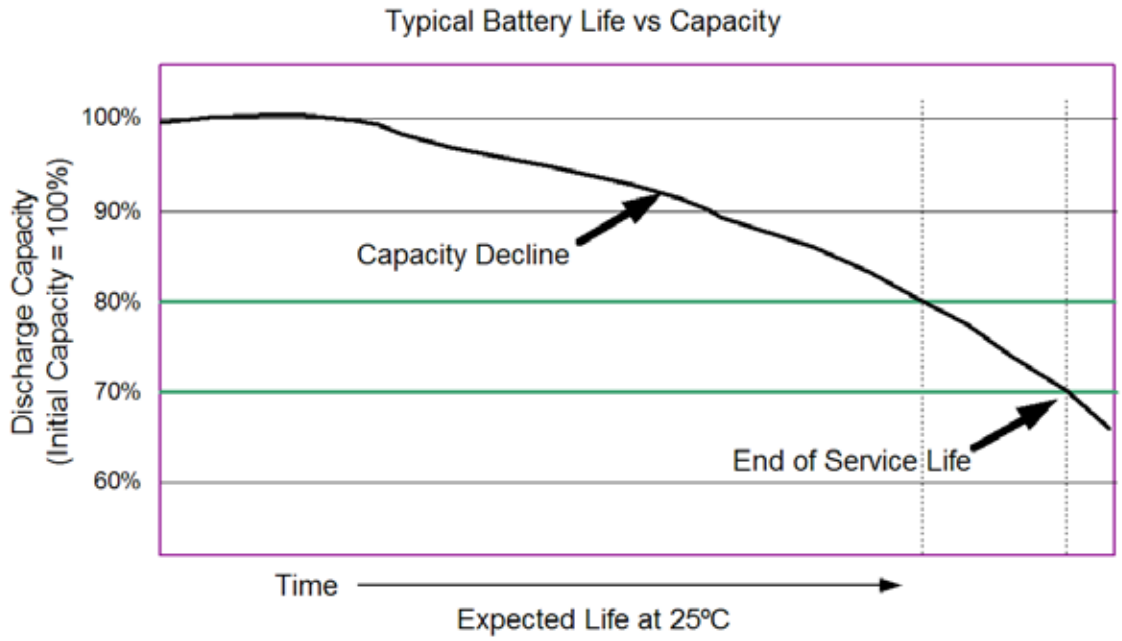
Therefore prior to a discussion on battery backup power systems in the FTTx network a brief technology overview of the FTTx batteries should prove helpful.

The 12volt 7.2Ah capacity, sealed valve regulated lead-acid (VRLA) battery has emerged as the standard for providing backup power for single-family home optical network terminals or ONT's. For this discussion we will focus on this specific battery type. The 7.2Ah battery is able to support typical ONT loads for eight hours upon loss of AC service. Several suppliers produce a battery of this type and there are millions of them produced per year. GS Battery was the first supplier to provide a battery specifically developed for the FTTx market, in response to Telcordia SR-4228 specifications.

There are significant variations in battery construction and manufacturing consistency with no one design optimized for all applications. Variables used to optimize a battery for a specific application include the thickness, geometry, lead purity, alloying of the dissimilar positive and negative plates, specific gravity of the electrolyte and the immobilizing technique. Cyclic batteries, for example, typically have a greater number of thinner plates to increase the surface area exposed to the electrolyte. This enables a more rapid chemical reaction, or high discharge rate, to occur generating a high current flow. The greater surface area of the plates in contact with the electrolyte also allows for a rapid recharge. Batteries optimized for float service applications, as in the FTTx application, are called upon to discharge intermittently, and at a slow rate for a long period of time. To support this application much less plate surface needs to be in contact with the electrolyte allowing for thicker plates resulting in longer life. Float service batteries do require longer recharge times but for our application recharge time is not a key parameter.

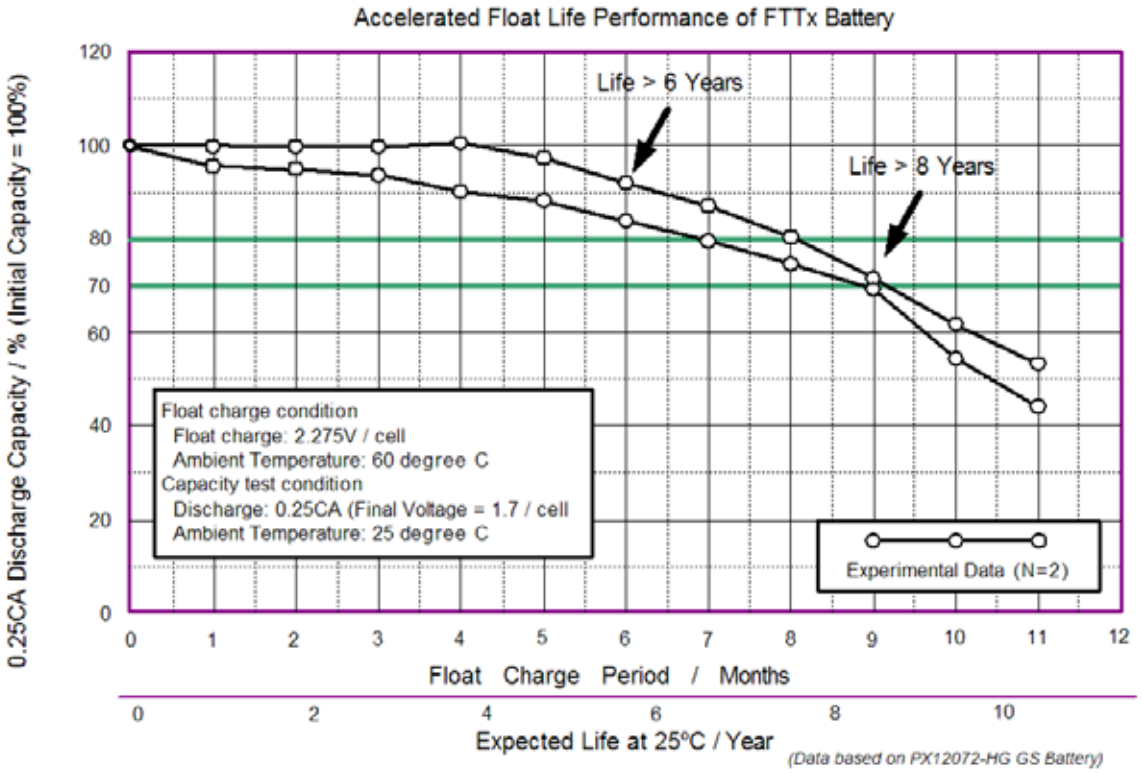
With recent focus on the FTTx battery, service providers and component suppliers have collaborated to optimize the value of the installed battery by reevaluating when a battery is no longer able to perform. The battery industry defines the useful service life of a Telecom VRLA battery as retaining the ability to provide at least 80% of its rated capacity. Unlike our FTTx application, typical Telcom applications connect multiple 12Vdc batteries in series to produce 24Vdc, 48Vdc or higher voltage strings. This makes monitoring and detection of the sharp end of life capacity decline of a single battery difficult to determine. Due to the diagnostic and charge circuit in an FTTx battery backup power supply (BBPS) it is possible to precisely charge the single battery over a wide temperature range and closely monitor the capacity decline as it is approaching the 70% remaining capacity level. Below the 70% level a battery can no longer reliably support the load for a predictable length of time as the rate of capacity loss accelerates as shown in the battery life verses capacity chart below. (figure 1) Extending battery life from 80% remaining capacity 70% represents a 10% to 20% more useful service life.

Figure 1.



The accepted method for performing accelerated life tests on valve regulated lead acid batteries is to operate the battery in an ambient temperature of 60ºC while on float charge. One year of life is represented by one month of operation at this high temperature. Capacity is periodically measured at 25ºC and plotted until less than 70% capacity is remaining, at which point the battery is considered to be at the end of its useful service life. The following chart (figure 2) represents accelerated float life testing performed on a leading long life FTTx battery comfortably predicting a service life in excess of six-years.

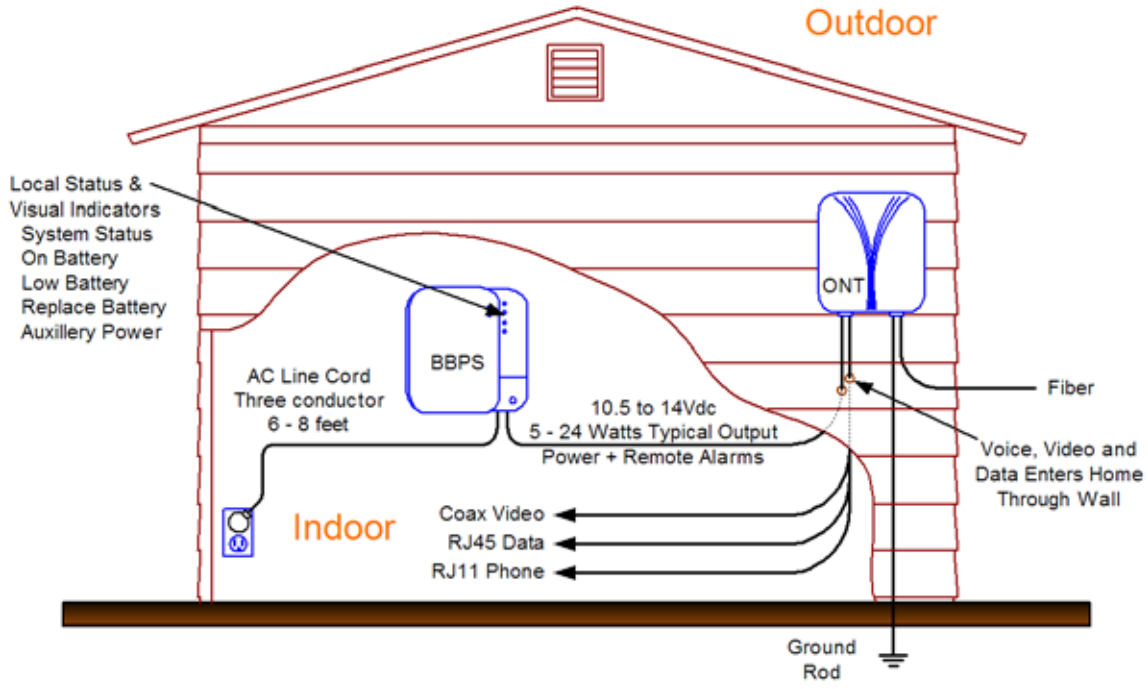
Figure 2.



Installed FTTx Batteries
There are two general approaches to placement of the FTTx battery backup power supply at a single-family home or small business. The two approaches represent vastly different battery ownership philosophies having opposite initial costs and opposite ownership costs as well as having a direct impact to the subscriber's media experience.

Indoor Installations
Setting up the BBPS inside the single family home is a relatively simple process usually performed during the initial service installation. It is typically mounted on a wall close to an AC outlet, usually in a garage or utility room. For many newer homes it may be located in a structured media enclosure along with an indoor ONT, but for the majority of homes the ONT is located outdoors adjacent to the utility meter. After the power supply to ONT power and alarm connections are made, the battery is installed and the unit is plugged into the AC outlet, the BBPS is up and running. A diagram showing a typical indoor installation is shown below. (figure 3)

Figure 3.



Many telecommunication companies deploying FTTx networks are locating the BBPS inside the subscriber's home. The initial battery, which they provide, is typically a long life model having a six-plus year design life. At this time the larger telecommunication companies are stating that the replacement of depleted batteries will be the subscriber's responsibility.

Some of the issues associated with placement of the battery backup power supply indoors include:

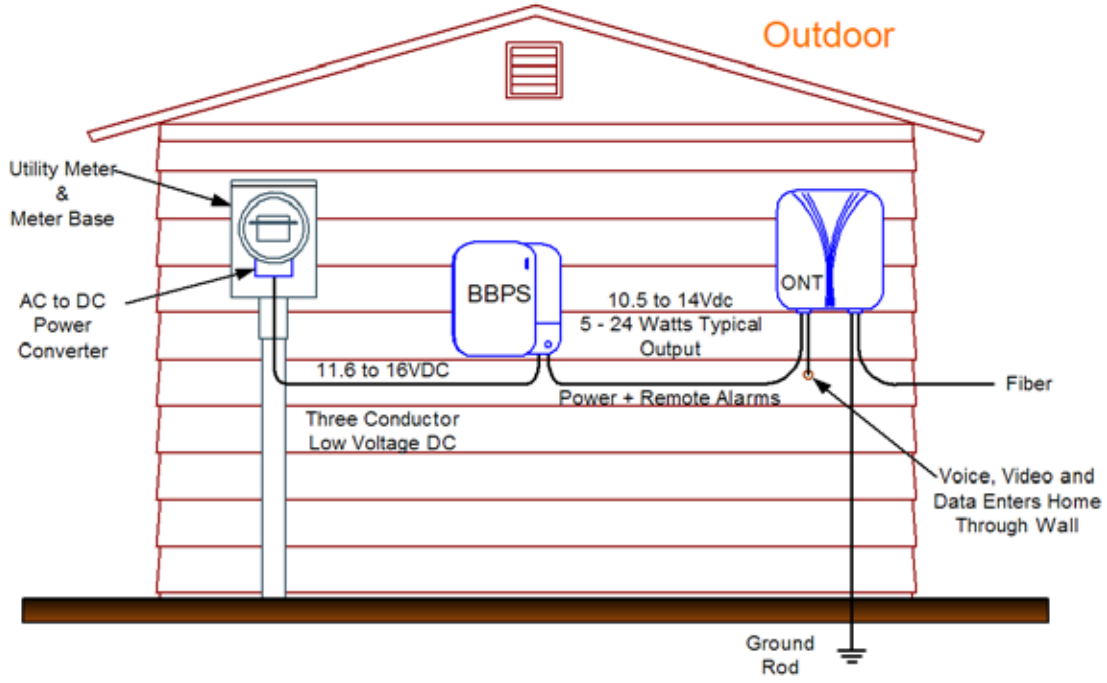
- Inadvertently removing the AC line cord from the outlet will discharge the battery. If left unplugged the battery can be permanently damaged.
- Most indoor BBPS are not tolerant to wide operating temperatures and are often placed in uncontrolled temperature environments including garages, carports and basements.
- Some indoor BBPS can have a 10ºC to 15ºC temperature rise above ambient in the battery compartment. A 10ºC rise in temperature over 25ºC reduces the battery life in half.
- Mailing a replacement battery to a subscriber does not guarantee it is installed and the spent battery is properly routed to a recycle center.
- To guarantee the battery is replaced and recycled, the service provider will need to set up an appointment with the homeowner and perform the replacement.

Restricting service provider access to the battery requires some level of homeowner participation in battery replacement and disposal.

Outdoor Installations
Installing the BBPS outdoors adjacent to the ONT where other network and utility demarcation equipment is located enables the service provider 24/7 access to this critical network component.

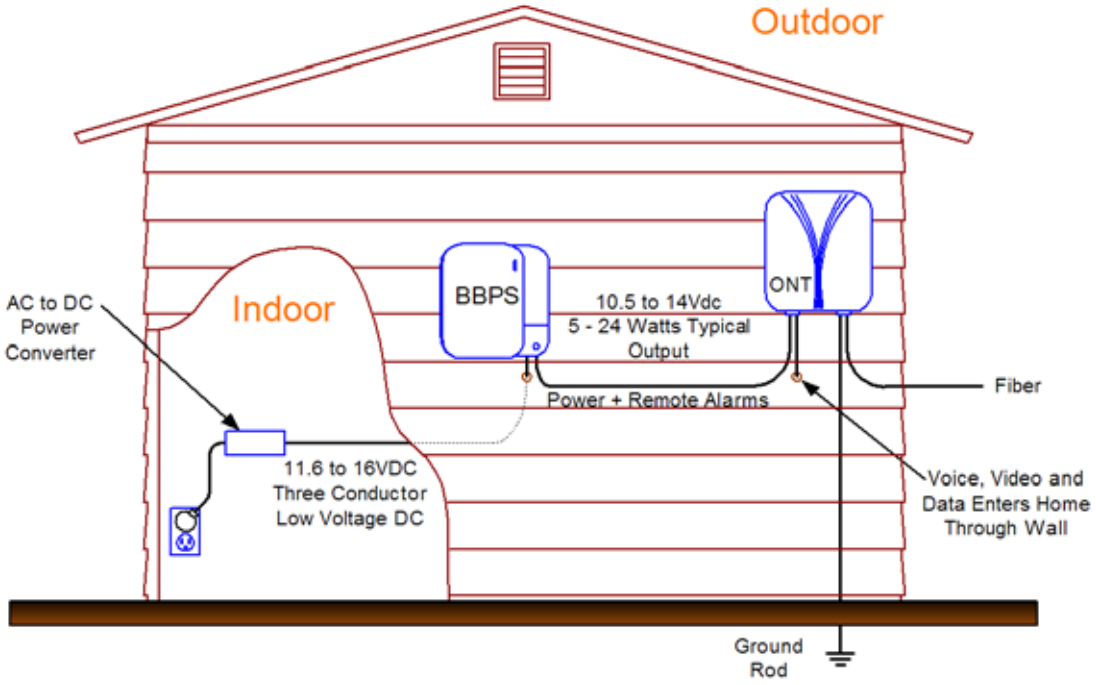
A reliable installation having a low cost of ownership would be to access AC power from the utility power meter and output safe electrical low voltage (SELV) DC power, similar to doorbell wiring. Installation of the meter tap requires a mutually beneficial business arrangement be established between the local Utility and the service provider (figure 4).

Figure 4.



For situations where working with the local Utility is not an option, a battery backup power supply can be located next to the ONT and be powered by a highly reliable AC to DC power converter located inside the home accessing an indoor AC outlet. The SELV DC wiring can be routed through the wall to the outdoor battery module (figure 5). This scenario also provides 24/7 access to the battery, which is the most likely network element to fail. (Note: An AC to DC power converter has an MTBF greater than 20 years at full load and 30ºC.)

Figure 5.



Issues associated with placement of the battery backup power supply outdoors include:

- Placement of the BBPS outdoors exposes the battery to seasonally high and low temperatures possibly impacting battery life. In many regions, a battery located outdoors can be exposed to the same or lower average temperatures as an indoor located battery.
- Low temperatures impact battery runtime – Batteries produce electricity as a result of an electrochemical reaction. As a battery cools the chemical reaction slows reducing the batteries capacity to perform electrochemical work. Battery warmers are available and preserve significant runtime capacity at temperatures to -40ºC or -40ºF.
- The purchase costs of an outdoor battery backup power supply system are roughly two to three times more expensive than of indoor BBPS system. This cost disparity is leveled when the administrative cost of setting up a homeowner appointment is added to the lower initial cost indoor BBPS.

When to replace the battery

FTTx battery backup power supplies perform a periodic capacity test and trigger an alarm when the battery is no longer capable of supplying 70% of rated capacity. In an outdoor installation, when the battery fails the self-test, an alarm is sent to the ONT, which is then relayed to the network operations center (NOC). For the indoor located BBPS, when the battery fails the self-test, an audible and visual alarm is triggered alerting the subscriber that action is needed. What action is needed? Herein lies the problem today.

It has been reported that some customers have replaced their indoor FTTx battery themselves and have experienced problems. The 7.2Ah batteries available today at local retail electronics stores or internet outlets are a general purpose design that is a compromise between cyclic and float service construction. Retail batteries are often a commodity grade intended to last a year in a variety of applications. Problems encountered include low initial voltages due to poor inventory management, shortened life due to high storage temperatures and incorrect terminals that can cause a shorting condition. In some cases the homeowner has had to replace the battery again in as little as three months. This can cause hard feelings and taint the quality of the media experience.

Replacement Programs
Near future battery replacement programs will support both the service providers and individual homeowners having indoor or outdoor installations. For indoor BBPS systems where the service provider monitors the “replace battery” alarm a list of customers needing batteries can be sent to the replacement program administrator who would then send out replacement batteries in packaging including replacement instructions and return postage to the closest battery recycler. The service provider would be billed once the batteries are mailed. For system operators not wanting to participate in the battery replacement process and not monitoring the “replace battery” alarm should, at a minimum, provide educational mailers with monthly statements including contact information for replacement programs and the approved battery model and manufacturer. For outdoor installations the service provider can budget battery replacement and dispatch teams to canvas service areas quickly replacing batteries in a manner transparent to the customer. This approach supports deployment of best value batteries, economical replacement and proper recycling.

Here are a few frequently asked questions regarding FTTx single-family home batteries:

Question: Should the service provider send a replacement battery to the subscriber and charge them on the next bill? *Yes, the service provider should send a replacement battery. The battery is a critical network component and not all customers have the time, talent and motivation to shop for a replacement. If the FTTx subscriber deserves battery backup when the system is installed why wouldn’t they need it throughout the life of the service?*

Question: Should the service provider amortize the replacement battery cost into the cost of providing the service and replace the battery at no charge? *Yes. A battery costing $30 and lasting six years would represent a monthly cost of less than $0.50.*

Question: Should the subscriber purchase the battery from the battery manufacturer or his distribution channel? *Neither should be a first choice, but if the subscriber is not supported by the service provider, being educated in batteries and having options is a plus. A quality battery replacement program would make battery replacement no different than what you would do today to replace your cell phone or UPS batteries.*

Question: How do we make sure that the thousands of old batteries are properly routed to certified recyclers? *There are many options available today in your local community. A battery replacement program in which the service provider participates appears to be the best method to ensure spent batteries find there way to proper recycle centers.*

Question: Are some of the early FTTx builds now replacing batteries? What are their plans to do so? *Some of the early FTTx systems Alpha Technologies participated in are now budgeting replacement of their initial 3-year design life batteries. For the most part these four year old batteries are exhibiting a little more than 80% remaining capacity.*

Conclusion
The FTTx industry is now at a point where there are a couple hundred thousand subscribers now on line for three years or more. These batteries are coming due for replacement and service providers need to participate to assure the high quality media experience is maintained. The service provider has a responsibility to the customer, community and environment to participate in a battery replacement program assuring spent batteries are properly recycled. Alpha Technologies has an extensive network of battery recyclers and distribution centers in North America and can support FTTh battery replacement needs.

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