PSE in Ultrafast Broadband Access Networks

Differential Powering of Edge Elements and CPE to Reduce Fixed and Recurring Costs

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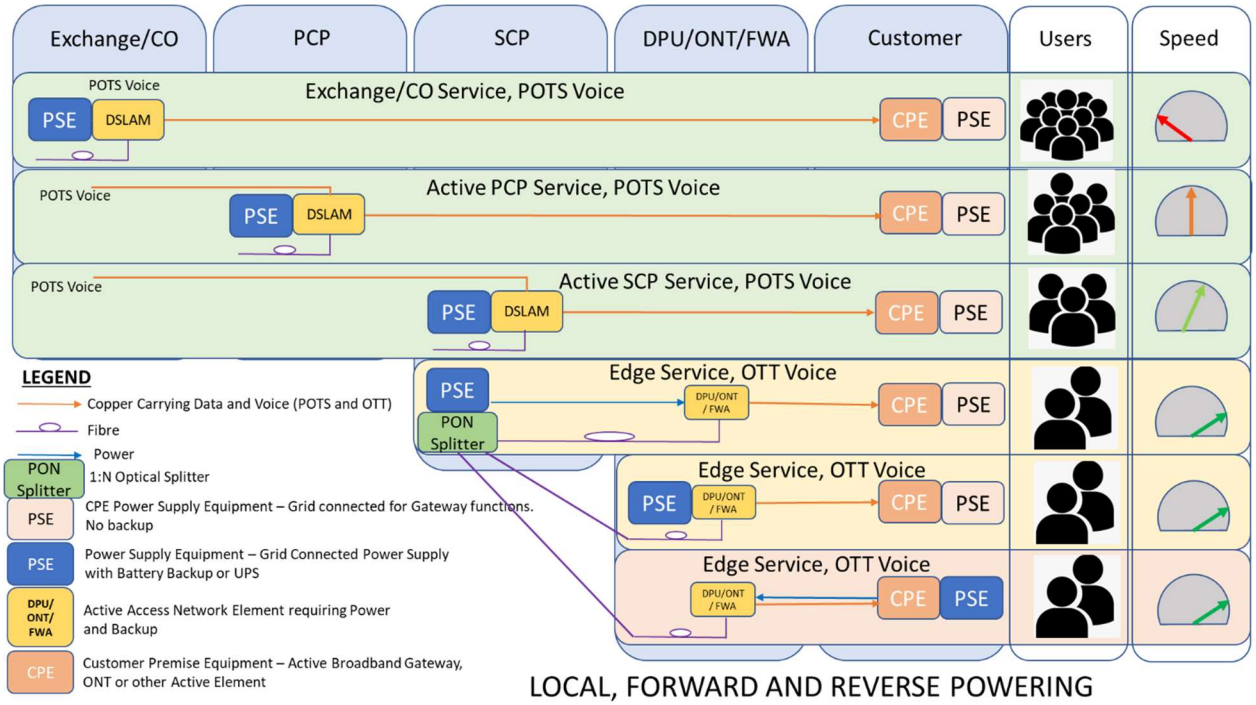
Abstract
Powering of active elements in communications access networks present significant economic and operational challenges. This paper investigates current forward and reverse powering methods and proposes a differential powering solution architecture building on the benefits from both current methodologies to reduce complexities.

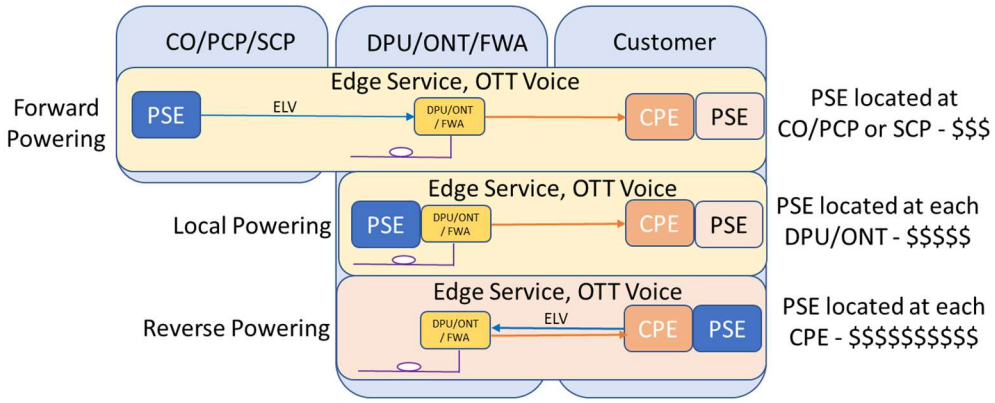
Problem Statement
Current forward or reverse powering solutions cannot provide operators or infrastructure providers with the required functionality at desired fixed and recurring costs for the powering of ultrafast broadband services in their access networks.

Background
The drive to provide higher bandwidth broadband services (ultrafast) to all customers using advanced DSL techniques, EPON/GPON and FWA, has driven the need for an architecture that requires active elements further out into the periphery of their access networks, closer to their end customers. This migration of active elements from the Exchange/CO, first to active PCP's, and now to SCP's, DP's, or inside customer premise, presents a challenge to provide cost effective and resilient power to those elements.



In addition, as the active elements migrate further out into the access network the number of customers that need to be connected to a single active element reduces as the serving area for the active element contracts. As the number of customers served by an active element reduces, the electrical power requirement for each element reduce, while the number of active elements requiring power in the access network may increase significantly, increasing the cost per customer.

CURRENT OPTIONS FOR ULTRAFAST DATA WITH RESILIENT POWER



In the forward powering model, powering either from the Exchange/CO or active primary or secondary cross connect points in the access network, the operator can amortize the fixed cost of providing PSE and connection to the local grid across the population of served customers. With smaller, less power-hungry active elements, each serving limited populations of customers, the initial fixed costs per customer to provide resilient power from the grid to the elements increases significantly, along with increased operational complexity and maintenance costs.

Reverse powering from customer owned grid connections reduces the fixed and operational costs associated with providing power to the active elements at the edge of the access network by eliminating the need for resilient PSE and connections into the local grid at the active elements on the edge of the access network. The principal of each served customer contributing to the aggregate load of the active element is attractive to the operator as it eliminates the recurring costs to power the element, this now becoming of the customers CPE power budget.

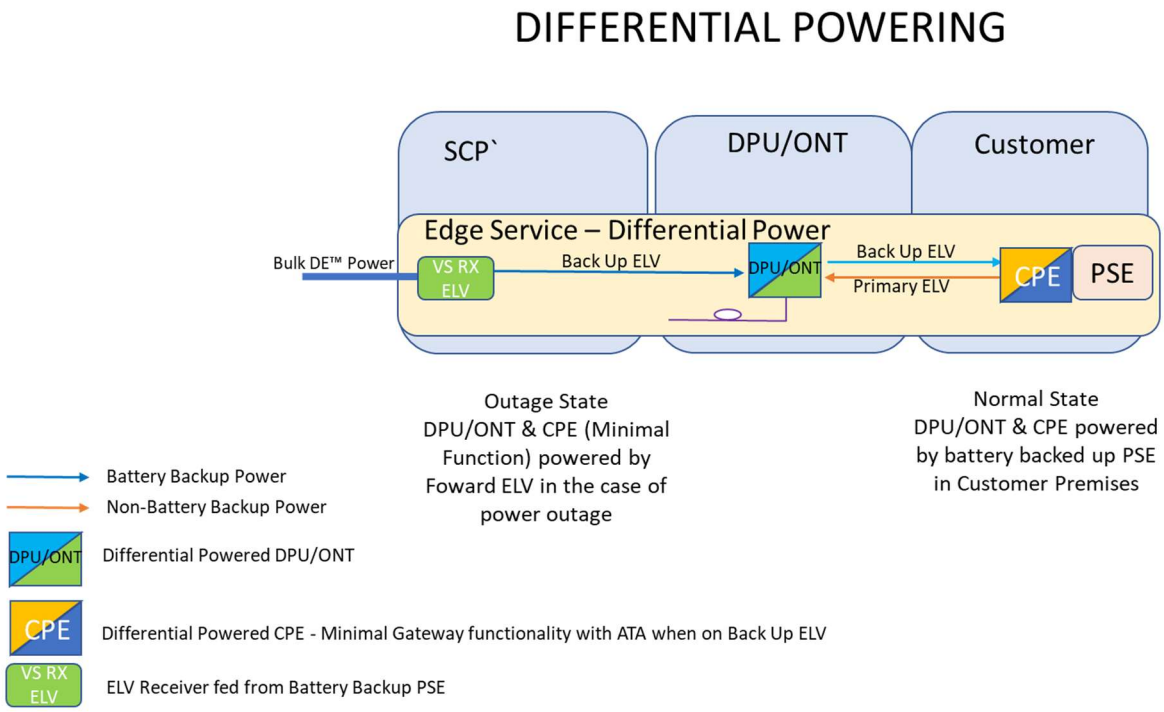
However, reverse powering increases the operational complexity required by operators to actively manage the CPE, and premise PSE, to monitor and ensure minimum service availability, i.e. Emergency Voice services. When applied to a large population of customer this results in significant incremental fixed and recurring costs, along with ongoing long term operational support responsibilities.

Solution

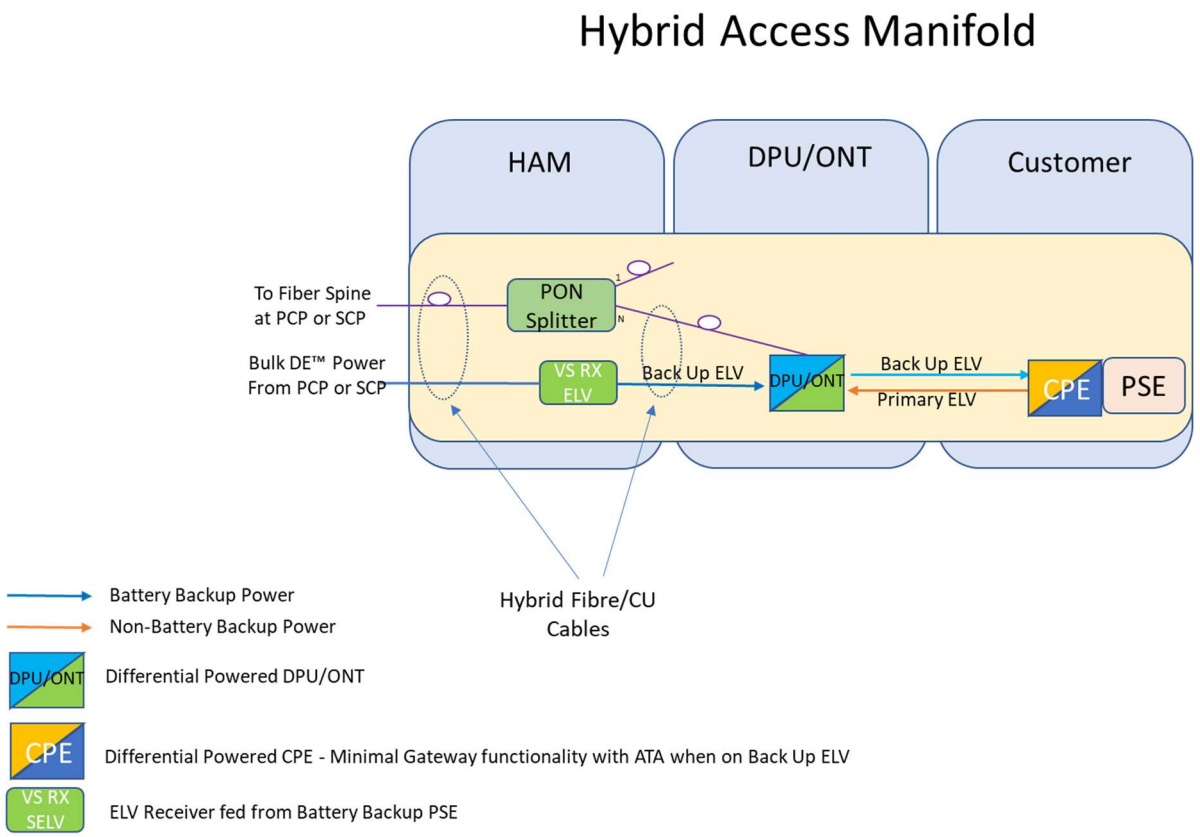
A promising solution adopts methods and practices from both forward and reverse powering architectures to minimize the number of operators provided PSE locations in the access network, while providing resilient power to the operator active elements and customer CPE to ensure basic SLA's for emergency services. The resultant functionality has CPE and access network edge active elements operating in a differential powering mode with the preferred PSE source via reverse powering from the customers to the CPE and edge active elements, and fallback power via forward powering from a shared PSE within the access network.

In the event of multiple customer power failures in an area removing the remote powering CPE, the access network edge active elements and CPE fall back to a minimal service configuration, to minimize

aggregate power requirements, whilst still providing emergency and basic services until the power is restored.
To avoid multiple PSE grid connections at all the active elements at the edge of the access network to provide the forward powering, fallback power is provided from the CO or other active cross connection points in the access network using Digital Electricity™ to provide bulk remote powering to access network distribution points, where multiple Limited Power circuits are distributed to the active edge elements and CPE, when required.



As the forward powering capacity is only used when the reverse powering from multiple customers is unavailable, the scale of the fallback PSE power plant and its necessary backup battery capacity can be optimized to provide power to a portion of the served customers, say a population served by a common grid transformer.
By providing cost effective differential power solution to active edge elements in the access network an opportunity to combine the SELV Source function with the EPON/GPON Optical Splitter function provides an ideal platform to utilize Hybrid Fiber/Cu cables to the edge active elements,– A Hybrid Access Manifold (HAM) function.



Conclusion

Differential forward & reverse powering with reduced numbers of PSE sources powering multiple HAM functions in the access network provides operators with a method that minimizes fixed costs, limits recurring costs for power consumed to maintain SLA's, provides a practical architecture to utilize Hybrid cables in the access network, and enables deployment schedules for advanced broadband services to be independent of the Grid supplier timelines.

References

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TR124 - https://www.broadband-forum.org/technical/download/TR-124_Issue-5.pdf