Anatomy of the Tier-3 Regional Energy Operations Center

Smart Grid

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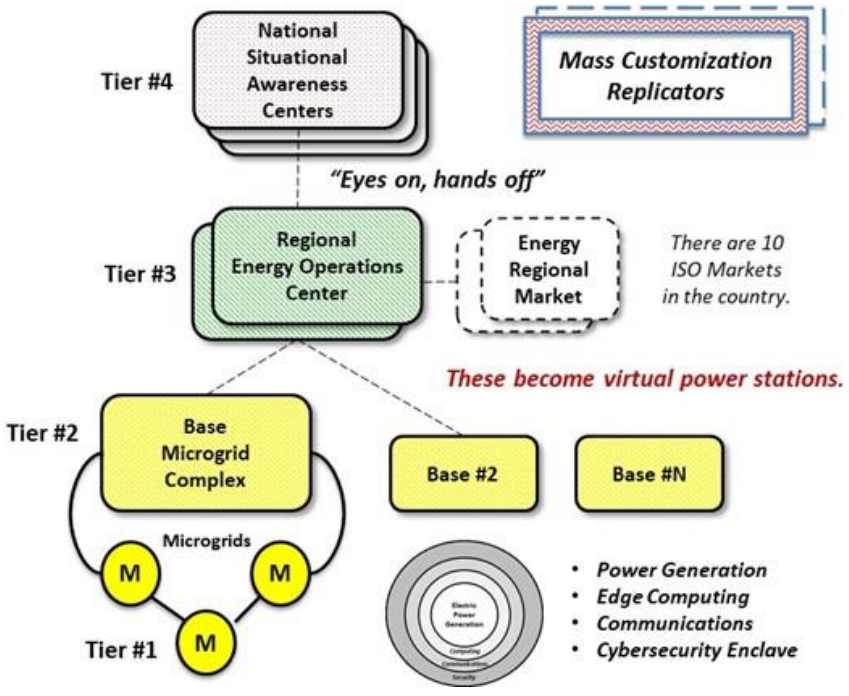
Continuing the sequence of the Smart Grid whitepapers from the previous description of the overall context of the 4-Tier Architecture of the Fractal Smart Grids[1], we now turn our attention to the next higher layer: The Tier-3 Regional Energy Operations Center.

For context, the Tier-3 Regional Energy Operations Center is a part of the Fractal Smart Grid approach for a country, and we repeat the overall architecture in the diagram below for reference.



[1] Whitepaper on the Anatomy of the Tier-2 Cluster Node

For perspective, in the United States we estimate that there will be over 100,000 opportunities for Tier-2 "Base Microgrid Complexes" which at Cluster Nodes and form the heart of control for city districts, small towns, military bases, university campuses, and large industrial parks. Usually the Tier-2 nodes are in close proximity to a high voltage transmission substation for simplest interaction with both the transmission grid and for local support of a distribution grid. They are primarily focused on managing the fleets of microgrids and building microgrids for reliability and optimization of operational matters.

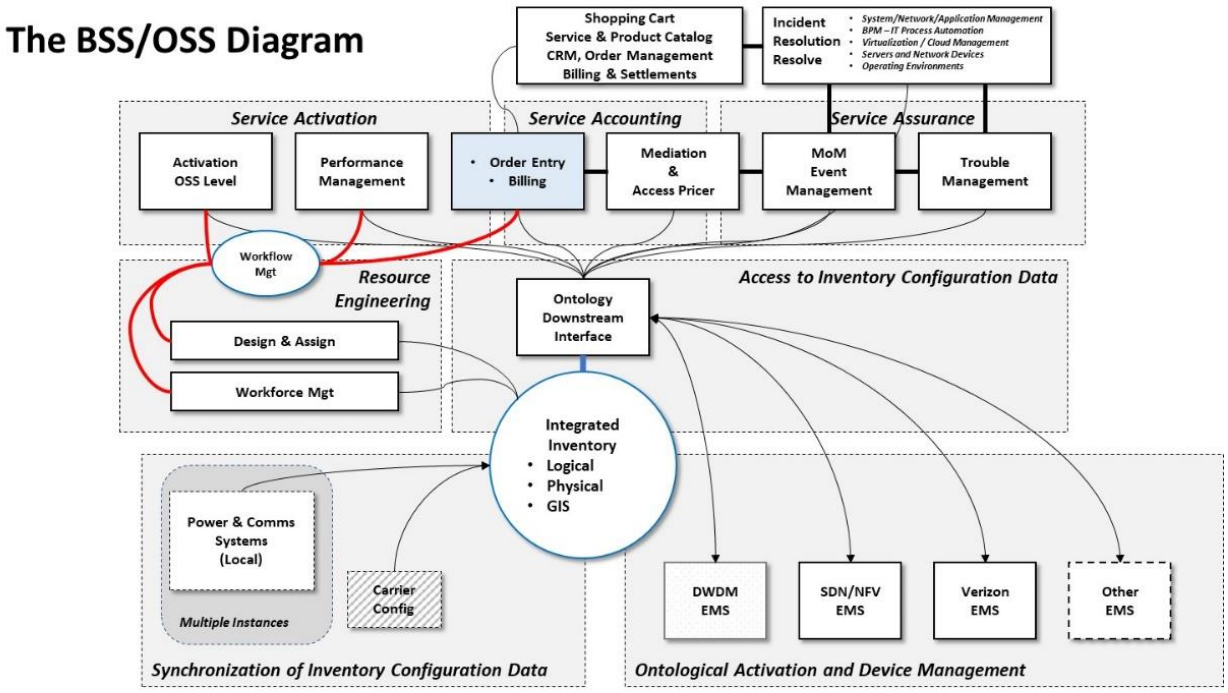
However, the Tier-3 nodes cooperate with the tier-2 nodes to provide proper balance to a region for supply of electric power and the quality of that power across the region. However, in doing so, they also are engaged in buying and selling of power – from virtual power pools in the region – for inter-regional balance of electric power as well as for export purposes out of the region to other regions for help in balancing power on an inter-regional basis.

The regional centers are actually constructed using the very same Infrastructure as a Service computing modules as were used for the Tier-2 Cluster Nodes[2]. It is just that the Tier-3 centers have a much higher capacity than the Tier-2 nodes by having more instances of the basic building blocks, and the capacity of any one building block may be substantially larger due to the higher volume of data that may be expected.

The OSS Aspects of Regional Coverage

The combined architecture for the BSS and OSS takes on the structure shown in the following diagram.

[2] *Supplemental Whitepaper Detailing the Structure of CloudStack*



- There are 3 workflow engines that must cooperate: Order Entry and Billing, Provisioning, and Partner Settlement.

The BSS layers include the processes for service activation and service accounting. And they are also supported by the service assurance process. It is useful if these processes can be implemented in microservices within the Platform as a Service general approach for containerization and Kubernetes orchestration. This is because the database for financial receivables will need to be regionalized inside the sovereign borders of each country implementing the decentralized approach as will be described further.

Once a new service has been ordered and it is time to activate the service, the workflow system routes the service order request to a variety of OSS processing tasks relevant to each type of service and specific move, add, change, or delete operation requested.

Of enormous importance to the OSS processes and even to some of the BSS operations is the maintenance of an accurate and integrated Configuration Management Database (or Inventory Database as it is sometimes referred to). This database is updated and used by a large variety of applications and

microservices. It contains geospatial, physical, and logical data. As a part of the logical data, it also contains the latest configuration parameters for the distributed cognitive processing modules housed within the various containers that are operating in the distributed environment.

In that, over time, there tends to be an expansion of useful applications operating in the real-time, interactive, and analytic processes that have been sourced from a variety of vendors, there can develop a mismatch in the syntax and semantics surrounding the configuration data and other data in event streams as well as reference data. It is therefore useful to maintain an ontological map lens that can be used to normalize the configuration data to a standard format, and then be translated as appropriate for each different system needing access to the configuration data. Of course, with the continuing evolution of the types of services being offered on an ongoing basis, the ontological map itself is not a static element. The tool for keeping the map itself up to date needs to use a generalized technique for evolution and expansion.

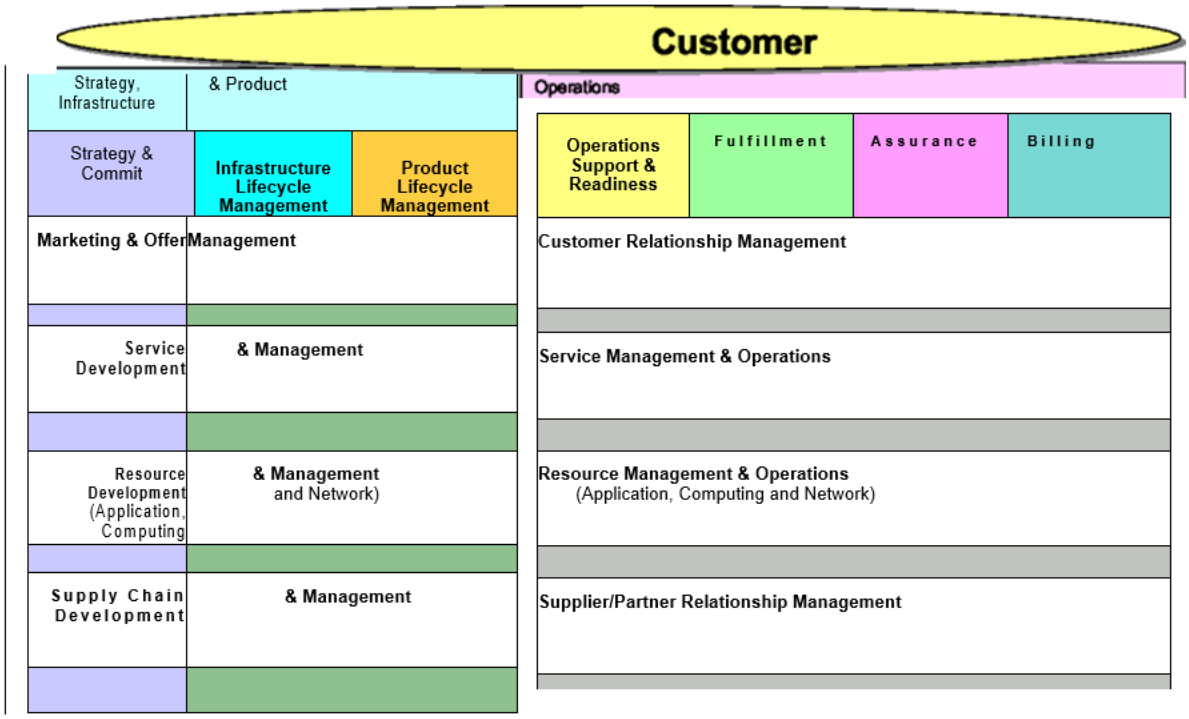
Because there are changes being made all the time to the configuration of resources in the field, the OSS also contains an audit function that tracks the actual components actually resident in the field so that anomalies can be quickly discovered and corrections implemented so that the automated operations can proceed accurately.

The BSS Aspects of a Global Implementation

The Tier-3 centers can also be the location for the Business Support System for everything needed to coordinate the secure supply chain for the “Multi Service Operator” responsibilities for the region.

In that the decentralized fractal patterns are in integrated planning approach for infrastructure, the control of business and operational matters at these nodes implies that they are full support communications situational awareness centers containing regional Network Operations Centers, regional monitoring and response for the assurance of unmanned Tier-2 computation pods, as well as the energy management system for the region in terms of all of the virtual power pools and demand response operations.

The fundamental business processes for all the service-oriented businesses that might run at a Tier-3 Regional Operations center oddly enough tend to all track along with the TM Forum eTOM Business Process Framework as summarized in the following diagram.



In the language of eTOM, the Business Support Services mostly congregate in the Customer Relationship Management Layer for retail purposes, and at the Supplier/Partner Relationship Management Layer for wholesale purposes where supply chain coordination is paramount. The Operations Support Systems tend to congregate at the Service Management Layers and the Resource Management and Operations Layer. But even with good summary level strategy as the eTOM represents, the question remains, “How are we going to implement it this time?”

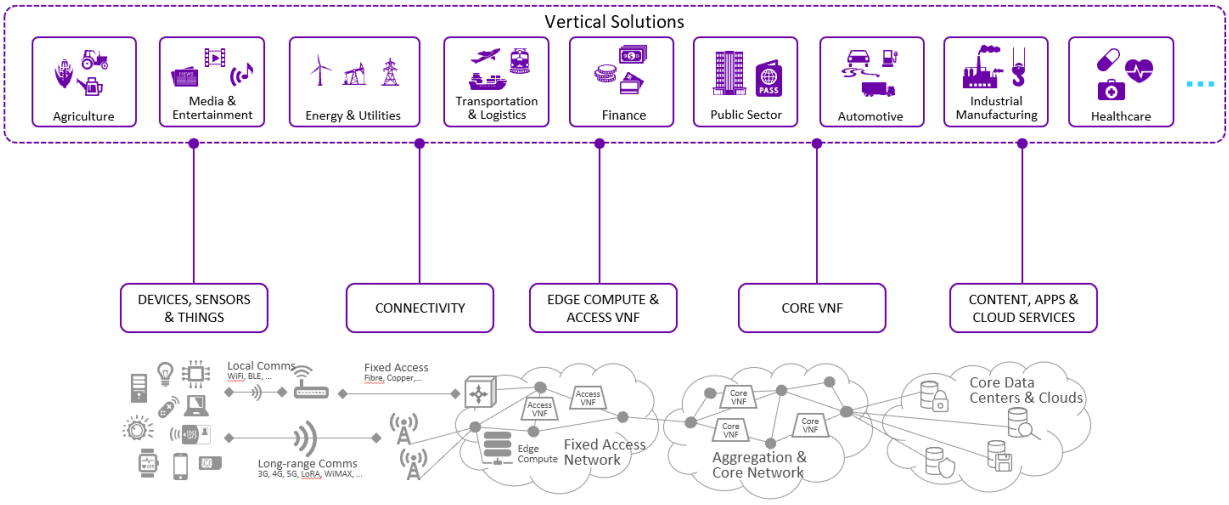
For operational control for the power grid, for telecommunications access support, and for the operation of the distributed computation pods, the operational support systems for these various functions all have different

vocabulary but use remarkably the same patterns for operational support. However, the differences in the different disciplines make all the difference in the world as to what applications are used to implement support. But in the final inspection, it is very convenient if these functions are carried out in a manner that allows for close collaboration between the teams.

Given the differences in the implementation of the fundamental processes for the different aspects of the integrated infrastructure system of systems, the Business Support Systems are nicely falling into the supply chain management structure supported by the BearingPoint Beyond Digital Business Marketplace. For business support purposes, the model of the Multi Service Operator is perhaps the best approach given the new infrastructure itself, and also the variety of services that will want to operate over this new infrastructure.

The depths of the operations of the Multi Service Operator that we will run at Tier-3 is well documented in other whitepapers in the reference materials[3] for the Catalyst. But suffice it to say that the Fractal Digital Marketplace will provide the opportunity for many types of service providers to sell their services over the new infrastructure as typified by the following diagram.

[3] The Multi Services Operator: Partnering and Monetization Platform Thread



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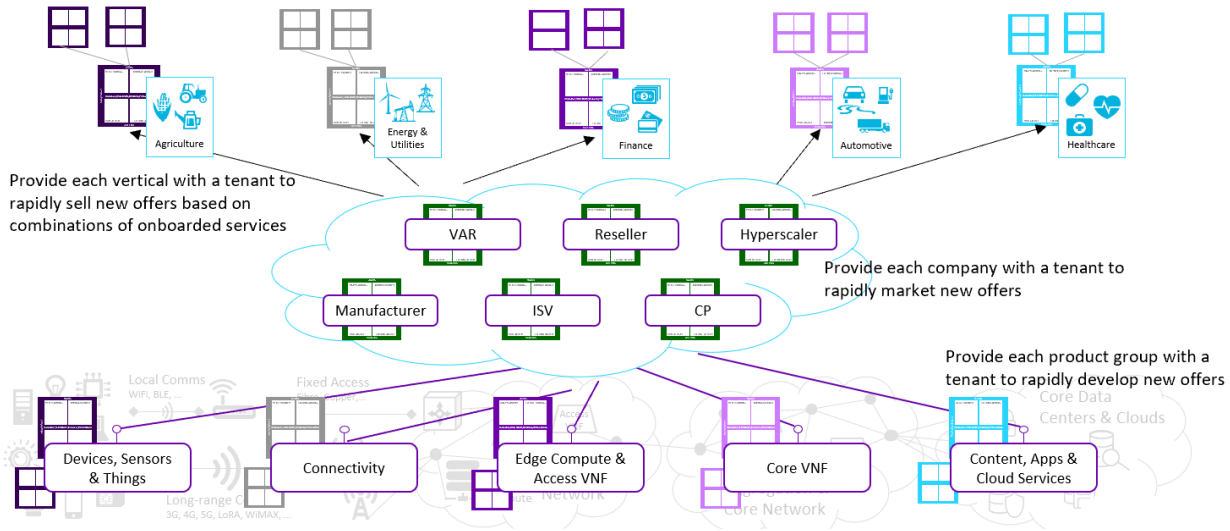
The secure supply chain approach afforded by the team of teams structure of the frictionless trading arrangements allow the Fractal Digital Business Marketplace to support multiple services, each provided by a different wholesale service provider, for all kinds of services as shown in the following diagram.



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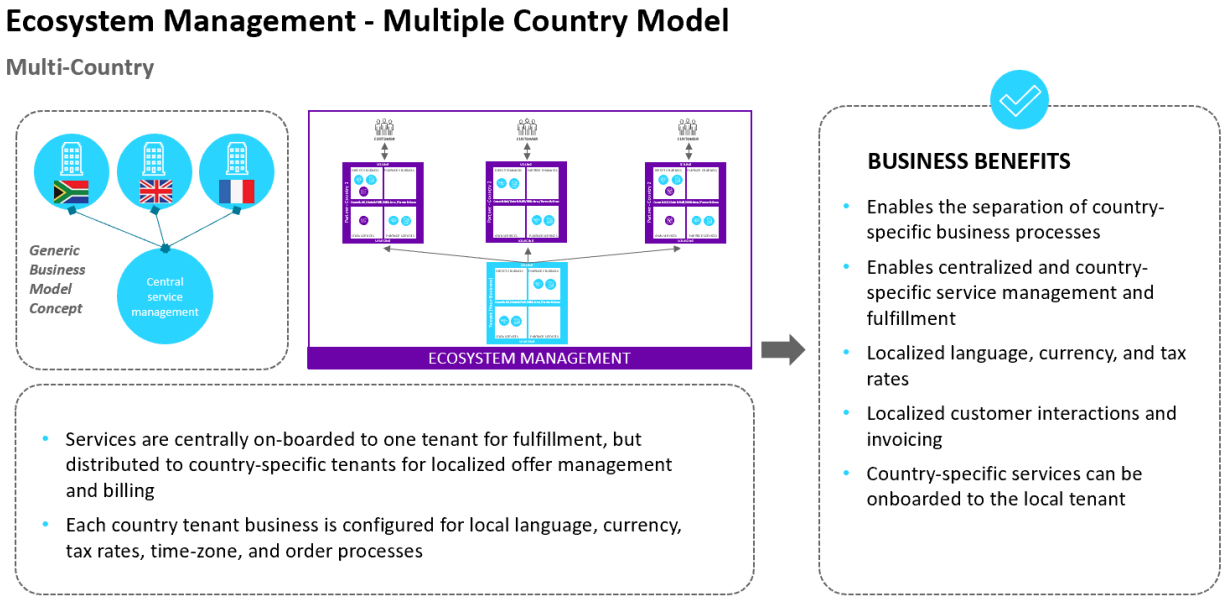
The Fractal Digital Business Marketplace will also support numerous retail channels taking care of retail service sales, installation, and service assurance for the multitude of local service areas.

Although explained in much more detail in the Multi-Service Operator whitepaper, there is one more very important aspect of why the tiered ecosystem is set up the way that it has been for the Fractal Digital Business Marketplace in Tier-3 of the model. This is that of implementation into multiple countries as described in the following diagram.



As has been pointed out elsewhere, the matters of national sovereignty come into play when service customers in multiple countries. In the United States, we could potentially operate with just a single instance of the Fractal Digital Business Marketplace. It could operate in the Amazon AWS cloud, and all would be simple. But in the international marketplace where money is being handled, there are

international laws that insist that receivables records must always remain within the sovereign borders of the country. Matters of privacy surrounding GDPR and personal privacy are different from country to country. Therefore, the fact that the Tier-3 center is a regional system conveniently allows us to delegate different instances of the Fractal Digital Business Marketplace and its databases to operate totally within each country being served.

Thus, even the BSS has been designed to allow the Agile Fractal Grid to operate in a global fashion, while allowing each country and/or region to maintain the customs, culture, and legal arrangements as is appropriate.