"The path to the future"

Immersion4 DUDE[TM] Architecture – "Distributed Urban Datacenter Efficiency" Architecture

NOTE

This document is not taking into consideration the supercomputer market as one of the biggest challenges they face is to move data around, a supercomputer uses a lot of power and generates enormous heat. An exascale system built with today's technology would consume about 650 megawatts of power or a little less than a small nuclear power plant generates. This requires almost a dedicated power plant right next door with an enormous amount of heat… To be environmental friendly it is needed to build a sustainable datacenter ecosystem starting with hydropower sources and FULL IMMERSION cooling technology

CHALLENGE – DATA IS ENERGY

According to the Datacenter market trend, in most countries, Exascale and public clouds as many business and personal applications are being pushed to the cloud, they become a threat to nation energy independence with a hard impact on their GDP. Today, DATA is at the center of many challenges in infrastructure and system design. Difficult issues need to be figured out, such as clean energy availability, scalability, consistency, reliability, efficiency, resiliency and maintainability. The fundamental principles remain the same when examining the pros and cons of various technologies for processing and storing data which applies to create the DUDE[TM] EDGE Datacenter architecture.


> ➢ Navigate the trade-offs around consistency, scalability, fault tolerance, and complexity
> ➢ Understand the distributed Datacenter / systems

DUDE Architecture CONCEPT – 'User-centric distributed cloud network architecture"

DUDE[TM] EDGE Datacenter architecture is a user-centric distributed cloud network architecture that is able to migrate virtual resources between data centers with an optimized service downtime, offer resilient access to virtual resources and minimize the cloud access latency. The Cloud is having many fashions such as public, hybrid and private. Compliant with National regulations related to GDPR, the DUDE[TM] Architecture concept address all of them with the utmost mission to host any IT Load and applications locally generating new sources of revenue to communities. EDGE Datacenters can now be implemented teaming with any service providers and/or national network 4G, 5G and/or fiber point of presence "POP" to create as well DATA hosting capabilities using as best internet network access connectivity.
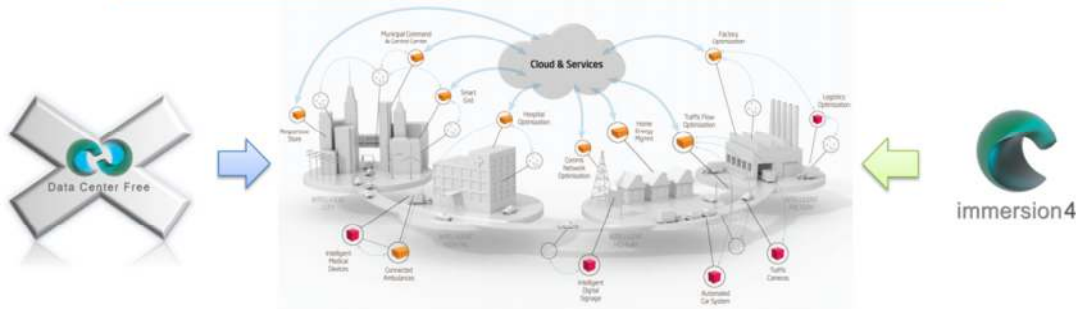
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LEADING WAY TO NEW REVENUE LINES
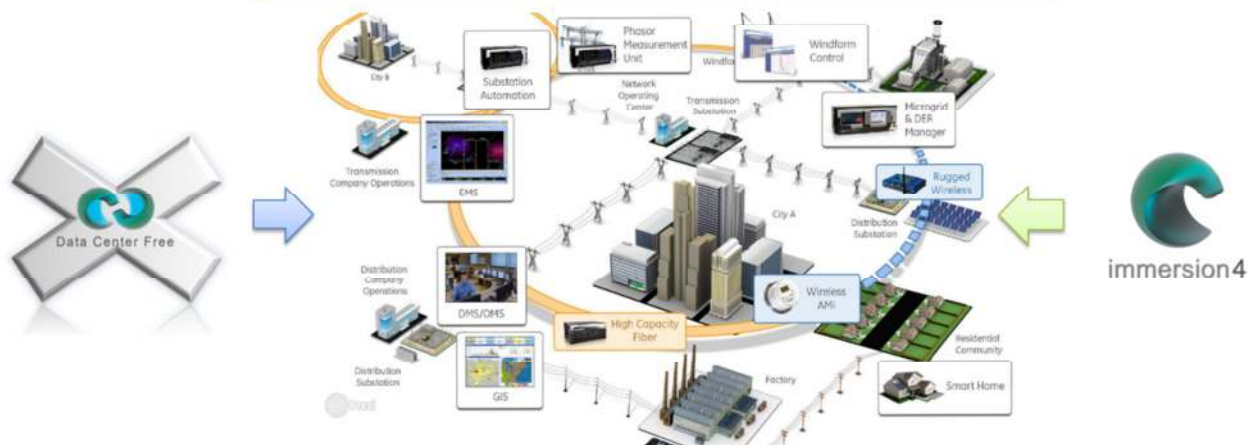
TECHNOLOGY – By building large, distributed Datacenter, the objective is usually to make them resilient, evolutive and scalable to collect & process DATA at the source. The DUDE^{TM} Architecture designed by Immersion4 based on Eco conservation under the concept "**DATA 4 Communities",** provides many advantages at many levels

➢ **REAL-ESTATE –** Under the concept of "4 walls and a roof is potentially a Datacenter", any existing or future Real-Estate building could host modular, **"reduced footprint" "pollution free"** EDGE Datacenter using DTM^{TM} Technology with a mutualized ENERGY & CONNECTIVITY infrastructure allowing customers to have access 24/7 to their IT.

➢ **EXASCALE DATACENTER REDUCTION -** Re-building downsized high-scale using distributed mission-critical datacenter architecture allows the migration between high-load systems as well as operating them reliably.

➢ **POWER SOURCES –** No need any more to upgrade the GRID and to increase traditional power sources to provide consistency and resiliency. Distributing Datacenter permits a smooth & better URBAN integration and energy risk distribution. Exascale Datacenter cannot be powered using solely renewable energies due to their lack of consistency. In fact they have an opposite effect due to their constant need of stable energy sources which not only oblige to maintain legacy energy sources but force municipalities and local providers to increase their capacities.

➢ **GRID –** Dividing Datacenters in multiple locations reduce the pressure of the power demand on the GRID while in the same time allows to reuse the dissipated heat within the existing or new upcoming building through Immersion4 BMS Building Management System.

➢ **POLLUTION –** Using DTM^{TM} technology, there is no more GHG & CO_2 emissions as well as water consumption. The absence of Datacenter infrastructure eliminates upfront sizing and Datacenter decommissioning mandatory for AIR and / or water cooling Datacenter. DTM^{TM} technology allows EDGE Datacenter integration in the most demanding environment powering the IT Load not the Datacenter.

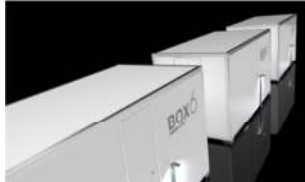

MUNICIPALITY EDGE CLOUD - NEW REVENUE GENERATION SERVICES

DUDE^{TM} ARCHITECTURE DESIGN

Created by Immersion4, DUDE^{TM} Architecture aka Distributed Urban Datacenter Efficiency Architecture is modular & evolutive accepting existing legacy IT loads of any kind as well as the one especially designed for FULL IMMERSION using DTM^{TM} technology.

It is a rethinking of the Datacenter concept which could address the need of implementing:

- **EDGE Datacenter for local IT loads** - Mutualizing energy, connectivity for the local market to host their IT load in an accessible 24/7 and secure environment.
- **EDGE Datacenter for distributed clusters** - Agnostic in every ways, it could welcome any of layered, object, data-centered, event and Hybrid based Architecture when it comes to distributed systems. It could be assimilated to the "Peer to Peer Model" as there is no central control in a distributed system. Any Datacenter part of DUDE^{TM} Architecture could have each node either be a client or a server at a given time. If the node is requesting something, it can be known as a client, and if some node is providing something, it can be known as a server.

DUDE ARCHITECTURE COMPLIANCE – OPEN ARCHITECTURE

From its inception the DUDE^{TM} Architecture has been design to comply & complement any Datacenter implementation adding within the most demanding environments such as URBAN communities "LIGHT OUT EDGE DATACENTER" no matter their destinations. It welcomes any hardware or software architectures such as :

- **Reactive Architecture -** The Reactive architecture is based on reactive principles consisting to build a responsive, resilient, elastic and message-driven system thus came quite naturally. Having a model to fall back on and check that progress is on the right track was something that I found helpful and I'll be using this model when building future systems as well.
- **Horizontal vs vertical scaling -** EDGE Datacenter point of presence will only grow and their IT load will only increase. At some point, the existing infrastructure & IT configuration setup will not be able to support the load and the capacity needing to be added. The two most common scaling strategies are vertical or horizontal scaling.
  - **Horizontal scaling ($$)** is about adding economically more machines (or nodes) within the Datacenter and or the IT Load, to increase capacity. Horizontal scaling allows scaling distributed systems adding virtual machines to a cluster is often as easy as a click of a button.
  - **Vertical scaling ($$$)** consist in buying a bigger/stronger IT either a (virtual) machine with more cores, more processing, more memory. With the DUDE^{TM} Architecture, distributed systems using vertically scaling is can be more costly than scaling horizontally.
- **Consistency & resilience** – Consistency is a tradeoff concept with several models (from mission critical to eventual consistency) which is a key concern in highly available Datacenter. At the same time, a consistent Datacenter have all its nodes seeing and returning the same data, insuring each node has the same information, they need to send messages to each other, to keep themselves in sync. However, messages sent to each other can fail to deliver, they can get lost and some of the nodes might be unavailable. Distributed EDGE Datacenter allows 99.999% availability (being down about 5 minutes/year). A straightforward way to get the availability number is to add some of them into a cluster. Even if some of the nodes are down, others will be up and the overall availability of the system will be higher, than the availability of individual Datacenter.

- **Data Availability (Durability) –** There is different levels of durability which can be done in different ways. At the cluster level, using DATA replication and storage on multiple nodes. When added, they will remain available going forward if Datacenter / nodes in the system go offline, crash or have their data corrupted.
- **SLA -** With large Datacenter processing millions of events per day, some things are mean to go wrong. Defining the needed Service Level Agreements depends on :
  - **Availability** - % of the time the service is operational. The DUDE^{TM} Architecture answer that need providing the requested "nine" availability (99.99% = 50 minutes downtime) is considered high availability.
  - **Accuracy & data integrity** - Most of the time especially for critical/ sensitive DATA the accuracy needed to be 100%, meaning no data was allowed to be lost.
  - **Capacity –** Due to its flexibility, the DUDE^{TM} Architecture allows to add capacity locally and/or on a remote site depend on the location.
  - **Latency –** IT Load usually have a lot of noisy requests and minimizing tail latencies, which correspond to the worst user experience is the critical issue due to network congestions, outages, service degradations. The DUDE^{TM} Architecture is addressing that needs allowing EDGE Datacenter implementation at the closest for DATA collection and processing.

CONCLUSION

Exascale datacenter and public cloud market is growing exponentially. **DATA sovereignty & integrity** are at stake due the GAFA expansion which is becoming a major issue for all nations impacting as well their **ENERGY independence thus their GDP.** These problems are the least but not the last as it has been proven that Datacenter impact as well on the nation's capabilities to meet **COP21 carbon objectives**. Ireland and Denmark are the live examples.

Ultimately in addition with the demographic trends, this is the challenge every city has to face. Only a systemic approach taking into consideration all parameters on a sustainable way can offer a reduced impact solution generating new revenue sources for the communities. National regulations related to GDPR can also have an important impact. Many nations impose their DATA to be processed locally and companies cannot use cloud services and datacenter located outside of their country. This might help the diffusion of decentralized, but local EDGE datacenters. Important issues are connectivity, URBAN space availability and generated pollution such as CO_2, noise,... EDGE Datacenters where the DATA are collected and processed have to be well connected to the network in collaboration with local telecom service providers using DTM^{TM} "pollution free" technology.

DUDE^{TM} Architecture address all of them with the utmost mission to host any IT Loads and applications locally in according with the mapping & zoning plans, generating new sources of revenue to communities. EDGE Datacenters can now be implemented teaming with any service provider networks such as 4G, 5G and/or fiber point of presence "POP" to create as well DATA hosting capabilities using as best internet network access connectivity.