
Software Development Process

Integrated Quality Management

System

GENCO Retailing

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Solutions Design

Version 1.3



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Related Documents

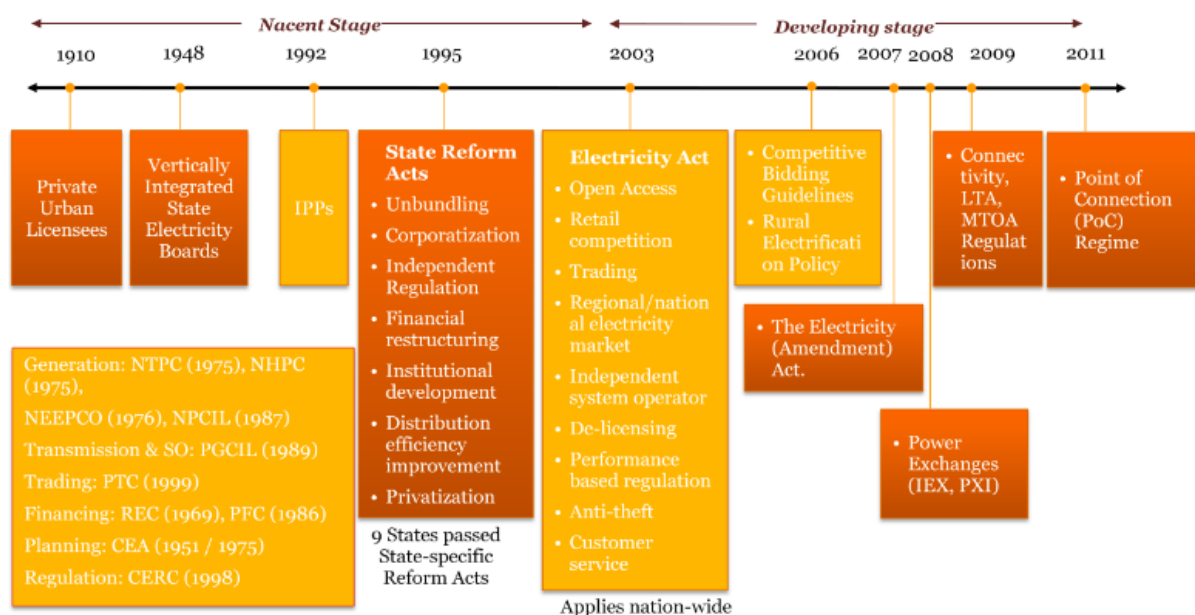
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1	Block Chin based smart metering solution PILOT Project of Power sale to domestic and commercial consumers directly from generating stations and settlement through smart metering & block chain	-

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1. Background

The Indian power sector, since independence, was dominated by state and centrally owned vertically integrated utilities with the prime objective of making “power available to all”. The opening up of Indian economy in early 1990s and large-scale liberalization, urbanization and industrialization led to a rapid increase in demand for power. The quantum of investment requirement grew exponentially, and Government alone was no longer able to make adequate investments in the sector. As a result, power generation was de-licensed and opened to private investment in 1991 to provide a boost to the sector.



From 1996 onwards, focus shifted to unbundling of State Electricity Boards (SEBs) with the broad aims of enhancing function-specific efficiencies and ensuring better returns to generation and transmission businesses. Soon after in 1998, the Electricity Regulatory Commission Act was notified, which laid down provisions for establishing independent regulatory commissions at state and central level to regulate electricity prices. This form of market structure was considered as a surrogate for competition in monopoly markets wherein the independent regulatory commission protects the interest of consumers and other market participants.

However, such a market structure is only transitional till the establishment of full-scale competitive market. Subsequently, the Electricity Act 2003 was formulated to address the changing needs of the power market. The Electricity Act 2003 focussed on two elements: “development of a competitive power market with transparent market-driven pricing mechanism which gives the consumers enough options to choose from”, and “providing the right policy, legal and regulatory platform to the consumers for exercising their choice.” Based on these two core agendas, the Electricity Act 2003 has six major themes:

- Reorganization of the state owned vertically integrated electricity boards.
- De licensing of power generation to enable higher investments.
- Trading and market development.
- Tariff and subsidies.
- Consumer interest; and
- Open Access

Promoting competition in electricity sector is one of the cornerstones of the Electricity Act, 2003. In the spirit of encouraging competition, various reform measures have been initiated by the Central and State Governments such as open access for consumers above 1 MW of load, competitive procurement of power, competition in power transmission and distribution franchisee initiatives

Subsequently, the Ministry of Power came out with competitive bidding guidelines for procurement of power, which allowed price discovery through market based mechanism. This ensured that private generation companies are allowed equal platform and opportunity to access the market as the public companies but most importantly it ensured competitive prices to benefit both, the consumers and the market.

Soon after, similar competitive bidding guidelines were put in place for enabling competition in power transmission as well. Today, distribution companies and open access consumers have the option of buying power from any generation company located at any place in the country, which offers favourable prices.

In contrast, competition in power distribution has been very limited.

The distribution franchisee (DF) model allows state-owned discoms to use private parties to perform specific functions, without the transfer of ownership. The objective of this model lies in the potential for a rapid reduction in commercial losses by adoption of better operational and management practices and enforcing cost effective Tariff. Additionally, given the absence of obligation for direct asset ownership, it also becomes easier to attract private investment, compared to the Distribution licensee model.

There are various models of DF that have been attempted.

- input-based distribution franchisee (IBDF), where the DF procures Energy from the DISCOM at a pre-determined rate and performs the billing & Collections. This approach has been able to improve the billing and collection efficiency.
- revenue franchisee/collection-based distribution franchisee (CBDF); where the success is linked to monthly revenue generation.
- Outsourcing is where this is based on commission basis.

There has been some success in some regions with the above model, however in some regions this approach has been aborted because the DF not able to pay the DISCOM in time. Still there is no space for market driven pricing in this eco system.

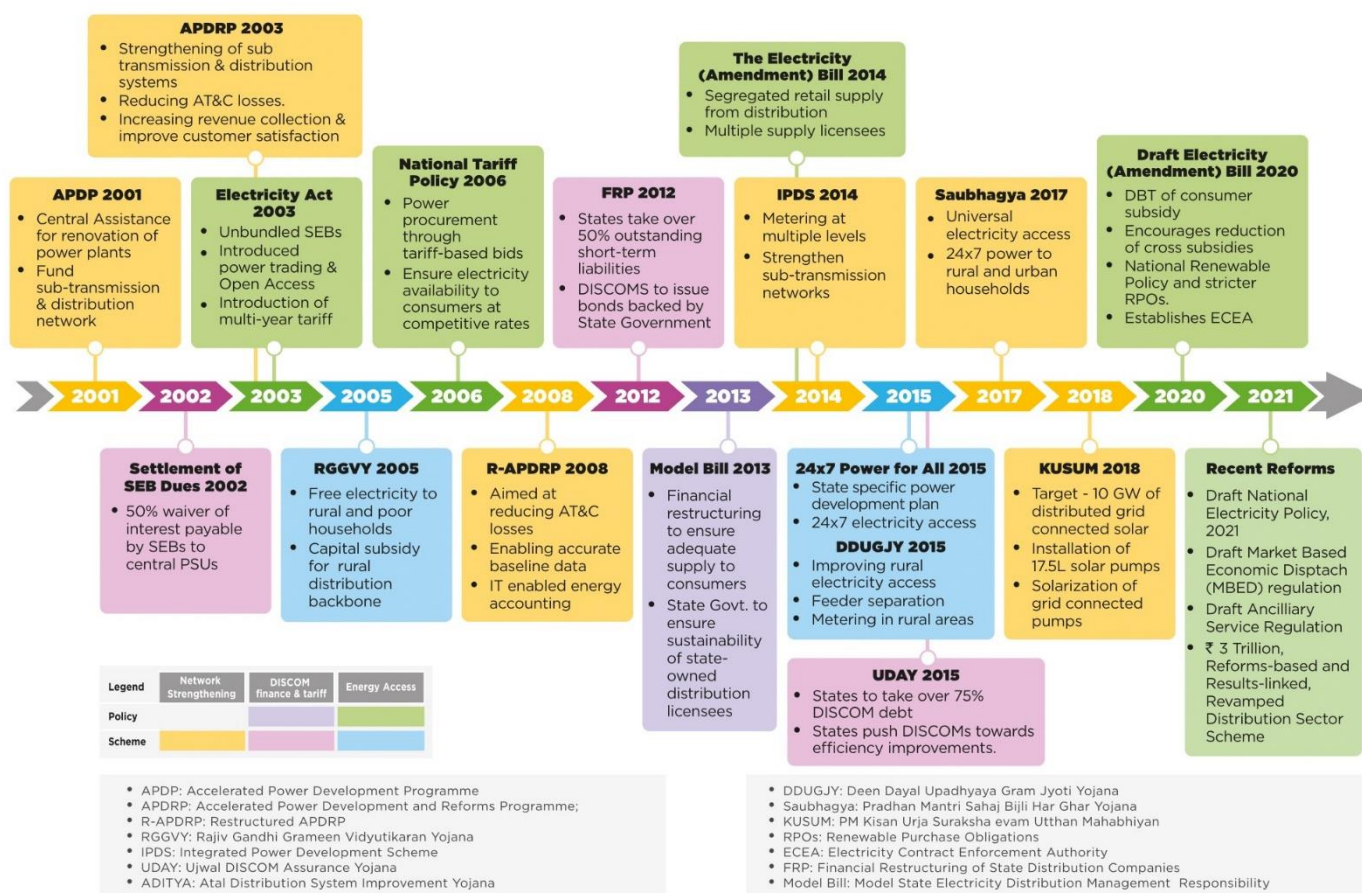
The Electricity Act, 2003 laid down the foundation for introducing competition at the consumer end through open access and provision for parallel licensees. However, the parallel licensee regime requires distribution licensees in an area to distribute power “through their own distribution system within the same area” has potential adverse consequences on tariff. Each distribution licensee investing in its own network would lead to replication of network and, as capital investment is a pass-through expense, it would also push up costs/tariffs for the end consumers.

Pure play privatization has had limited success in metros like Delhi, Mumbai and Kolkata. But the market today needs another reforms initiative, targeting end consumers of electricity.

Distribution companies in India manage businesses of two different natures – wire business and retail business. The wire business by nature is a monopolistic and regulated-return earning business. Retail supply, on the other hand, is more conducive to providing consumer choice in the form of multiple suppliers, as it involves purchase of electricity in bulk from generators and selling it to consumers, apart from customer services, billing, and collection of charges from consumers. In a market structure wherein the wire business as well as retail business is handled by a single distribution company, conflict of interest makes the distribution company wary of losing its retail segment to competition. Hence, the scope for introducing open access and retail competition is limited in this scenario.

To overcome this issue, it is pertinent to segregate the wire business and retail business. In such a market all wire businesses will serve as common carriers and will be paid a reasonable regulated rate of return on their investments. The retail business could be made open to multiple companies operating in the same area, with end consumers having the choice to choose their retailers based on price and service quality.

Retail competition is expected to enhance operational and cost efficiencies and give the end consumer more choice. Cost efficiency is achieved as competitors try to reduce input costs, and operational efficiency is focused upon as performance becomes a major criterion for consumers exercising their choice amongst various suppliers. Competitive power retailers would buy electricity from generators or in the wholesale market and package it to meet varied consumer demands. Their commercial viability would depend on their ability to meet consumer preferences, and, in the face of competition, this is expected to result in lower retail prices (as competitive suppliers cut margins) and greater effort by competing retailers on increasing efficiency and consumer welfare.



Bringing in user choice through competition also helps in redefining the regulator's role from being a price-setter to that of a monitoring body and arbitrator. In a competitive framework, the regulator's role would be to establish guidelines/rules for the competitive retail market and strictly monitor the market for compliance, instead of fixing tariffs for every service.

2. Introduction

With this background, the Generating companies are better equipped to take up the additional Role as Retail Energy supplier as well. The current DISCOM may continue to perform the role of Network Management agency (NMA) for the last mile termination of the supply to the consumer. The Utility may also be the Incumbent RES for certain consumers and for certain other consumers be the NMA alone.

The Real Time market (RTM) allows the Generators to optimize and sell surplus power better while improving the ability to manage renewable intermittency. The introduction of Green Term Ahead Market (GTAM) on September 1, 2020, allows RE generators to sell green power in the open market

The key aspect to be considered here is to enable the Dynamic Pricing and Critical Peak Pricing based Price Plans.

The problems that the pricing plans should address are

- 1) Inadequate fast ramping capacity of the legacy Power Generations, and hence leverage on the RE Plants to offer alternate pricing plans to the consumers.
- 2) Inadequate RE Forecasting results in inefficient operation of low or no marginal cost generators.
- 3) Better Demand Side management encouraging consumers for Load Shifting to have a more flatter consumption pattern through the TOUs and reach a better Peak to average Ratio.
- 4) Derive mechanism to close the gap between Average Cost of Supply (ACS) and Average Revenue Realized (ARR)
- 5) Enable Cost Reflective Tariff.

Fluentgrid together with Adani would like to conduct a Pilot Project to enable this eco system of RES to Domestic & Commercial Consumers with the required Transparency & Reliability creating a trust factor amongst all stake holders including the competing RES in the entire Electricity distribution eco system.

3. Goal of the Pilot

Objective of this Pilot is to prove the direct selling the electricity / power by generator to domestic/industrial consumers or group of consumers and account settlement between generator, utilities (transmission, distribution network management agencies) in between and the consumer. Here existing DISCOM will act as Network Management Agency (NMA) only.

The Success criteria of the Pilot being

- 1) The flexibility of the Plan Configuration including the dynamic pricing based on Day ahead market (DAM) , TAM (Term Ahead Market),RTM (Real Time market).
- 2) How Market based Economic dispatch of Electricity (MBED)can be done most optimally.
- 3) Establish how energy accounting is going to happen and how the forecasts and dynamic DSM Corrections can reduce penalties.
- 4) Establish how Deviation accounting is going to happen in a transparent mechanism governed by agreed and defined policies , rules for pricing of deviation(s) payable and receivable by State Entities and other design parameters
- 5) Usage of Smart Contracts to establish how the Permission governance for controlled access to the ledgers across the corridor starting from Generation until withdrawal from Consumer.
- 6) How Power Procurement Cost Optimization can be achieved by more accurate estimation the power demand and thus better control over the fixed costs to be paid across the corridor by not paying for excess capacity.
- 7) How will the network congestions on the Transmission be handled. Which means that the SLDC shall have to have the visibility to the aggregated contracted load (according to the Pack selection) against each STU, CTU & NMA. When a consumer changes his pack and the

system deems the need for change in Energy delivery path, then the contract change has to be permissioned by the SLDC. How this is expected to work need more thoughts.

4. Assumptions & Exclusions

- 1) For this Pilot, we shall handle the settlement process of RES (Pack change) within the APL, where in there is no Arbitration Process. The complexities involved in the SLA for Port-Out shall not be considered. We can have a simple approval process for Port-Out providing NOC for the Consumer to go out of his Consumer base.
- 2) The field level complexities involved during the RES switching like the Meter swaps etc are kept away from the POC. However, Fluentgrid shall apply sufficient thoughts to see how this Meter change can be mimicked from the Software keeping the Meter Serial No unchanged.
- 3) The Mobile App that shall enable Port in to the Genco for availing the RES does not go through any New Service Connection Process. This process definition along with the settlement process shall be thought about after the Pilot.
- 4) The analytics with the Meter Data that is gathered shall form the key element for the success of RES. However, this shall be taken up after the Goals of the Pilot are met. All Aspects
- 5) There shall not be focus on the errors on the Forecast Model.
- 6) For this pilot we shall consider the 10 Consumers, 1 NMA, 1 STU, 9 Plants who shall participate in the Consensus process of Block Chain, thus having 21 nodes of Hyperledger with multiple ledgers created for each Smart Contract.
- 7) The exception case of a meter not communicating for the entire month is not considered for this Pilot. We shall perform the calculation based on estimations and billing adjustments shall be posted once the actual readings are received for the meter.
- 8) Even though we may consider the Taxation in the data model for Electricity Tariff, this shall not be tested and be part of the Pilot since the current GST regime does not tax the Electricity Monthly bill.
- 9) For simplicity in billing only kwh is considered, and power factor related penalties are not covered for the Pilot. However, the Pack configuration shall include these.
- 10) All Balance notifications to consumers shall be sent as email and shall be on Mobile App rather than SMS for the Pilot.
- 11) Any Disconnections of consumers due to manual intervention for Malpractice etc are out of scope for Pilot.
- 12) The schedulers mentioned in this document shall be fine-tuned during the Pilot Execution phase to align the sequential execution. There can be some lag that may be identified during this alignment.
- 13) Even though for the benefit of POC we assume that RES is the Generation Unit, there may be a licensing model where there can be a non-Generating RES who may have linkage to Short Term markets through the Discovery of efficient Electricity Price (DEEP)
- 14) The Off-Grid Generators and the respective consumers on this platform will not be included for the Pilot

- 15) Design thoughts need to be applied for P2P Energy Trading, even though we may not include this in the Pilot.

5. Proposed Solution

It is envisaged that all Energy meters shall be Smart Meters compliant to IS15959 standards and we shall work together with the chosen manufacturer for a few Manufacturers Specific Parameters exchange for gaining that better efficiency. The Data model for the same shall be agreed with the Meter Manufacturer as we progress with the Pilot.

- 1) Fluentgrid Proposes its Standard HES system for the Data acquisition, and the output of the HES shall be compliant to IS15959-Json Standard & IEC-61968 Specifications of the Data Exchange to MDMS. (CIM Compliance). The standard Set and Get Configurations, and On-Demand commands shall be complied to in alignment with the CEA guidelines.
- 2) Fluentgrid proposes its MDMS system for interfacing with Fluentgrid HES system along with the Fluentgrid CMDS (Common Master Data management) that enables sharing of the consumer data, meter data with both the HES , MDMS. The Features Brochure of the systems are attached as annexure.

The primary role of the MDMS system is to apply the Validation Rules, Estimation Rules over the Raw data acquired, and dissipate the data to the Billing Engine. While HES shall store the data for not more than 3 Days until the data is consumed by MDMS, MDMS is envisaged to store the data for a quarter. There would be some significant enhancements needs in the standard Fluentgrid MDMS. The Network Hierarchy based Filtration and Reporting is not going to work. In the case of RES base mechanism of dealing with End Consumers, the Searching, Filtering can be based on NMA or RES or STU or CTU. The Administrative Hierarchy may have only one node at this point of time which would be the RES.

MDMS shall also perform the Load Forecast for the next day to be fed into the DSM system for Day Ahead Dispatch schedule.

- 3) The Fluentgrid Rating module shall be an extension to the MDMS system. The current Billing system of Fluentgrid is aligned to the traditional sense of Tariff configuration and billing. Hence it is envisaged that Fluentgrid must significantly rewrite the Rating Engine albeit use the same Fluentgrid technology platform.
 - I. Rating & Charging of the consumer based on the consumption based on the chosen Rate Plan.
 - a. Deducting the Fixed Charges and General Charges on the Base Pack and Add-On Pack, based on the configuration on Tariff Plan.

It is envisaged that all consumers shall be offered only Prepaid Plans for this pilot.

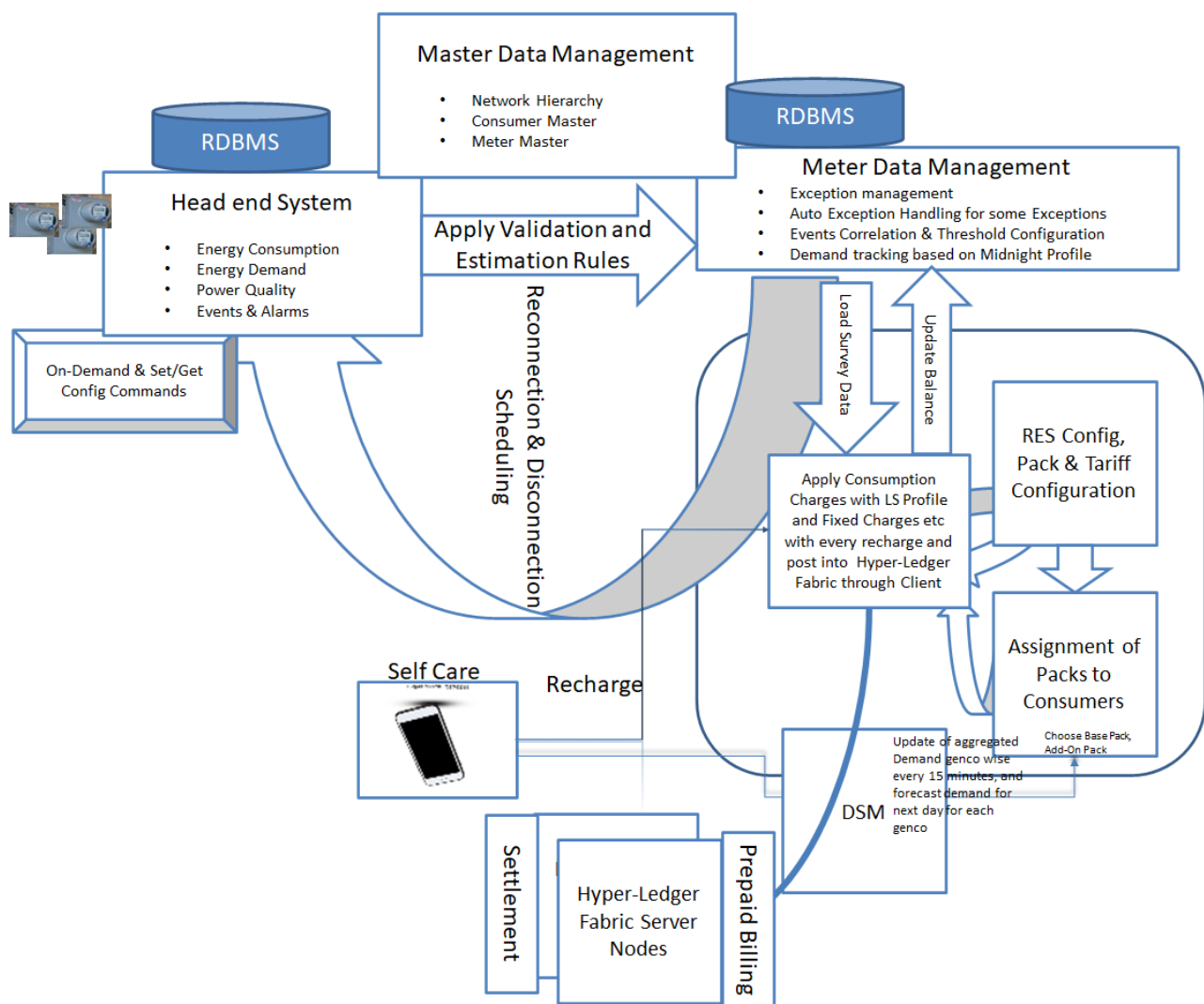
Each RES shall have their Rate and Tariff Plan defined. The Base plan may have additional components and Consumption Charges, while the Add-On plan may always have only consumption charges even though this shall be configurable.

- 4) Blockchain will be the cornerstone for the transparent settlement of the account across stake holders and the competing RES. One major goal is to ensure consistency & transparency of data (metering, consumer portability, billing accounting and settlements among utilities) in real time across competing suppliers and incumbent wire company to ensure seamless experience for

consumer and minimizing consumer risk of default for all stakeholders. The Rating and Billing engine shall initiate the posting into the channel. It is envisaged that Hyperledger Fabric shall be right framework that allows components such as consensus and membership services with Permissioned Blockchain.

A temporary Mobile App for POC purposes that will fulfil the need for Port-In of consumers into the new RES and Port-Out of the consumers from the incumbent RES (currently the DISCOM). This app shall also mock up the Recharge and plan selection of the consumer. This app shall be the Consumer Self care App. This shall be custom built by Fluentgrid.

5.1 Architecture



The key aspects that are to be noted in the above diagram is

- MDM is expected to handle the VEE Rules and dissipating the data into the Rating Engine.

The only profile that is needed is the 15-minute Profile and the Monthly Billing Profile. The Daily Load Profile & the instantaneous Profile can be ignored for the Pilot. It is to be noted that since TOU readings is necessary the HES shall poll the EOB Profile on a daily basis.

The Validation Rules that are expected to be configured for the Pilot are

- 1) Zero Consumption Check
- 2) Negative Consumption check
- 3) spike check
- 4) Consecutive zeroes
- 5) Time Tolerance Check

It is to be noted that these checks shall be hard checks which means that any exceptions from these data shall not be considered for billing.

There shall be Estimation Rules that will insert into the Load survey transaction data for those missing intervals and also for the EOB Profile. This estimation is performed based on the average of the 3 Consecutive historical Load Survey/EOB Profile data of last 3 days from same interval. This shall be executed every 1 Hour. It is envisaged that the Rating shall happen based on the estimated consumption both for the consumers and the stake holders based on the estimated data in case actual transaction data does not arrive in time. This also means that there can be a maximum gap of 1 hour for not Rating and Charging and posting. Once the actual data arrives, corrections shall be done and posted for the estimated data based on the last received interval data.

- MDMS shall offer configuration for Happy hours during which Disconnection shall not happen even though Balance is less than the threshold.
- MDM shall offer the service for update of Balance from the Rating & Charging Engine. Once the balance is updated , based on the threshold configuration (One threshold for Disconnection and the other threshold for Reconnection)
 - MDMS shall base on the current relay status issue a Disconnection command to HES if not Happy hours and the Relay status is connected and the balance is less than the Disconnection threshold.
 - MDMS shall issue Reconnection command is the relay status is disconnected and the Balance is above the Reconnection threshold.
 - MDMS shall have a scheduler that runs in non-Happy Hours to see if Disconnection needs to be triggered.
 - MDMS shall also issue a “setBalance” Command to HES to allow the meter to display the Balance – This shall be issued every 4 Hours that can be tuned during the implementation phase. This shall be configurable, but definitely not every 15 minutes.
- Rating and Charging Engine shall update the balance based as the aggregation of the balance in the Consumption part.
- HES after performing the Connect or Disconnect shall set the relay status back on the CMDS for the reference of HES or MDMS or the Rating Engine.
- When there is a base pack assignment or change in pack, the Load Curtailment command is issued to the HES with the pack max Demand. The meter is then expected to control the

connect / Disconnect based on the max Demand. MDMS shall also store the Contracted load.

- MDM is expected to perform a 1 Day Load Forecast and feed that along with the current day aggregated demand segregated RES wise to DSM for allowing the DSM to adjust its deviation schedule.
- The Pack Information of each of the RES shall be exposed as API for the Mobile to consume and allow the consumers to choose the pack. Similarly For creation of Packs also there shall be API that allows other RES to offer their Packs.
- MDM is expected to provide the following reports for the Pilot
 - Data availability report including how many intervals are estimated.
 - Exception Reports
 - Aggregated consumption by RES, NMA, STU,CTU
 - Meter 360 Degree View searchable and filterable by RES, NMA, STU,CTU.
 - CAIDI, CAIFI, SAIDI,SAIFI
 - Contracted Load vs Max Demand Deviations for each consumer.
- The consumer irrespective of the RES shall have an account no that would remain through the lifecycle of the consumer until his supply is completely dismantled.

5.2 HES API

- 1) Load Curtailment API to be exposed for the Rating and Charging Engine, so that when ever a pack is changed, which entails changes in contracted load, the command is issued to the meter for enabling the load curtailment at that load limit.

5.3 MDMS API

- 1) TOU API for the consumer meters that can when requested by the Rating and Charging engine on Pack change, redirect the request to HES for the change in calendar and register this TOU for billing determinants Exchange.

5.4 Pack and Tariff Configuration

There can be multiple Plants/Units with a Genco that can be configured. Each of the Plant/Unit (RES) can be of Thermal/Renewable with configurable hours of operation.

Base Packs shall be configurable against each of the Units/Plants that are operational 24X7 only. All RES can offer Add-On Packs. These packs can be applicable to varied category of consumers.

- 1) A Consumer has to be subscribed to one base pack with a validity period and can have a max of one Base plan only as active. After the validity period, the consumer will have the option to change his contract to another RES, or if he does not opt to change there will be auto renewal of his current base pack.
- 2) Every base pack shall have configurable charges. Some of the charges can be
 - a. Universal charges - some fixed amount to take care of the cross subsidy that may be imposed by the government that may be applied.
 - b. Fixed Charges – Some Fixed amount for this pack with configurable Contracted Load for this Pack that may be applied

- c. Free Units available with this pack that can be utilized before being charged
 - d. Per Unit cost beyond the free Unit based on which the consumer can Top-up his recharge. This cost can be configurable at varied configurable TOU Slots.
 - e. Other charges like Meter Rent, VAT or GST etc should also be configurable.
 - f. There can be charges based on no. of Outages, Voltage fluctuations etc. Provision needs to be enabled for the quality related service also.
 - g. Base pack may also have a slab-based approach for Consumption charges, that should be made configurable.
 - h. Excess Demand charges as each kw above the contracted Load may be levied a charge. There can be steps of increase configurable also.
 - i. Penalty can also be a type of charge, that can be configured as deduction for possible contract break cases. The penalty may be a % of the fixed charge for the remaining days in the contract.
- 3) There also can be configuration that defines a Load curtailment to be enabled for the consumer at certain load if the consumer crosses certain Demand.
 - 4) Power factor-based cost should also be configurable.
 - 5) Export energy costs also to be configurable that can be configured as adding to the credit.

Add-On Plan shall also be configurable against each of the RES. This also can be applicable for certain category of consumers.

- 1) A consumer may opt to choose multiple Add-On Packs.
- 2) This can be applicable over certain days of the week or over certain TOU and can be applied only over certain period.
- 3) There can be different Per Unit Costs based on TOU.
- 4) Max Load applicable for this plan should also be configurable. If the consumer exceeds this max load then this Add-On pack cannot be availed.
- 5) Configuration for state wise additional charges is also required in case this needs to serve out of state consumers and CTU charges become applicable.
- 6) The add-on Plan rate has to be applied first before applying the base plan rates.
- 7) If there are two add-on plans active during the same TOU, then apply the least rate first.

All transactions for change in pack or addon packs shall be posted as a fact into the Ledger based on the smart contract after due consensus.

All the pack information shall be exposed through REST API for consumption by the Consumer Self Care Application.

There shall a User Interface offered to allow upload of the losses of each of the Nodes in the Energy Delivery network as % of losses and the charges per kwh of energy delivered, the Service Margin of RES & The Generation cost.

5.5 MDMS Enhancement

Every Consumer when being served by a RES shall have a energy Delivery path virtually created. The grid remains the same. But the Energy injection and drawl will differ based on the delivery path change made due to Pack change made by consumers.

MDMS has to dissipate the following information on a periodic basis.

- 1) Every consumer consumption based on the Block Load Interval period configured in the system. For more efficient dissipation of information, they may be grouped based on NMA or based on Generation Plant to be consumed by the Rating & Charging system.
- 2) Aggregation of consumption across each Power Generation Plant.
- 3) Aggregation of Consumption across each NMA that would give a measure of the power being drawn by the NMA.
- 4) Aggregation of consumption across each STU that would give a measure of the power being injected into the STU.
- 5) Aggregation of consumption into the CTU, that gives a measure of the power being transmitted as Inter-state.
- 6) Last Gasp Events greater than X minutes shall spawn off Notifications to NMA & the respective consumer. The X Minutes shall be configurable.

There is also a need on the User Interface to render reports & Dashboards based on the above aggregations over varied periods of time, with a break-up of the consumers under these distribution elements at varied periods of time.

To enable the above functionality following can be the logical data model of FGWeb schema as a part of dirOrganization

- 1) STU Master – with the following fields
 - a. Name
 - b. Description
 - c. GeoLocation – Reference to the Geo Id. (State)
 - d. STU Transfer capacity as additional attribute
- 2) NMA Master – with the following fields
 - a. Name
 - b. Description
 - c. GeoLocation – Reference to the Geo Id. (State)
 - d. the Drawing STU – Reference to STU Master – can be additional attribute.
 - e. No of Substations
 - f. No of Feeders
 - g. No of DTRs
- 3) Plant Master -- with the following fields (The relation with the RES as being modelled in Prepaid has to be established)
 - a. Name
 - b. Description
 - c. GeoLocation – Reference to the Geo Id. (State)
 - d. Design Capacity
 - e. Declared Capacity
 - f. Date of Declared Capacity
 - g. Injecting STU – Reference to STU Master
 - h. Capable of Injecting into CTU ?

In the Consumer Master existing table add one field for NMA being served to this consumer.

The energy delivery path of the consumer can be derived by deriving the Generation Plant to which the consumer is subscribed to (from Prepaid Engine) ; deriving the Injecting STU from the Plant Master. If the consumer's NMA GeoLocation is the same as the Plant GeoLocation, then the consumer is being served only by 2 Nodes in the grid. If Different then CTU Node is in the Delivery path, and if the Plant is not capable of delivery into the CTU directly, then the Plant Injecting STU also must be taken into the Delivery path.

5.6 Rating and Charging

- 1) There shall be a batch job that shall run day to seek the Monthly Billing Profile read on a daily basis of consumers from MDMS, and perform the balance deduction by seeking the wallet from the Consumer ledger and post the balance to MDMS, and create a channel for posting into the ledger based on the smart contract into the Block chain by creating the block of the following facts
 - a. Energy Consumption for the Day with TOU wise break up
 - b. Balance update on the wallet
 - c. The chosen pack against which charging was applied.
 - d. Voltage at each phase
 - e. Outage if any
 - f. Other Events if any.
- 2) There shall be a batch job that shall run every 15 minutes to seek the aggregate consumption of the Load Survey data for all consumers grouped by each Plant and post into DSM system for the DSM system to enabling adjustment of the Schedule.
- 3) A batch job that will run on a daily basis to check the contract validity of the base Pack for each of the consumers, and perform auto renewal if there is no request for Port-Out, if the pack is still valid. Trigger notification for such action. Also send reminder based on threshold configurations.
- 4) There shall be a batch job running every 6 Hours (4 times a day) that shall seek aggregated Consumption over each Generation Unit, each NMA, each STU, each CTU for 15 minute interval data and post into the Hyper-Ledger Channel.
 - a. It is envisaged that the NMA shall post the outage of Feeder, DTR in their ledgers. We will have to mock this scenario through the Hyper-ledger Composer REST Service and the result posted back to DSM in the scheduler for DSM to readjust the deviation schedules.
 - b. Any outages at the Generation Plant end or the Power transformer end or at the Feeder End or at the Distribution Transformer end shall be posted into the respective ledgers.
- 5) There shall be a Monthly batch job running for the Pure play Renewable Energy Meters at the consumer level whose Wallet is carrying positive balance. If the same consumer has any Normal Meter, this balance shall be transferred to the Wallet of the Normal Meter(s) sequentially. The consumer is expected to have declared his wallet settlement process against the consuming account when subscribing to packs.
- 6) There shall be a batch job running monthly to manage the Fixed charges and other Charges as configured on the Pack for every consumer by seeking the Wallet balance for the Ledger. This shall also post the balance back to the Consumer Ledger against the same channel as point 1. This shall be applied on those packs which has Monthly fixed charges configured.

- 7) There shall be a service offered that enables recharging of the consumers wallet from his self-care application. Every recharge done shall be posted into the consumer Ledger as recharge and to the RES Ledger as revenue.

5.7 The API of Rating & Charging can be as follows

API	Description	Clients	Business Rules/Remarks
Pack Creation	Creation of Tariff configurations for the RES with applicable NMAs including General/Fixed Charges and Variable Charges.	UI, Other RES if they have their own UI	If from UI, then the Pack shall be created in Draft state else in Approved State
Approve Pack	Change the status from Draft to Approved	UI	Only 1 Level approval considered.
Update Pack	All the data created can be edited as well including update of the General/Fixed, Variable Charges.	UI	Only if it is in Draft State.
Get List of Pack	List of Pack based on RES or NMA	UI for List and Filtration (of Draft Packs or approved Packs) and Mobile for Consumer Self Care (Only Approved Packs)	For Flexibility, allow the ability to filter based on key value pair, and key can be the column name.
Consumer Subscribing to a pack	Date of Subscription shall have to be X Days after Date of Application to ensure billing on the same day is not impacted.	Consumer Self Care, UI	<p>Goes into a queue for RES Switch and await for Port-In Success. Date of Application, Date Of Subscription to be tracked; The Switch can be future dated, else apply penalty if the current Pack is configured for; If Same RES auto Approved.</p> <p>Check with MDMS for the TOU Configuration of the meter(s) of the consumers and request for update of the TOU on the meter accordingly.</p> <p>Add a validation that a</p>

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			<p>consumer cannot subscribe to a pack that consumer does have the NMA mapped to.</p> <p>Also check for Pack Validity Date.</p>
List Packs subscribed by a consumer	With ability to filter by Status/Consumer/Pack-Type/RES	UI, Self-Care	For Flexibility, allow the ability to filter based on key value pair, and key can be the column name.
Consumer Unsubscribe to a Pack		UI, Self-Care, From Pack Subscription (after Port-Out), scheduler (For expired Packs & Future Subscriptions)	Active Base-pack cannot be unsubscribed. Add-on Packs can be unsubscribed for a future date or penalties may apply based on Pack configuration.
State Change of Pack Subscription		UI, Self-Care, Subscribe/Unsubscribe API	From Draft to Subscribed or From Subscribed to Un-Subscribed or from Subscribed to Expired.
Creation of TOU Calendar	Creation of the Calendar of day of the week and the Timeslot of each day	UI	
Deletion of TOU		UI	Only those that are not used in the Packs should be allowed for deletion.
Update of TOU			Only those that are not used in the pack should be allowed for Update.
Get TOU		UI	
Consumer Recharge	Wallet Recharge given a consumer account.	Self-Care	

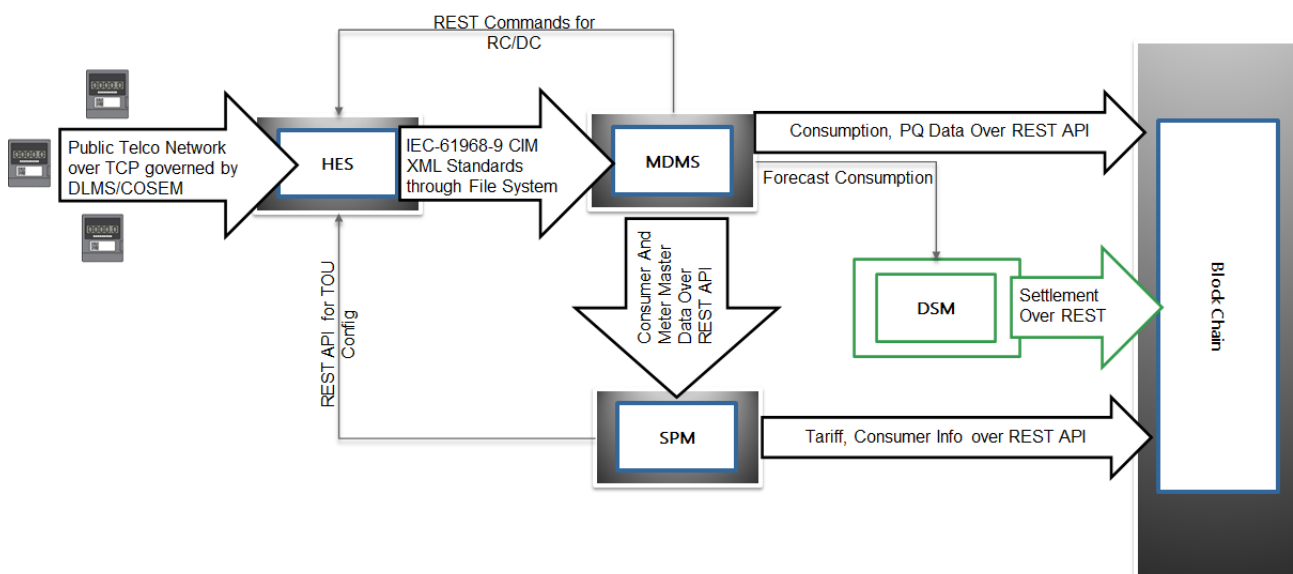
Recharge History	Given a consumer account	UI, Self-Care	
Credit/Debit adjustment of Wallet	Given a consumer account	UI	

5.8 Consumer Self Care

- 1) Allows the consumer to register for Port-Out and register the Port-In RES of his choice. This will trigger an update into the CMDS and from CMDS trigger a post into the Hyper-Ledger Fabric Channel for KYC Registration will all consumer details including the bank details.
 - a. If the consumer ports-out before the contract end period , there will be a deduction of the Fixed Charges for the remaining duration of the contract period. How many months of such deduction shall be configurable. The consumer may schedule his Port-out for the last date of his validity period of his contract.
 - b. The Wallet carry over shall not happen during this process. Either the consumer has to forfeit the Previous balance or the Port-In waits until the wallet balance reaching a consumer specified threshold.
 - c. The NMA is expected to post against each of the consumer that the NMA has access to on the Fabric to post the Feeder, DTR assignment for each consumer. This is outside the scope of the Pilot. Or can there be a REST service from the Hyper-Ledger composer to post this fact to be able to demonstrate the Energy accounting also?
- 2) Allows the consumer to switch to applicable base packs that gets updated on the Pricing engine and trigger a post into the ledger with the contracted Load and the pack identifier as the facts.
- 3) Allows the consumer to add Add-On Packs at any point of time that gets updated on the Pricing engine and triggers a post into the ledger with the pack Identifier as the fact.
- 4) Allows the consumer to monitor his load Survey Profile consumption selectable over Daily/weekly/monthly
- 5) Allows the consumer to view their consumption TOU wise selectable over Daily/weekly/monthly/configurable period.
- 6) Allows the consumers to view his estimated consumption for next day , and allow him to change his future consumption and view the change in his bill vs estimated bill. This can be considered as a next phase.
- 7) Based on the consumer set Threshold for Consumption (TOU Wise daily/monthly configurable), enable Notifications and alerts for excess consumption.
- 8) Alert based on abnormal consumption for Daily/Monthly. The abnormality can be set by the consumer.
- 9) Sanctioned Load vs actual Demand representation over a selectable period of time. The Sanctioned Load can vary over TOU based on the pack selection of the consumer.
- 10) Demand Cross Over alerts based on the no of times crossed as configured by the consumer.
- 11) Alert/Notification based on consumer configuration for the following events
 - a. The Current day TOU consumption higher than the Previous day same TOU consumption by certain threshold configured by the consumer

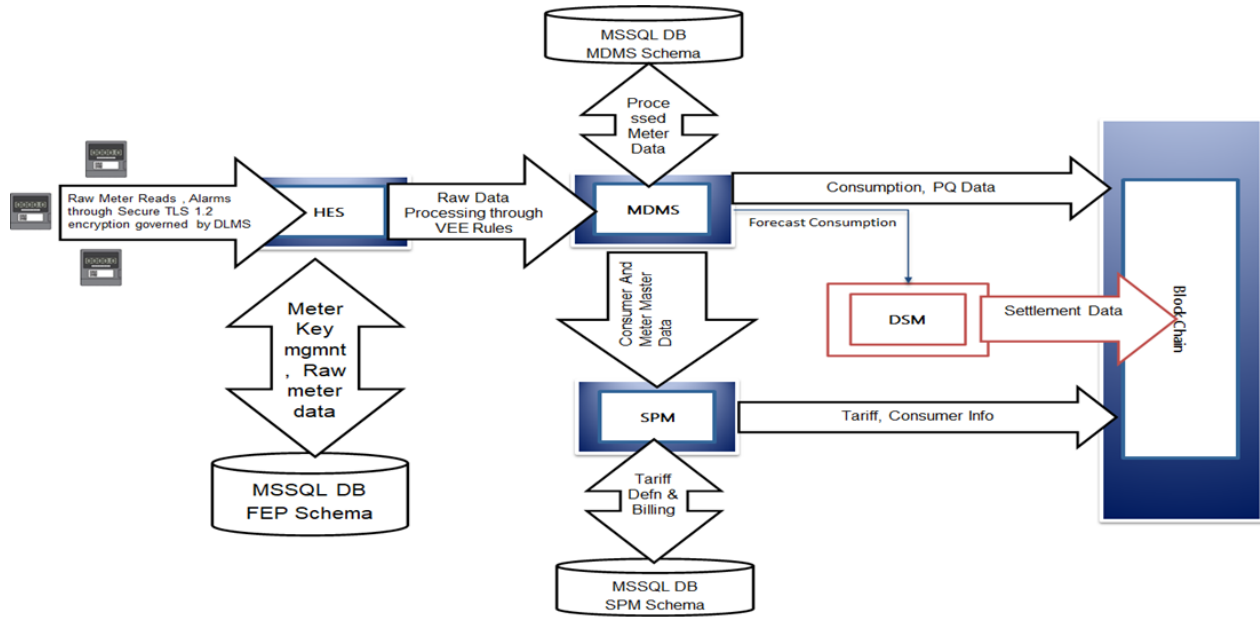
- 12) Various Alarms including the Outages , duration of the Outages in each TOU.
- 13) Allow the consumers to perform On-Demand for Instantaneous Profile.
- 14) Allow the consumer for Connect/Disconnect for safe locking of premises and allow configuration of alerts for consumption recording during this period.
- 15) Allows view of Pack Change History and his current subscribed packs with their validity.
- 16) Recharge history including the bills done on a daily basis and how the balance has been deducted.
- 17) Allows the consumer to perform his recharge.

5.9 Integration Architecture



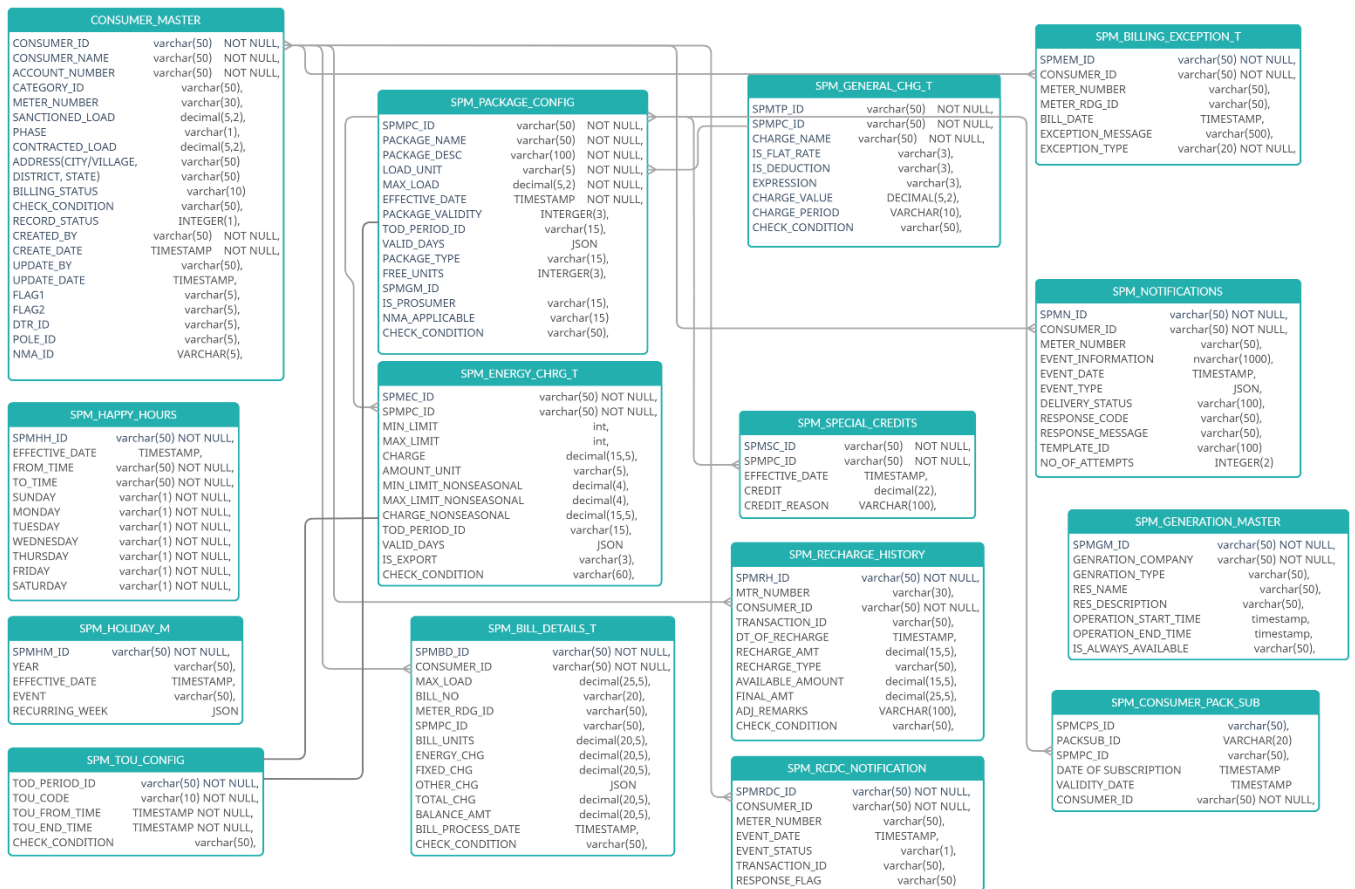
The above diagram illustrate the Integration architecture. The communication between the Meter and the HES shall be over TCP-IP over the Airtel GPRS-4G network. The APN gateway configured on the SIM shall be on the Public IPV6 to enable the Fluentgrid HES Server to be able to communicate over the internet with the Meters. The SIMs and Meters shall be organized by Adani, while the HES software and the Server to host it shall be organized by Fluentgrid.

The data from the HES shall be processed into the MDMS system through ETL Jobs by processing the IEC-61968-9 compliant XML files. MDMS shall apply the VEE Rules, and dissipate the appropriate billing determinants to the Fluentgrid SPM system for further managing the billing and wallet of the consumer. This shall be through REST services over https inside the LAN of the Fluentgrid Cloud Infrastructure. Adani's DSM system shall communicate over the public network for consuming the Forecasted and actual consumption and to post the settlement data into the Blockchain. The interface with the Blockchain shall be over Jax-RS specifications leveraging on the Spring Framework.



The above diagram represents the Data Flow from the Meter until the data posting into the Blockchain.

5.10 Data Model for Consumer Rating & Charging



6. Block Chain

Block chain is a distributed digital ledger of transactions that are simultaneously stored and updated across several Computers connected in Peer-Peer network. Block chain consists of distributed data storage , peer-peer transmission, a consensus mechanism, an encrypted algorithm and smart contracts. Some characteristics of Block chain are decentralization, openness, automatic execution of contracts, security credibility and anonymity.

There are two major types of block chain

- 1) Public block chain. Here any public can participate in the transactions without any specific permission. However, every transaction goes through a consensus model with every peer in the network causing a low throughput. Crypto currency works in this type.
- 2) Private block chain is invitation-only and anyone who wishes to access it must ask for permission from the governing body of the blockchain. They allow different levels of access that determine which users can write, read, and audit the blockchain. Since the transactions are more closed , the consensus model is relatively simple enabling a higher throughput.

6.1 Hyper-Ledger Fabric as the tool for trust relationship between Energy management stakeholders.

In a conventional transaction, when a consumer purchases Energy, the consumer transfers the money physically to the Distribution Licensee. In the digital world, money exists as data, which can be copied precisely with minimal effort. A consumer can easily copy the money, spend the original, and spend the other copy, which is known as the double-spending problem. To overcome the problem, someone trustful is needed as an intermediary. It checks the balance of the consumer, deducts the balance of the consumer according to the bill, and added the balance of the Distribution Licensee according to the bill.

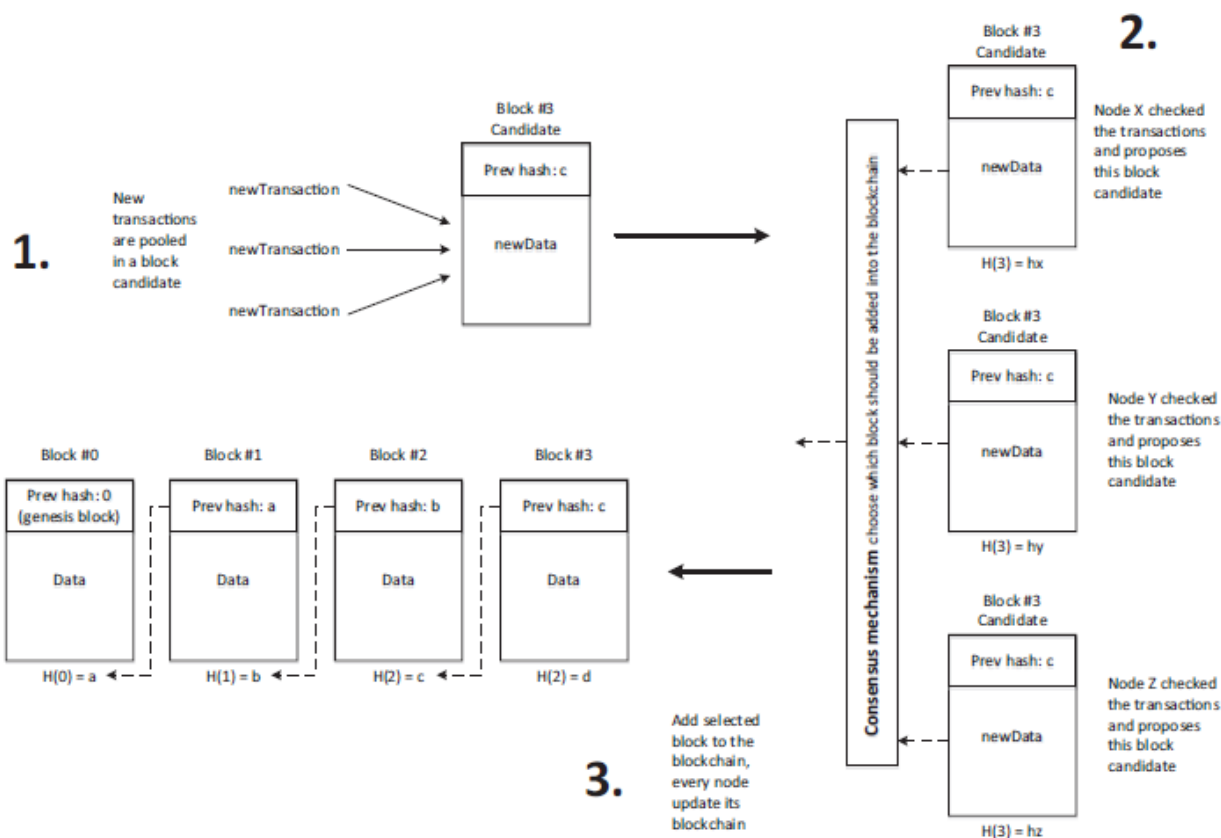
Similar to the currency it also applies to the energy accounting across the varied stake holders in the chain including the Inter-State Transmission Companies, Intra-State Transmission Companies, Load Dispatch Centers, Distribution companies etc.

This intermediary may raise transaction fee for the service, and eventually limiting small transactions. The intermediary is also needed to mediate a dispute between parties. Another concern is that this intermediary can reverse the transaction that occurred by force, which is not desirable for a non-reversible transaction

The condition will make stake holders wary of their peers and consumers, gathering more information than they would need, risking the identity of the peers and customers. Blockchain eliminates the intermediary, and the transaction written in a blockchain is immutable.

A blockchain consists of blocks, which ordered in a time sequential manner, secured and linked using a hash function. The block is timely stamped so it cannot be backdated. A block consists of a bundle of transactions. Each transaction consists of certain business fact. This can be with the transaction of electricity or the money transaction.

A hash function is a mathematical one-way function that produces fixed output, given any input. A slight change in the input will produce significant changes in the output. The hash is also one way, which means, given the input, it is easy to calculate the output, but not otherwise.



When someone initiates a transaction, it is pooled in a block candidate, and nodes in the network validate the transaction. There will be many versions of block candidates since every node adds its address into the block candidate, but there must be only one block candidate added to the blockchain at a time. Here, a consensus mechanism chooses which block to be added. The cycle is then repeated over time. Once the data entered the blockchain, the data cannot be deleted. If someone made a wrong transaction, then it must be corrected by reverse transaction, leaving the previous transaction intact. This way, a blockchain maintains traceability of an asset and it is good for auditing.

The consensus mechanism consists of a set of rules, which is used to achieve an agreement on single business data, such as determining whose block candidate will be accepted as a block and added into the blockchain. There are some popular consensus mechanisms in the blockchain used by varied block chain applications.

A smart contract is a set of condition, which agreed by interested parties, and stored in the blockchain. It scans the blockchain and it automatically performs the predefined actions once the conditions are fulfilled. Once written in the blockchain, a smart contract has also become immutable, and will always be executed. In a transaction, a smart contract acts as a trusted escrow service.

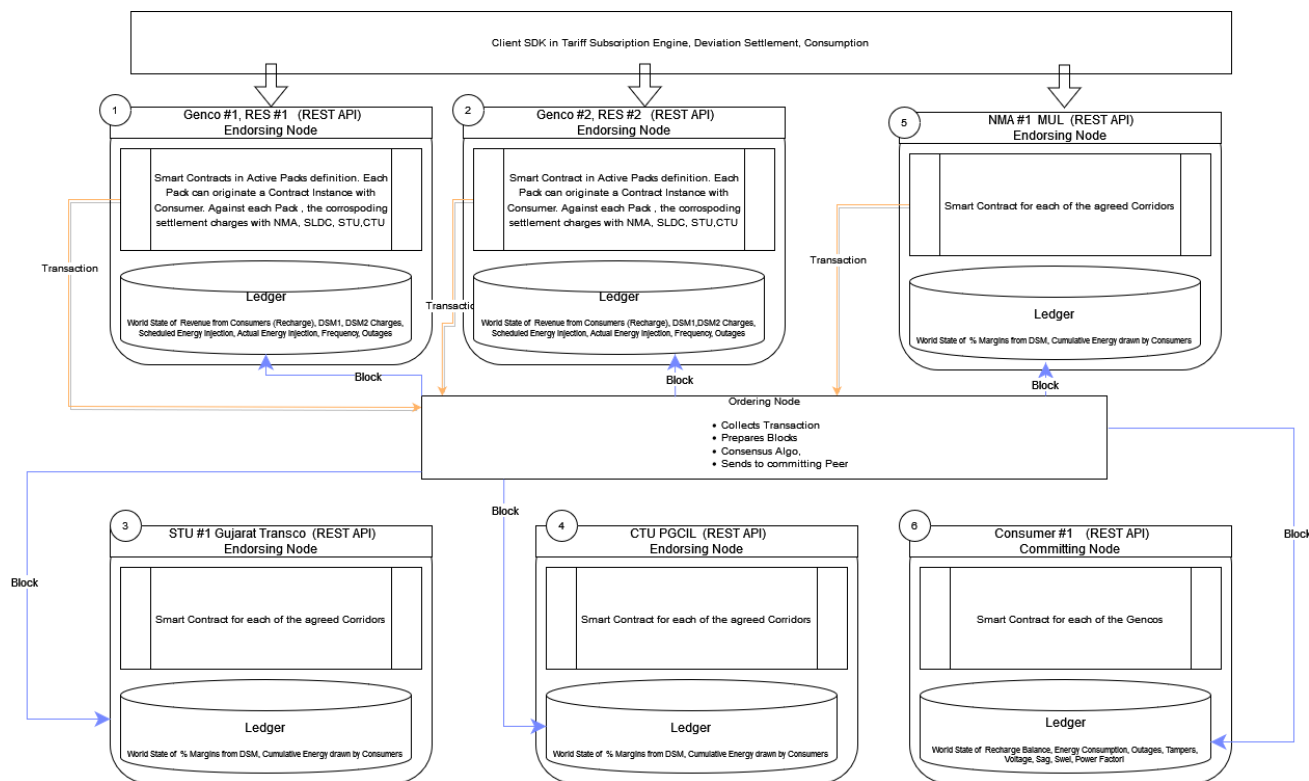
We intend to use Hyperledger-Fabric as the Technology to manage the transaction of all the stake holders in the eco system. This is a Permissioned & Private Blockchain.

Hyperledger Fabric offers the ability to create channels, allowing a group of participants to create a separate ledger of transactions. This is an option for networks that this solution intends to leverage for enabling the Energy Delivery path to the consumers. A Energy Delivery corridor forms a channel and the consumers falling in that channel are made to perform consensus on all transaction by the stake holders in that corridor. Hyperledger Fabric smart contracts are written in chain code and are invoked by the Prepaid engine or the DSM software to the blockchain when that application needs to interact with the ledger. Chain code can be implemented in several programming languages. For this Pilot we shall use Java Chain Code.

The REST API of the Hyper Ledger Fabric shall be used for the get/post of the chain codes for varied transactions, and these API shall be invoked by the Fluentgrid platform of applications.

The key components of the envisaged architecture are

- 1) Ledger – for each of the stake holders in the Energy Chain including
 - a. Generation Companies
 - b. State Transmission Companies
 - c. Central Transmission Unit (PGCIL)
 - d. Distribution Network Management Agencies (Today it is a DISCOM spread in each of the states)
 - e. Consumers
- 2) Wallet
- 3) Events
- 4) Chain Code
- 5) Peer Network
- 6) Consensus
- 7) Membership Services
- 8) Systems Management



There are three fundamental types of nodes

- **Committing Node:** Maintains ledger and state. Commits transactions. These are the Consumer nodes.
- **Endorsing Node:** Specialized committing peer that receives a transaction proposal for endorsement, responds granting or denying endorsement. Must hold smart contract. All the rest of the stake holders including the RES,Genco,STU,CTU, NMA can fit in here.
- **Ordering Nodes (service):** Approves the inclusion of transaction blocks into the ledger and communicates with committing and endorsing peer nodes. Does not hold the smart contract. Do not hold the ledger. The Load Dispatch Center Nodes can act as this kind of Node.

Node	Function of the Node	Remarks
Retail Energy Supplier	1) Starts the Transactions for Consumer Energy Consumption, Events, PQ Data. Rating and Charging is applied based on the pack of the consumer for whom the transaction is posted by applying the Smart Contract of the consumer. 2) Endorsing the transaction originated from Genco for those Corridors where this RES is there in the Chain. (Executing the DSM Logic) 3) Commits Transaction	For the POC Genco and RES is of the same Node.
Genco	1) Starts Transactions for Scheduled Energy vs Actual Energy Injected along with DSM-1,DSM2 2) Endorses the transactions originated from RES (Execute the Billing Logic) 3) Commits Transaction	
STU,CTU,NMA	1) Endorses the transactions originated from RES , Genco for those transactions where the respective STU/CTU/NMA is there in the corridor (Channel).	They will also have to commit the tx for
LDC – Load Dispatch Centre	1) Ordering Node 2) Committing node	
Consumer	1) Commits transactions from RES for its own Channel only. Hence a channel needs to be created for each of the Corridor combination. So all the consumers served by that Corridor only shall be committed here.	

Each of the energy Corridor agreements that are there with Genco until NMA & RES (For POC Purposes RES is not a separate entity) there would be channel created for delivery of energy.

The flow of the Chain of events for a successful transaction would be

- The Rating& Charging Engine or the DSM application sends a transaction proposal using organization specific REST APIs.
- The fabric runtime receives a transaction proposal and sends it to the channel for execution.
- The CTU,STUs,NMA Endorsers in the channel execute the transaction and prepare read/write sets and send it back to the SDK.
- On verification of endorsement policy, read/write sets are sent to orderer nodes.
- The orderer nodes collect transactions, prepare blocks and send it to committing nodes.

- The committing nodes append it to the blockchain database.

For the POC, the following shall be the various Nodes

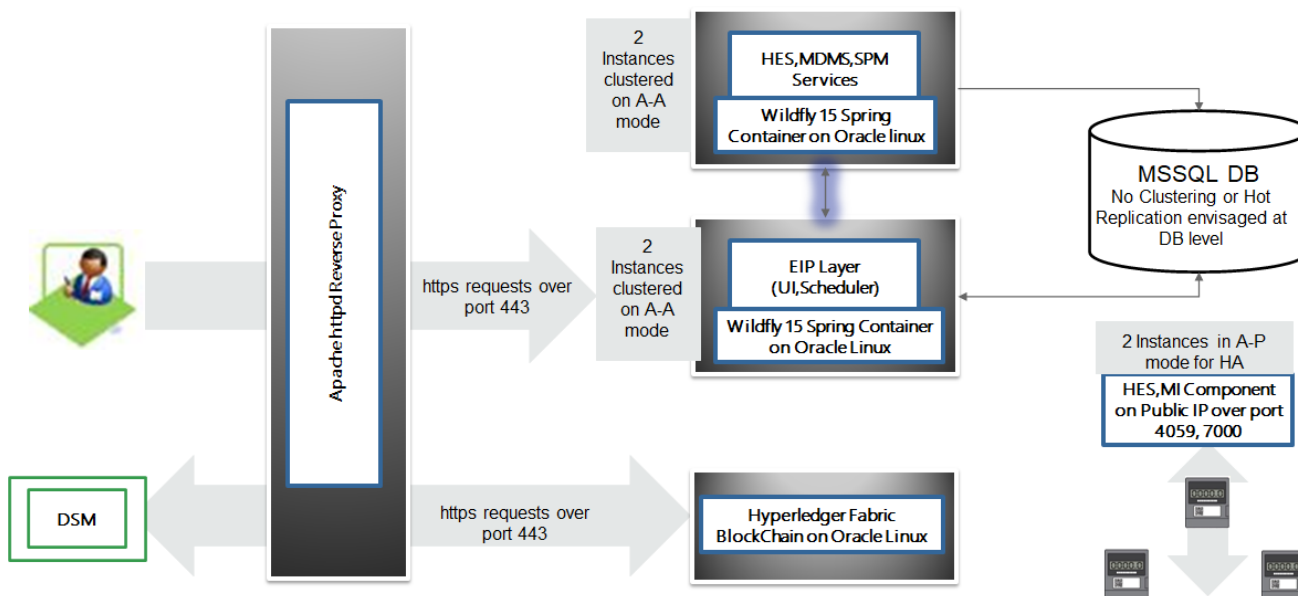
1. ADANI MUNDRA (Gujarat) Genco & RES, with 4620 MW Design Capacity of Thermal Plant, shall be committing Node and Endorsing Node. Being RES shall also handle Consumer Transactions for the consumers that this RES serves.
2. ADANI BITTA (Gujarat) Genco & RES, with 40 MW Design Capacity of Solar Plant, shall be committing Node and Endorsing Node. Being RES shall also handle Consumer Transactions for the consumers that this RES serves.
3. ADANI TIRODA (Maharashtra) Genco & RES, 3300 MW Design Capacity of Thermal Plant, shall be committing Node and Endorsing Node. Being RES shall also handle Consumer Transactions for the consumers that this RES serves.
4. ADANI MUNDRA NMA Shall be a endorsing Node, and commit Node only for the declaring the Losses month over Month. And declare the Feeder/DT level Outages and other Distribution data.
5. Gujarat Transco STU Shall be a endorsing Node, and commit Node only for declaring the Losses month over month and declare the feeder outages , Energy Injection , Energy Drawl eventually.
6. PGCIL CTU Shall be a endorsing Node, and commit Node only for declaring the Losses month over month and declare the feeder outages , Energy Injection , Energy Drawl eventually
7. SLDC Gujarat shall be an Ordering Node.

There shall be one and only one peer for each of the above Organizations.

Following shall be the Chain Code that shall be executed by the Nodes based on the channel that this block is expected to be published in

1. Billing Logic – Consumption including the TOU slot, Genco/RES for this slot, Consumer Details (Account Number, Name, NMA, Meter Number, Pack ID)
 - Calculate the Balance and Update the World State of the consumer. The RES that serves this consumer shall initiate this transaction.
2. Change in Pack, World State of Consumer will be updated, Update the Pack details in all the Organizations.
3. Consumer Recharge - World State update for Consumer balance. Same Channel as billing logic
4. Loss % - Committed by STU, CTU and NMA - monthly basis
5. Generation Company, posts its Energy Injection every 15mins. as the Billing logic.
6. Deviation Settlement - logic, check in ADANI Doc
7. Corridor Settlement - Monthly basis based on the Recharge Package(Revenue), NMA, CTU and STU.

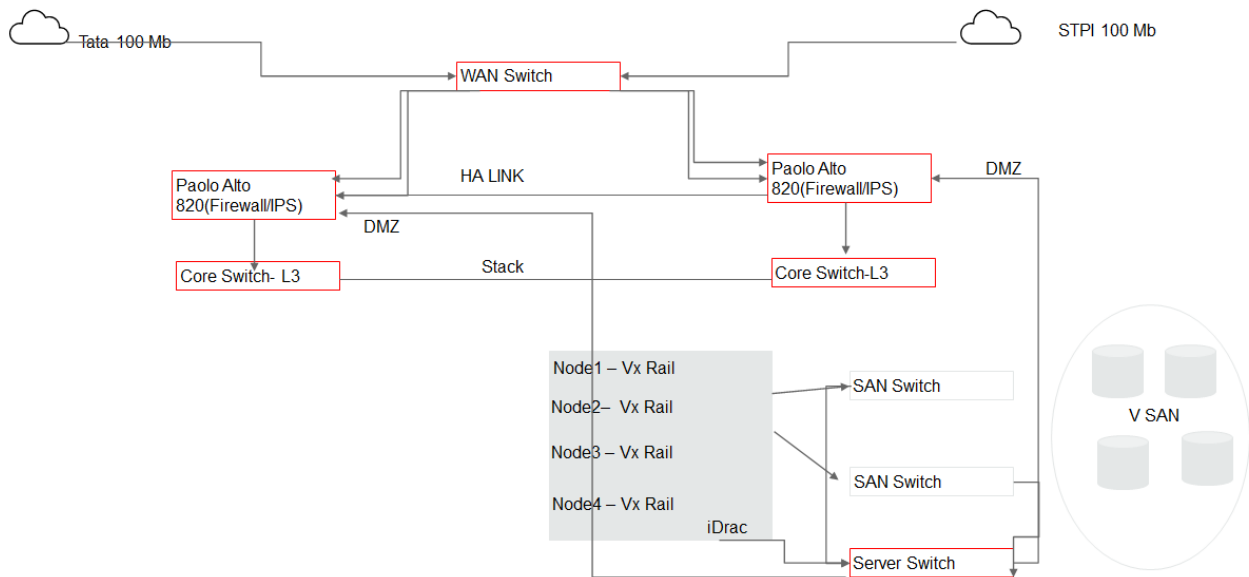
7. Deployment Architecture



All the software licenses offered by Fluentgrid shall be hosted on the Fluentgrid Cloud Infrastructure in the Data center at Fluentgrid Vizag Premises. The Meters installed in the field shall be offered by Adani to communicate over Public Airtel GPRS-4G network to the HES server hosted on Fluentgrid Cloud Infrastructure. The Web Access to allow monitoring the Meters and its data across the multiple software hosted by Fluentgrid shall be web based over https. All related access shall be provided to Adani to enable smooth conduct of this POC.

The Adani DSM system shall be hosted at Adani DC and shall communicate over public network.

The Fluentgrid Infrastructure network can be represented as follows



8. Implementation Plan

<<To be Updated as on May 2022>>

	Key Milestone	Duration	Start Date	End Date	Dependencies	Responsibility
1	Project kickoff	1 days	14-Dec-21	14-Dec-21		
2	Meter HES integration		15-Dec-21	30-Jan-21	1	
3	Test infra provisioning	2 days	16-Dec-21	18-Dec-21		Fluentgrid
4	Connectivity provisioning between Meter & HES				Meter Manufacturer Decision Made and Data Model Shared with FG; Public SIM	Adani
5	HES Application hosting	2 days	21-Dec-21	24-Dec-21		Fluentgrid
6	Test meters provisioning, IPV6 SIM cards provisioning	1 Day				Adani
7	Integration testing - Meter-HES	15 days			4,5,6	Fluentgrid
8	Site Installation of Meters				7	Adani
9	MDMS		03-Jan-22	15-Feb-22		Fluentgrid
10	MDMS Application Hosting	2 days	03-Jan-21	04-Jan-21	2	Fluentgrid
11	Meter Data Flow into MDMS Verification and Validation	10 days	01-Feb-21	15-Feb-21	8	Fluentgrid
12	Customization of MDMS		21-Dec-21	15-Mar-22	1	Fluentgrid
13	Data Model upgrade for the Energy Distribution Path	5 days	21-Dec-21	15-Jan-22		Fluentgrid
14	Enhancements for enabling Reports & Dashboards for aggregations	20 days	20-Jan-22	28-Feb-22		Fluentgrid
15	Services for Aggregated data dissipation & Forecast Algorithm	20 days	15-Feb-22	15-Mar-22		Fluentgrid
16	Rating & Charging		21-Dec-21	30-Mar-22	1	Fluentgrid
17	Pack Management Services	40 days	21-Dec-21	30-Jan-22		Fluentgrid
18	Building the UI Layer	30 Days	20-Jan-22	28-Feb-22		Fluentgrid
19	Billing Services and Scheduling, including integration with MDMS	15 days	01-Mar-22	30-Mar-22	15	Fluentgrid
20	Integration to DSM	10 days	10-Mar-22	20-Mar-22	Need services from DSM to be exposed	Adani, Fluentgrid
21	Disconnection/Reconnection	10 days	10-Mar-22	20-Mar-22		Fluentgrid
22	Block chain (Decentralized ledger)		03-Jan-22	30-Apr-22	2	Fluentgrid
23	Deployment and Configuration	10 days	20-Jan-22	31-Jan-22		Fluentgrid
24	Data Model & Policies Design	15 Days	03-Jan-22	15-Jan-22	22	Fluentgrid
24	Establish the REST Services for the design	30 Days	20-Jan-22	28-Feb-22	23	Fluentgrid
25	UI Layer for Hyper-Ledger	30 Days	01-Mar-22	30-Mar-22		Fluentgrid
26	Integration with Rating and Charging for Consumers	15 days	01-Apr-22	15-Apr-22	24	Fluentgrid
27	Integration with DSM for Settlement with other stake holders	30 days	15-Mar-22	15-Apr-22	25	Adani
28	Validations of the Settlement and the Energy Accounting	15 days	16-Apr-22	30-Apr-22	26	Fluentgrid, Adani
29	Development of Consumer app		15-Mar-22	15-Apr-22	12,16	Fluentgrid
30	Development of app	30 days	15-Mar-22	15-Apr-22		Fluentgrid
31	Pilot Success Criteria Established		30-Apr-22	15-May-22		Adani

9. Annexure-I

9.1 Billing Design Details.

1. Subscription/Un-Subscription of Pack

1. Status column in table SPM_CONSUMER_PACK_SUB having values like – *Approve, Draft, Expire, Unsubscribe*
2. *Date of Subscription is X(configurable) from Date of Approval/Date of Application*
3. Date of Application – When pack is applied by consumer via mobile app
4. Date of Approval – When pack get approved by SPM UI

Case 1: New BASE pack for the first time consumer

While subscribing BASE pack for the first time then subscription will be auto-approved.

Let say: X=1 day (Configured to arrive at date of subscription)

UP0001 (Universal Pack1 with 5KW) --> Base pack with unlimited contract period

SPM_CONSUMER_PACK_SUB

PACK_CODE	DATE_OF_APPLICATION	DATE_OF_APPROVAL	DATE_OF_SUBSCRIPTION	VALIDITY_DATE	CONSUMER_ID	STATUS
UP0001	2021-12-01 00:00:00	2021-12-01 00:00:00	2021-12-02 00:00:00	-1	123	Approve

Validation to be placed at service layer consumer cannot subscribe to base pack offered by RES which his NMA is not mapped to.

Case 2: New BASE pack of same RES for the existing consumer

For same RES subscription of new base pack gets auto-approved but existing base pack will get unsubscribed and validity date will be updated to previous day to date of subscription

Let say: X=1 day (Configured to arrive at date of subscription)

UP0002 (Universal Pack2 with 10KW) --> Base pack offered by same RES with unlimited contract period.

Same pack can not be subscribed by consumer --> Validation at service layer

SPM_CONSUMER_PACK_SUB

PACK_CODE	DATE_OF_APPLICATION	DATE_OF_APPROVAL	DATE_OF_SUBSCRIPTION	VALIDITY_DATE	CONSUMER_ID	STATUS
UP0001	2020-12-01 00:00:00	2020-12-01 00:00:00	2020-12-02 00:00:00	2022-01-02 23:59:59	123	Unsubscribe
UP0002	2022-01-02 00:00:00	2022-01-02 00:00:00	2022-01-03 00:00:00	-1	123	Approve

Case 3: New BASE Pack of different RES for the existing consumer

For different RES subscription requires approval and date of subscription will be X days from date of approval and also existing base pack will get unsubscribe and validity date will be updated to previous day to date of subscription of new Pack

Gen Plant → RES 1 → NMA 1 → Consumer 1

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→ NMA 2
 → RES 2 → NMA 4
 → NMA 1 → Consumer 1

Let say: X=2 day (Configured to arrive at date of subscription)

UP0003 (Universal Pack3 with 10KW) --> Base pack offered by different RES with unlimited contract period.
 So Consumer1 can have base pack from RES 1 and RES 2.

Validation to be placed at service layer consumer1 cannot subscribe to base pack offered by RES 3
 Till the time current pack is not approved its status will remain Draft.

Before approval – Billing will happen on UP0001

SPM_CONSUMER_PACK_SUB

PACK_CODE	DATE_OF_APPLICATION	DATE_OF_APPROVAL	DATE_OF_SUBSCRIPTION	VALIDITY_DATE	CONSUMER_ID	STATUS
UP0001	2020-12-01 00:00:00	2020-12-01 00:00:00	2020-12-02 00:00:00	-1	123	Approve
UP0003	2022-01-02 00:00:00	null	null	-1	123	Draft

After approval – Bill date → 2022-01-04, 2022-01-05 → UP0001

Bill date → 2022-01-06 → UP0003

SPM_CONSUMER_PACK_SUB

PACK_CODE	DATE_OF_APPLICATION	DATE_OF_APPROVAL	DATE_OF_SUBSCRIPTION	VALIDITY_DATE	CONSUMER_ID	STATUS
UP0001	2020-12-01 00:00:00	2020-12-01 00:00:00	2020-12-02 00:00:00	2022-01-05	123	Unsubscribe
UP0003	2022-01-02 00:00:00	2022-01-04 00:00:00	2022-01-06 00:00:00	-1	123	Approve

Case 4: New Add-on Pack

Add-on pack can be subscribed/unsubscribed any point in time.

Let say: X=1 day (Configured to arrive at date of subscription)

P50001(Monthly_5 add-on pack with 1 month validity from date of subscription)

Subscription of Add-on

Auto-approval, date of subscription will be X days(configured) from date of approval

SPM_CONSUMER_PACK_SUB

PACK_CODE	DATE_OF_APPLICATION	DATE_OF_APPROVAL	DATE_OF_SUBSCRIPTION	VALIDITY_DATE	CONSUMER_ID	STATUS
UP0001	2021-12-01 00:00:00	2021-12-01 00:00:00	2021-12-02 00:00:00	-1	123	Approve
P50001	2022-01-01 00:00:00	2022-01-01 00:00:00	2022-01-02 00:00:00	2022-02-01	123	Approve

Subscription of Multiple Active Add-on

_____ If multiple add-on Pack is active then least tariff pack will be applied for billing

Subscription	Validity		TOU	T1, to T4 time slots in Billing	
1 Base Pack	Unlimited				
2 Addon Pack - weekends	01-Jan-22	31-Dec-22	T1,T3		
3 Addon Pack - Festival	01-Jan-22	31-Dec-22	T4, T1		
Day of Billing	Festivals	Weekends	Base Pack		
Monday	X	X	A		
..					
..					
Saturday	X	A	X		
Festival Sunday	A	X	X	Least Tariff	
Day of Billing	Festivals	Weekends	Base Pack		
Monday	X	X	A		
..					
..					
Saturday	X	T1,T3	T2,T4		
Festival Sunday	T4, T1	T3	T2	Least Tariff	

Un-Subscription of Add-on

Updation of status to unsubscribe with updation of validity date(today's date + X days)

SPM_CONSUMER_PACK_SUB

PACK_CODE	DATE_OF_APPLICATION	DATE_OF_APPROVAL	DATE_OF_SUBSCRIPTION	VALIDITY_DATE	CONSUMER_ID	STATUS
UP0001	2021-12-01 00:00:00	2021-12-01 00:00:00	2021-12-02 00:00:00	-1	123	Approve
P50001	2022-01-01 00:00:00	2022-01-01 00:00:00	2022-01-02 00:00:00	2022-01-12	123	Unsubscribe

Penalty will be applicable if Pack configured with some penalty against switching of pack.

Scheduler for status updation to expire against subscription of pack

Every day scheduler which will update the status as "Expire" when validity_date is past date than today and also notify consumer regarding expiration of pack.

On 12-01-2022

SPM_CONSUMER_PACK_SUB

PACK_CODE	DATE_OF_APPLICATION	DATE_OF_APPROVAL	DATE_OF_SUBSCRIPTION	VALIDITY_DATE	CONSUMER_ID	STATUS
UP0001	2021-12-01 00:00:00	2021-12-01 00:00:00	2021-12-02 00:00:00	-1	123	Approve
P50001	2022-01-01 00:00:00	2022-01-01 00:00:00	2022-01-02 00:00:00	2022-01-11	123	Expire

Pack Selection for billing of customer

For Billing consider date of subscription of pack with status as Approve

Current date Billing – Check bill date against subscribed pack is falling between date of subscription and validity date with status not Draft.

Back date Billing - Back date bill then pack should be applied with validity date even if its expired for today.

I. CONSUMER BILLING WITH BASE PACK AND BILLING WITH ADD ON

ASSUMPTION: Calculate the consumption units (i.e. it may be through service)

TOU METERS:

1. The Components will be calculated as mentioned below.

1.1. Energy Charges

a. The consumption will be captured at different intervals and calculated on daily basis with the defined tariff based on pack

For example:

PACK	PACK ID	VOLUMN	FIX CHARGE IN RS/MONTH	CONTRACT PERIOD	PRICE RS/KWH DAY TARIFF	PRICE RS/KWH NIGHT TARIFF
Universal_Pack_5	UP0001	Up to 5kw	100	Unlimited	5	4.5
Weekend_pack_5	Wk0001	Up to 5kw	100	Every Saturday and Sunday only	3	2.5
Diwali_pack_pack_5	DW001	Up to 5kw	100	11 th Nov 2021	2	1.5

BILL CALCULATION:

BILL FOR PROSUMERS CALCULATION:

For prosumer: The regular recharge will be applicable for import energy consumption & Prosumer pack will be activated for export energy & settlement will be monthly.