dcbel

Utility Partner Integration Brief

DCBEL.ENERGY

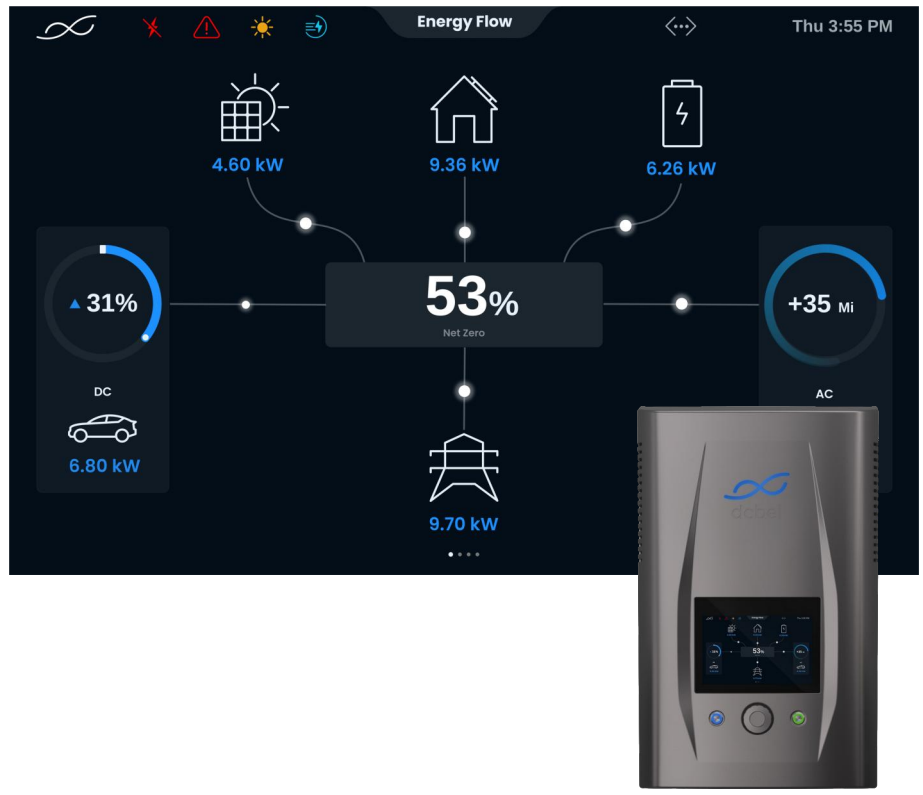
As a company, dcbel sits at the nexus

of residential solar power, electric vehicle charging, smart home energy management and customer-centric utilities. Our products help customers rethink energy delivery as a decarbonized, distributed, and digital ecosystem that puts them at the center of their own energy decisions.

dcbel Home Energy Stations consist of both hardware and software that integrate many consumer functions into a single unit and software platform. Leveraging a purpose-built multi-layer Internet-of-Things (IoT) platform (dcbel Chorus), a native energy operating system (dcbel Orchestrate), and innovative inverter technology (dcbel Digital Multilevel Inverter), dcbel products can be configured from the factory, at the time of installation, or remotely to enable (or disable) any of the following uses:

- Dual EV charger (AC Level 2 and DC fast charging)
- Rooftop solar inverter
- Home battery inverter
- Smart charging capability
- Vehicle-to-home capability (backup power or rate arbitrage)
- Vehicle-to-grid capability (peak capacity reduction and balancing reserve)
- Smart home energy management and optimization

A dcbel Home Energy Station sits at the heart of a home's energy ecosystem

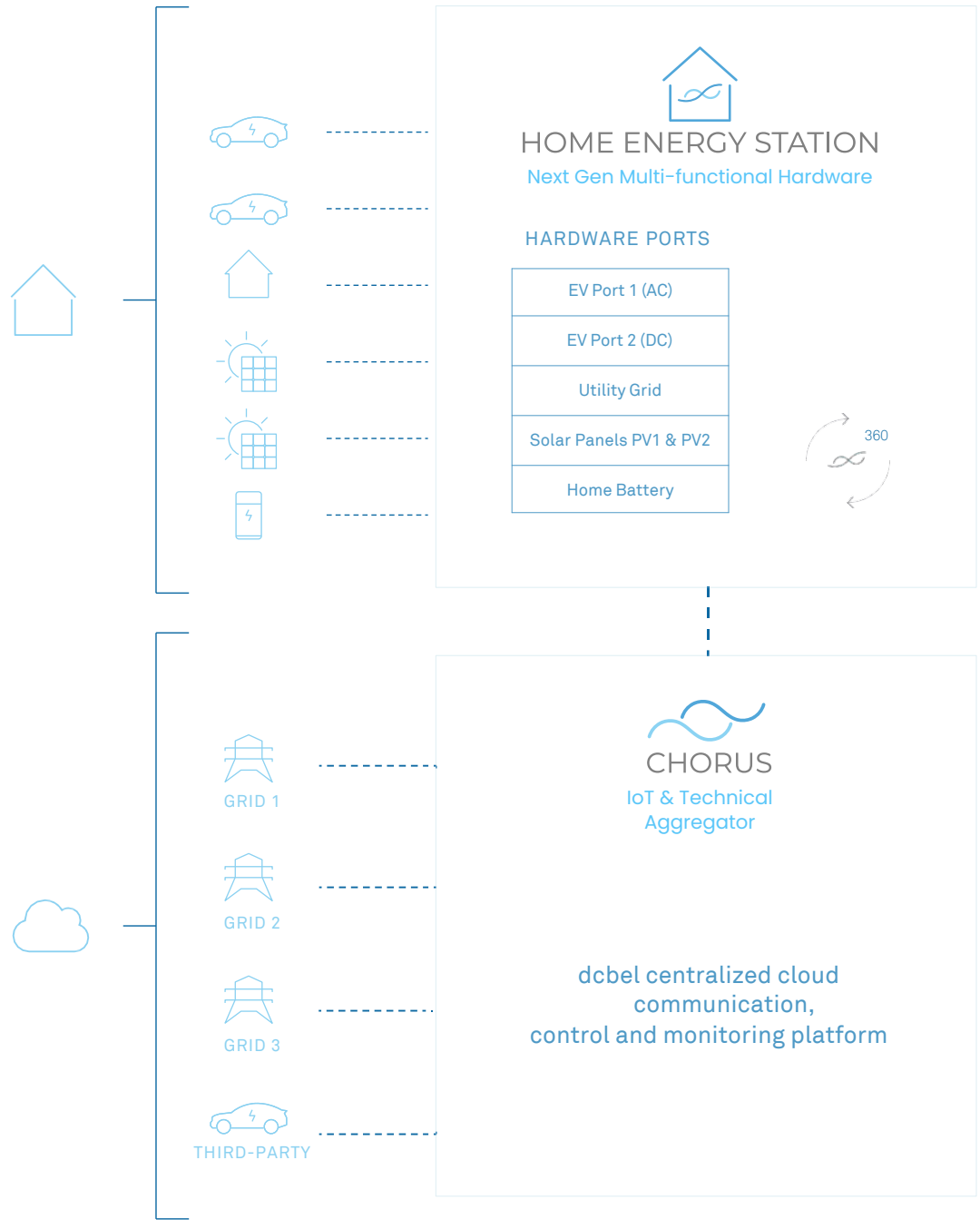


It uses machine learning to automatically predict energy requirements, lower bills, reduce carbon emissions and detect issues before they happen.

It also enables safe, straightforward grid interconnection, allowing consumers to be active participants in a variety of energy programs and markets through virtual power plant aggregation, benefiting both utilities and consumers.

Grid interconnection of Distributed Energy Resources (DERs) such as EV batteries through aggregations, alongside traditional resources such as rooftop solar, will be key in valuing the benefits of Distributed Energy Resource in line with new policy changes (FERC 2222).

dcbel's networked architecture also presents a simple yet flexible way for utilities and DER aggregators to integrate with other behind-the-meter energy resources via a single user interface.



An Architecture Designed with Grid Integration in Mind

The energy grid, designed for unidirectional flow of power, has progressively been changing to support new sources energy in the form of DERs, and safely support the bidirectional flow of power. Like all multi-stakeholder ecosystems, dynamic data exchanges is a key factor to success. In the context of the energy grid, communication means a live "conversation" among grid operators, consumer-owned DER devices, consumers (opt-in or out), Regional Operators, and many other actors. dcbel's Chorus IoT platform ensures a secure and scalable approach to communication with the ecosystem.

External Stakeholder (Utility or Aggregator)

Secured Authentication

Microsoft Azure

CHORUS

IoT & Technical Aggregator

External APIs
(REST, Sockets)

Standard APIs
(OCPP 2.0, CSIP, OpenADR)

Data Lake
Historical / forecast / status data unstructured and accessible in BI Tools

Apps & Content Services
Utility rates, weather forecast, solar forecast

Control Commands
Start and stop charging, reboot, load management and more

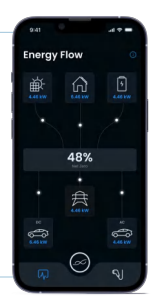
Device Management
Provisioning, device status, remote diagnostics and software updates

Asynchronous encrypted telecommunication via TCP/IP

Every minute, dcbel assesses maximum available charging output and load (EV charging vs home) prioritization is evaluated based on available content such as weather or tariff, and constraints.

Mobile portal

User inputs / constraints (e.g. EV charging schedule)



Chorus Cloud Platform

Chorus is an IoT management platform that monitors all installed dcbel units and provides subscribed users (e.g. dcbel owners and utilities) with real-time alerts as soon as it detects any operating abnormalities.

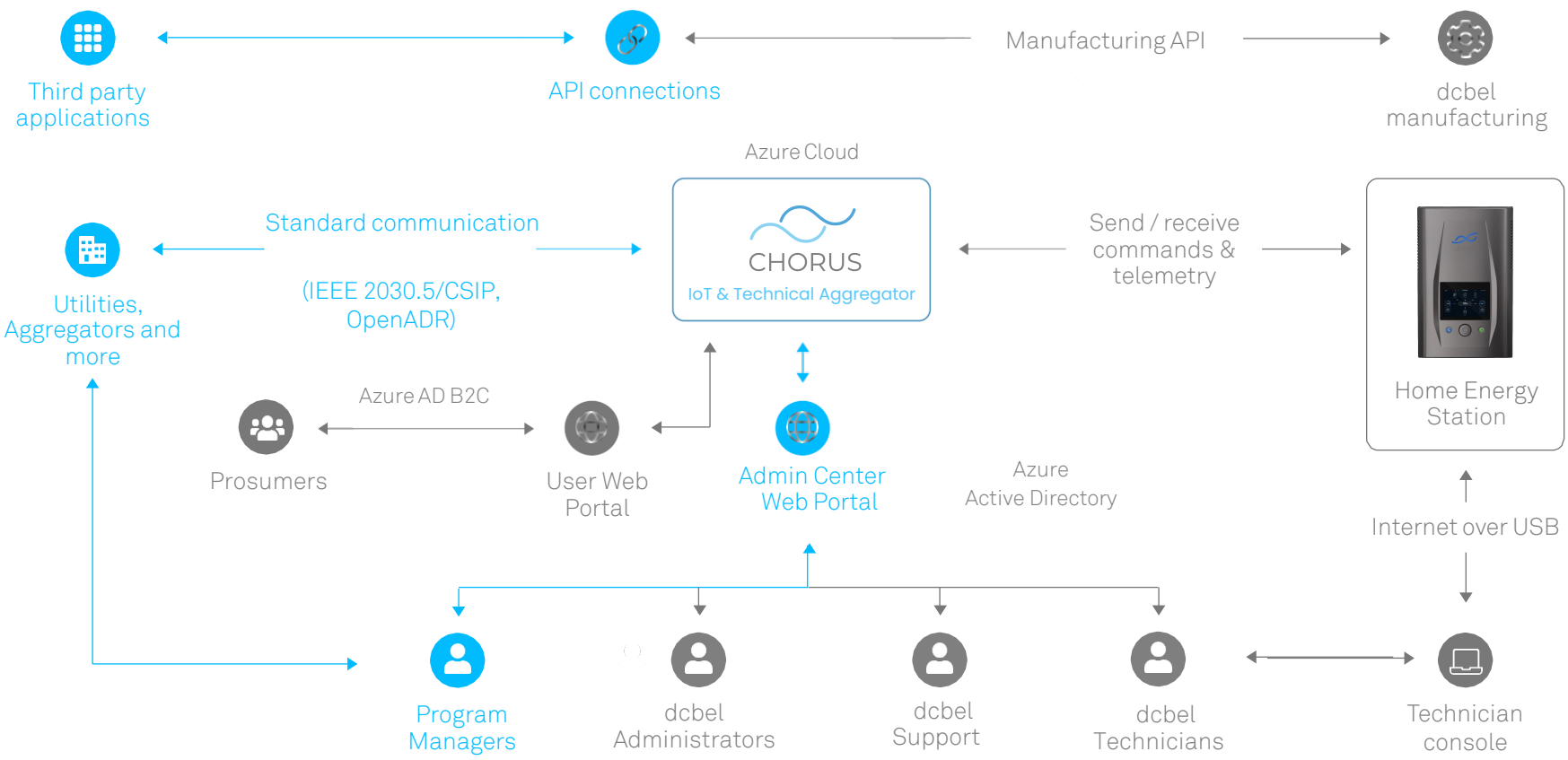
Chorus communicates with dcbel via the Orchestrate Energy OS and continuously balances and optimizes loads (home, EV charging) and source generation (utility grid, rooftop solar, battery storage).

For utilities and DER aggregators, Chorus also provides scheduled or real-time control of dcbel units to support a broad range of use cases including peak shaving, backup power, or vehicle-to-grid energy reserve.

CHORUS IOT KEY FEATURES INCLUDE:

- Fully secure IoT platform
- Asynchronous communication
- Real-time geolocated monitoring
- Mobile applications
- Over-the-air updates
- Protocol framework & library

Chorus Ecosystem



CHORUS IOT PLATFORM

Cloud platform within a MS Azure environment, purpose-built by dcbel to handle data collection, processing, optimization, and communication across all ecosystem actors (dcbel, utilities, aggregators, applications, OEMs, developers and more).

CONTROL CENTER

- Operation center to monitor and control all installed dcbel Home Energy Stations
- Device management from onboarding and support to sunsetting
- Role-based portal with permission management
- Analytics dashboards and reports
- Utility program management and device registration

TECHNICIAN CONSOLE

Desktop application for secure wired dcbel installations by dcbel Technicians (Smart Home Integration Partners or SHIPs).

MOBILE PORTAL

Customer-facing applications will empower customers to have full visibility and control over the management of their Home Energy Station.

Orchestrate Energy OS

Orchestrate is a grid-edge computing platform and smart energy OS at the core of the Home Energy Station. It is responsible for the system's energy management and DER control functionalities, as well as running local and cloud based apps.

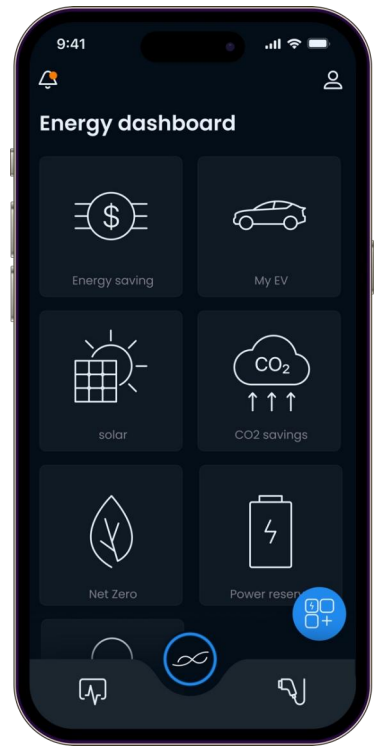
Orchestrate allows for incredible flexibility and everyday cost reduction on IT deployments while enhancing reliability over current hardware-only platforms. Further, running data transactions locally (as opposed to in the cloud) can reduce costs by more than 60% over traditional cloud or blockchain platforms. This approach unlocks scalable grid-edge computing, reducing cloud operating costs by more than $300 per user, every year.

App Ecosystem

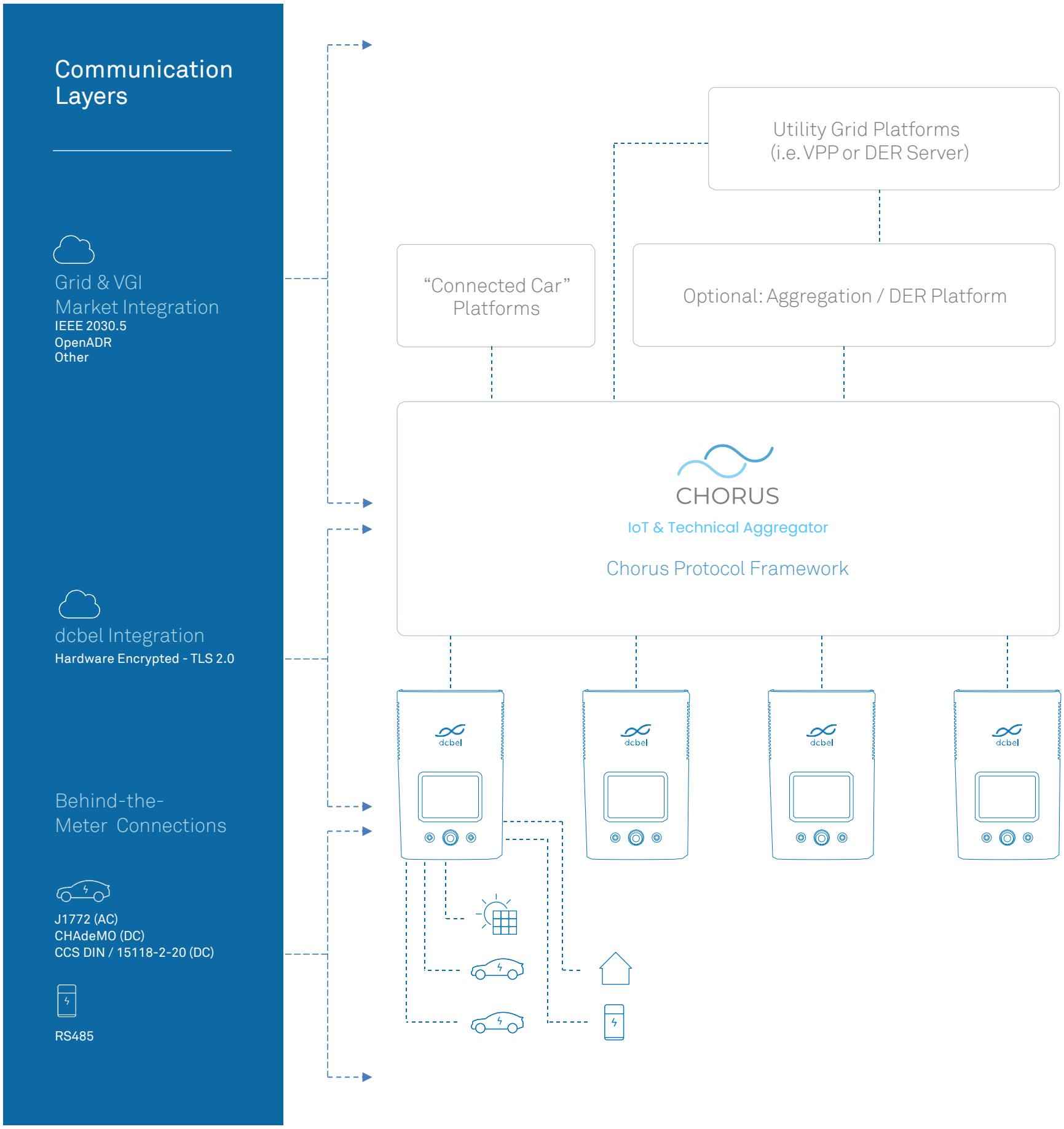
The dcbel decentralized computing architecture was designed to enable third parties like utilities, aggregators and OEMs to build and integrate home energy apps across their unique use cases and make them available to dcbel users on the App Hub.

Our networked architecture and Orchestrate Energy OS can support an unlimited number of diverse Apps running locally or on the cloud depending on the function they serve. Local apps are typically time-critical or need to continue to operate during a telecom blackout. Local apps reduce cloud computing costs and are well-suite for single thread CPU intensive calculations that are not data heavy. Data-intensive or non time-critical apps can be deployed and hosted in Chorus.

All apps are developed, deployed and maintained independently while being able to communicate with each other. This flexible architecture allows both dcbel and 3rd party developers to seamlessly integrate new protocols and features as the energy market and business objectives evolves.



dcbel Communication Architecture



Physical Communication Protocols

Depending on the use case, dcbel installation may also require additional devices such as a Smart Islanding Switch (db Bridge), Home Current Sensor (db Tempo) and Home Battery. All of these devices communicate with dcbel Home Energy Station via the RS485 port.

dcbel communicates with electric vehicles via either J1772 (in AC mode), CHAdeMO, or CCS (ISO 15118 or DIN SPEC 70121) (in DC mode) depending on the EV connector selected and installed.

The station draws from a library of EV charging communication protocols to automatically detect the bidirectional capability of the EV.

All communication protocols can be updated remotely over the air. This ensures that dcbel maintains compatibility with new home battery and EV models released in the future.

Every station is communication-ready with a RJ45 port that can be connected to an Ethernet cable (preferred for optimal reliability). Alternatively, dcbel can use external hardware to connect to the home's Wifi network.

Operational During a Communication or Power Outage

In the event of a communication failure between a Home Energy Station and Chorus Cloud, dcbel remains fully operational. It houses all of Orchestrate's computing power locally, allowing it to continue to store data during an outage. Data will be synchronized with Chorus Cloud once communication is restored.

During a power outage, dcbel will be powered by the home battery. In the absence of this component, dcbel will enter standby mode and be powered by the dcbel UPS until a compatible bidirectional EV is connected to power the home.

Once the power outage is detected via the dcbel current sensor (db Tempo), dcbel will first confirm whether the Smart Islanding Switch (db Bridge) has properly islanded the home from the grid before initiating blackout power mode.

Grid Interconnection

Many of the protocols in use today were developed within industry silos and were not designed to support a full ecosystem of grid-edge connected devices. As the electric vehicle, residential solar and smart home industries begin to converge and interconnect with legacy electrical distribution networks, it becomes increasingly urgent to find a way to standardize and support the multitude of protocols.

DER AGGREGATION SERVERS (OR VIRTUAL POWER PLANT) MANAGEMENT

- Operation center to monitor and dispatch events to registered Home Energy Stations
- Device management from provisioning and support to sunsetting

CHARGE POINT OPERATOR COMMUNICATIONS

- Custom protocol based on OCPP 2.0

DER PROGRAM MANAGERS

- Demand response event: curtail one of many loads or send power back to the grid
- Active feeder curtailment

SOLAR & HOME STORAGE INVERTER MANAGEMENT

- UL 1741 SB (Rule 21 for California) & IEC61850 Protocols

External Communication Services

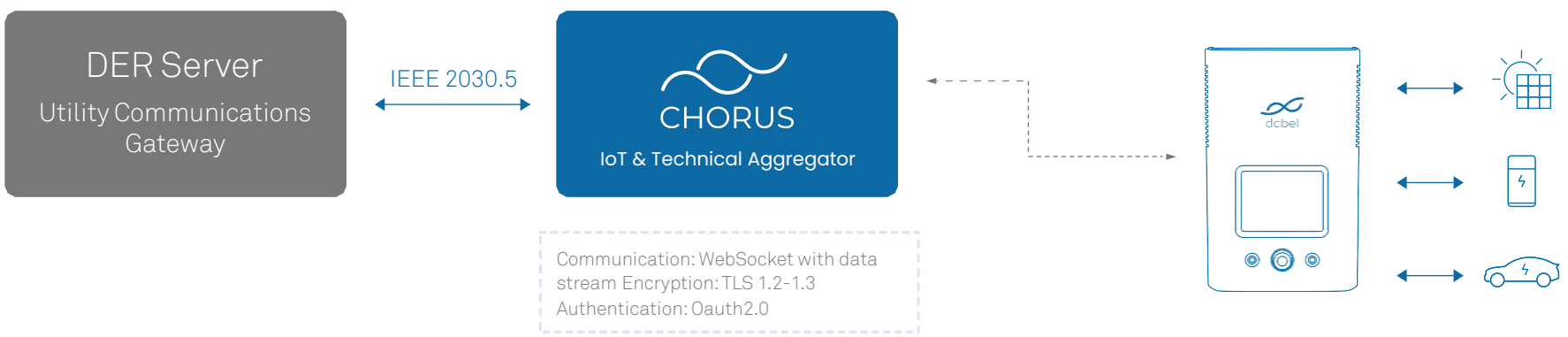
Communication between Chorus and third parties can be done via three different secured services:

- **Internal integrations:** dcbel operations integration through manufacturing (MRP), product life management (PLM) and user onboarding (CRM) applications
- **External open APIs:** Request-based connection to third parties (available on demand)
- **Standard APIs:** IEEE 2030.5 CSIP
- **Data lake:** Unstructured historical/ forecast/status data accessible by an authenticated user's BI tools

Common Smart Inverter Profile (CSIP)

With the increased use of DERs, it is critical to ensure reliable and secure communication, as well as manage voltage and power quality issues that could result from distributed generation resources. While there have been many methods, the two approaches that best fit these requirements are OpenADR, for a decentralized and demand response-focused approach, and IEEE 2030.5 for direct smart inverter control and adjustments. The IEEE 2030.5 CSIP protocol supports a wide range of DER control applications, with inverter control representing a subset of that functionality.

dcbel favors IEEE 2030.5 CSIP for DER dispatch of its Home Energy Stations, providing smart inverter capabilities to all connected devices (PV, ESS, EV). With support for both generation and storage, IEEE 2030.5 CSIP enables higher compatibility with grid-tied PV systems and new behind-the-meter energy resources such as home batteries and EV batteries. In addition to remote monitoring and control, it also allows increased customer engagement (opt-in or opt-out) and information (dynamic pricing based on load profiles).



As an alternative to any standard communication, third parties and partners can leverage dcbel proprietary external APIs to communicate events or event information such as pricing.

External Open APIs

Chorus provides APIs that may be used by authenticated users, such as third-party partners and businesses.

Functionalities available to these users can vary according to their role and the privileges granted by Chorus. Capabilities provided by the APIs can be particularly useful from a provisioning and utilities perspective, as they permit "at-scale" or batch execution of the functions normally manually accomplished by internal or external resources.

Functionalities that will be available via dcbel APIs include:

USER MANAGEMENT

- Create a new user
- Assign a role to user or group of users
- Set privileges to a role or group of roles
- Disable users

HOME ENERGY STATION MANAGEMENT

- Assign a site where a dcbel will be installed
- Update Home Energy Station information such as equipment and model, utility rate schedule, micro-weather data, and more
- Send commands to a station (enable/disable, reboot, control load and more)

HOME ENERGY STATION MONITORING AND ALERTS

- Access station data stored in the cloud

DEVICE CONTROL

- Send commands to dcbel

Chorus Cloud will provide real-time visibility into the Home Energy Station's health and overall performance.

Data measurements communicated to Chorus include but are not limited to:

- EV AC - (V, A, W, State, Direction)
- EV DC - (V, A, W, SoC, State, Direction)
- PV - (V, A, W, Curtail, State, Direction)
- ESS - (V, A, W, SoC, State, Direction)
- Digital Multilevel Inverter - (V, A, W, Hz, °C, Fan speed, Operation mode, State)
- Operating temperature - (°C / °F)
- Fans - (RPM)
- dcbel interaction - (Button pressed, screens consulted)
- ATS - (V, A, Hz, Relay position)
- Tempo home current sensor - (A, Hz, import or export)
- Alarms & notifications
- Errors

Various APIs, based on the DER Program requirements, will be made available via secured authentication and authorization.

Chorus Security

IoT poses unique security, privacy, and compliance challenges. Unlike traditional cyber technology where issues revolve around software and how it is implemented, IoT involves both the cyber and the physical worlds.

dcbel is the only EV charger / PV inverter with an embedded Trusted Platform Module (TPM) 2.0 chip for superior hardware security encryption, futureproofing its adherence to possible future grid compliant requirements as more and more grid edge devices are connected.

For this reason, it is not possible to directly access a dcbel unit. All communication is done via the Chorus IoT platform, which oversees the encryption and transfer of information to dcbel. This provides easier integration, the ability to support new and legacy protocols, and assurance that physical assets already deployed will be compatible with protocol evolution.

A secure approach to role management

Chorus is a unique IoT platform thanks to its ability to provide access and control to different users over the same dcbel unit while respecting customer privacy and regulations.

Subscribed users will get event notifications based on monitored performance on a dcbel or a group of dcbel units through user applications, administration portals or operational requirements for administrators and utilities.

Certificate management

Chorus is a multi-tenant Software-as-a-Service (SaaS) solution. This means that there is only one instance of Chorus that is distributed across the cloud (with exceptions for testing, staging and development).

When a device is added to Chorus, it will provide a certificate that is signed by one of the tenants' certifying authorities. Chorus will validate the chain of certificates, apply associated limitation/permissions (scopes), and store the device's certificate for later use.

For components that reside under different tenants, the administrator of tenant must agree to allow the other to communicate with elements under their respective tenants.

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To learn more, contact us at
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