Watts In An ID?

Utility-Tied, Energy Consuming Asset Life Cycle Management

A Technical Paper prepared for SCTE by

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1. Introduction

Cable operators' energy-consuming asset portfolios are extensive. Tracking the energy consumption of each of these asset's lifecycle requires utility account alignment, which can present a unique challenge. Operators outside plant represents ~50% of total consumed power, according to the SCTE power pyramid, and these assets are distributed among thousands of utility grid connection points. Coupled with facility account management, maintaining alignment between asset, utility account, and meter numbers can become quite complex. To drive data accuracy and completeness for our energy consuming network devices, we are creating and deploying persistent, unique identifiers that will help us manage asset lifecycle and track data in our expanded in-house energy management tool. Using a combination of machine learning and heuristic matching, we can maintain asset alignment and issue new identifiers as well as retire identifiers when an asset is removed from the network—

To meet this challenge, we are integrating several tools to manage our diverse population of energy-consuming, utility-tied assets.

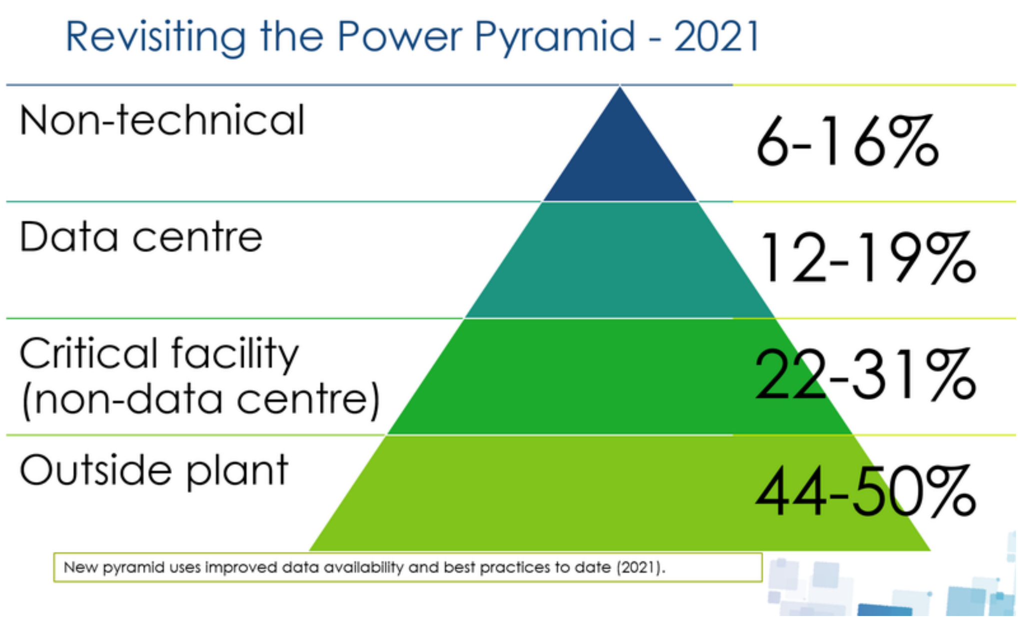

Figure 1 - SCTE Power Pyramid

2. Manual Data Alignment

Recognizing the need to align asset utility data with internal geospatial data we initiated an audit program. Early on, one problem was easily identified - three different data sources all referenced the same asset with disparate geospatial data. Utility billed asset location was sometimes nonexistent, latitude and longitude varied between internal data sources, and addresses were often not a textual match. Beyond the simple complexities of "Rd" or "Road", years of manual data entry meant misspelled street names, towns or street numbers were omitted from one of the data sets.

Patterns emerged when iterating through the manual audit data. Some utilities relayed pole numbers in billing data; other utilities were able to provide geospatial information with a join of their front-end billing and back-end geographic information systems (GIS).

With each new utility dataset ingested, nuances were uncovered that further informed and enabled process improvement.

3. Tools Ecosystem Integration

Auditing each location to align utility account data proved to be operationally sound and effective but lacked one key item—permanence. Auditing thousands of locations' metadata is time-consuming; unless operators want to commit to auditing at some regular cadence, integration between tools is required and a persistent, unique identifier which all tools must reference is a fundamental necessity.

Internal conversations between tool owners and user communities began to shed light on opportunities for change. Application programming interfaces (API) were developed to allow tools to communicate key elements and join them with a persistent identifier.

3.1. EMD: Energy Management Database

Energy Management Database (EMD) is an internally developed tool that captures energy-related invoice data. Specific to operations and the overall network, electric utility invoice data is ingested, then a comprehensive overview of electricity consumption and spending across Comcast is provided. While the tool has many use cases and reports, this paper focuses on how the first step in aligning energy-consuming assets is foundational to creating a unique and persistent identifier for all utility-tied asset lifecycle management.

EMD ingests invoice data via utility electronic data interchange (EDI). As some utilities do not provide an EDI feed, a scraping bot service was developed to process paper invoices. The invoice details are ingested each billing cycle and compared to existing records for each location. This comparison allows for updates to data, such as smart meter upgrades; EMD is then able to write this data to appropriate tools via APIs.

3.2. Machine Learning Integration

Identification and confirmation of active or inactive power supply locations can be difficult; without dispatching network technicians to many locations, a solution was needed to confirm power supply asset location and utility connection type. We developed a tool we call LOCUS (Locating Outside Plant Comcast-to-Utility Services), which uses machine learning to identify and classify power supply locations. By identifying whether a location is metered or unmetered, EMD can ingest the data and confirm or dispute the assigned utility account or meter number.

Utilizing our multi-class model, LOCUS combs mapping software via open APIs to identify power supply cabinets and the associated utility connection methodology. Our training model consists of thousands of confirmed power supply locations with their associated latitude and longitude being referenced at a rate of approximately 10 per second. Additionally, utilizing geospatial radii, LOCUS "walks" the map until exhausting the maximum radius, returning null findings for any ingested unknown datasets. The model classes include aerial-metered, aerial-unmetered, underground-metered, and underground-unmetered.

By identifying both the installation methodology and the utility connection type, accounts can be more easily matched to the appropriate asset. Additional benefits arise when large areas undergo forced relocates, as occasionally the previous account is not disconnected; in these situations, the matching of account to asset leads to potential utility billing records clean-up.

Figure 2 and Figure 3 show examples of LOCUS navigating to supplied geospatial location data and analyzing the connected asset. In Figure 2, there would have been billed usage, but low probability of it being an actual power supply. In Figure 3, the billing location data was directed to a PS location and was verified as a metered, aerial power supply.

Figure 2 - Example Map View: No Power Supply at Pole

Figure 3 - Example Map View: Metered, Aerial Power Supply at Pole

This system is also used to validate the removal of power supply locations for billing closure confirmations. If an account cannot be tied to an active asset, LOCUS will sleuth the surrounding area, based on predetermined radii, for any identifiable power supply locations, then is passed on to other teams for evaluation before investing person-hours to review locations manually.

3.3. Real Estate Database

Leveraging an existing real estate database, used to track owned and leased "brick and mortar" facilities, EMD ingests appropriate metadata for owned and leased sites. Within this dataset, the facility's primary use type, e.g., administrative, headend, datacenter, is conveyed and used to generate the asset type portion of the identifier. This site classification also aids in mapping each facility for the appropriate major bucket: technical, non-technical, and data center.

3.4. Power Supply Operational Database

Power Supply Notebook (PSNB) manages the inventory and tracks the status of Comcast's outside plant power supplies. More than 200,000 power supplies are managed using this software. Power supplies provide telemetry each minute, reporting the current status of the device and select parameters. When parameters reported through telemetry are out of tolerance and require maintenance, PSNB can initiate the process. Ensuring that all devices powering the Comcast network are captured and tracked through PSNB is imperative in understanding any potential impacts on customer services. Loss of commercial power or other network impairments are most effectively addressed when the plant topology is accurate.

Integrating PSNB with EMD will trigger an alert to validate whether the utility account is still required if a power supply's output power is zero for a set timeframe, ensuring utility accounts stay aligned with network changes.

3.5. Design Database

Geospatial tools provide designed location metadata and system-unique identifiers for all objects within the network. For our purposes, the locations and devices metadata for all power supply objects, along with all critical facilities and data centers, was required (non-technical facilities not represented). An API was developed, allowing EMD to ingest all relevant fields and house that data in the primary relationship table within the database.

3.6. Visibility

Energy Management Database, and the associated tools integrations, allowed insight into the changing of internal metadata as well as utility metadata rate of change (utility mergers/acquisitions, smart meter upgrades, etc.). This new level of visibility further demonstrated the need for a persistent identifier, leading to the development of Global ID (G-ID).

4. Global ID

4.1. G-ID Data Flow

Global ID (G-ID) is a persistent identifier that will be used across all tools and databases for each individual physical asset. The G-ID will maintain inter- and intra-system relationships and store all individual tools or account identifiers as associated by G-ID in a primary table configuration to allow change management through the asset lifecycle.

The stages of the asset life cycle are design phase (GIS), construction, activation (PSNB), and invoice management (EMD). At the design phase, when an object is published for an asset (power supply or technical facility), the design database object ID is available via API. EMD then ingests and begins a heuristic matching process to all known assets in PSNB. Power supplies can share a location, be stand-alone, or exist several feet to several pole-spans apart, heuristic matching is needed to ensure proper G-ID assignment.

This same matching is used to align billing data. If a utility bill is ingested by EMD and is not already assigned to an asset, heuristic matching is used to locate the appropriate design and operational datasets. If none are found, an alert is issued to the appropriate team(s) for intervention and record creation.

As we have various system-level IDs, tracking the changes to any single ID back to tool or phase—is difficult—as these IDs can change due to factors such as location change, design schema change, decommission, or physical replacement of an asset. G-ID maintains the persistence of the unique identifier across all tools and phases of the asset lifecycle, which will allow changes to be tracked and documented.

This change control allows for more accurate inventory alignment and improves data quality for reporting and analysis.

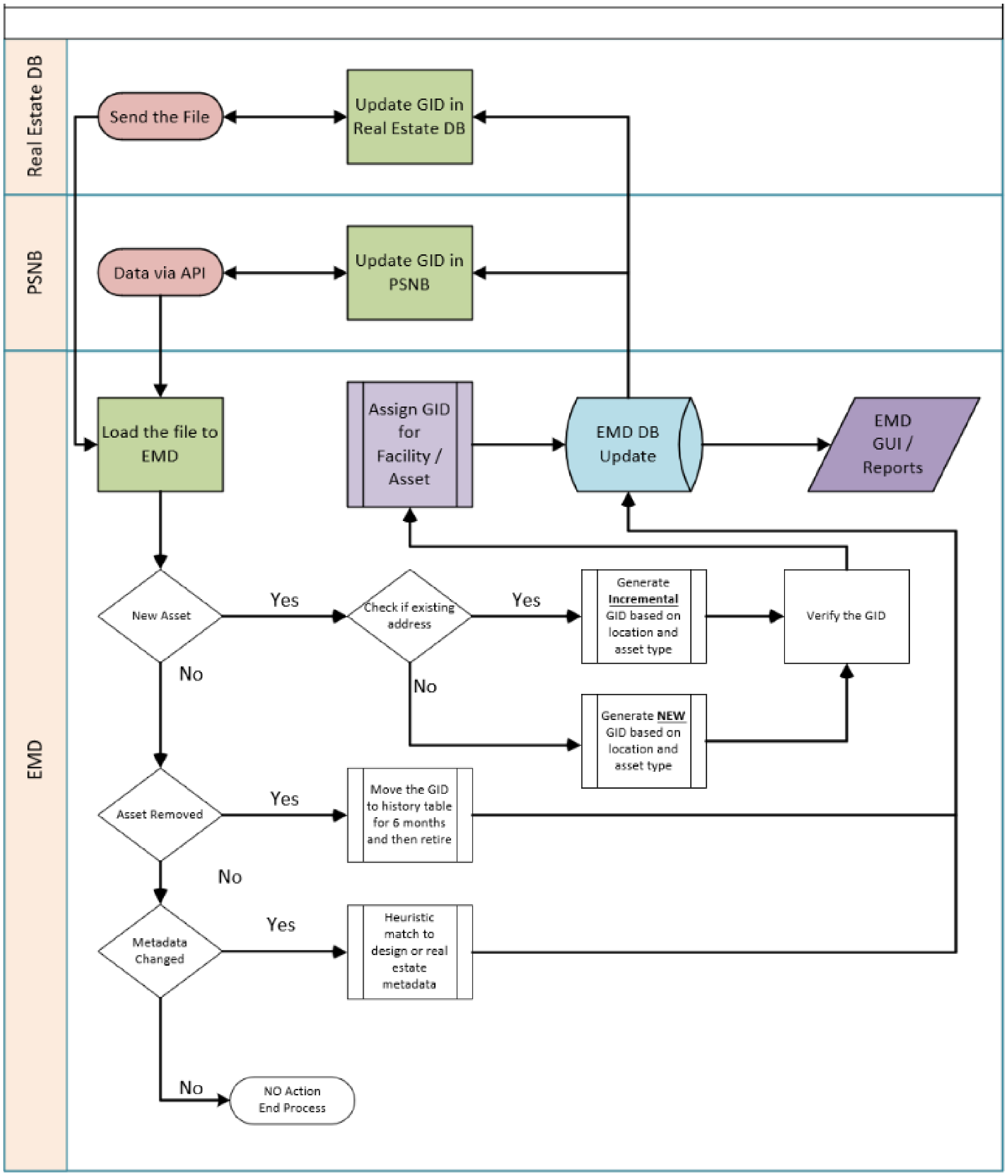

Figure 4 - Global ID Data Flow

4.2. EMD and PSNB

As power supplies are added to the network, moved to a new location, or removed, the associated record in PSNB is updated to ensure that the inventory remains accurate. Assigning a G-ID to each power supply record in PSNB ensures that the relationship between the record in the design database and the management application remains intact. When a new power supply is added to PSNB, EMD provides a new, unique G-ID and writes it to PSNB. The G-ID provides a durable relationship between the record in PSNB, the GIS system, and utility provider account information. When power supplies are moved, but retain the same utility information, the PSNB identifier will remain unchanged, the G-ID will be updated according to the heuristic logic and, if within the specified radius, remain unchanged. If the move is outside the specified radius, the old G-ID will be retired, and a new G-ID will be issued for the asset. If the associated record in the design database changes, the relationship is managed within EMD to ensure the correlation between the GIS system and physical location remains intact.

When new power supplies are installed, a record is created in PSNB. The record does not contain the G-ID at the time of creation, as it has yet to be assigned. A scheduled process (delta report) compares the inventory changes in PSNB with the records in EMD and identifies the moves, additions, or deletions. When a new record is identified, EMD will issue a G-ID that is then added to the record in PSNB. This reconciliation process is key in ensuring that all power supplies in PSNB are accounted for in EMD. An API is used for the processing and updating of records in both PSNB and EMD. The G-ID, along with utility provider information stored in EMD, are provided, and updated in PSNB using this process. By conveying the utility data, such as account and meter number or utility contact information, network teams have the data readily available—should a utility-connected location be damaged or need utility response.

4.3. Global ID – Built for the Future

As we ideated and iterated through the G-ID schema, we found unique use cases and requirements from many of the tool owners. From character limitations to future use cases, all aspects were considered in the final identifier.

Ultimately, a 19-character alpha-numeric string was finalized. Utilizing characters for country and state codes, asset type identification, system initiator, location, and finally, asset identification are all components of the ID.

As several power supplies can exist in one location, there is a relational hierarchy to maintain the geospatial relationship and a unique, persistent identifier. The same applies to power supplies installed at a Comcast facility if the address and utility connection are the same, the location portions of the G-ID will be replicated. Maintaining separate location and asset strings within the ID allowed for associated records to be identified while still permitting a unique identifier. For reporting purposes, this allows the identification of multiple assets drawing power from the same utility meter.

Country	State	Type	Initiator	Location	Asset
U S	C A	O S P	T	0 0 0 0 0 0 1	0 0 0 1
		Outside Plant	T = Test Load		

Figure 5 - Global ID Structure

5. Conclusion

The need to align energy-consuming assets with their appropriate utility account(s) initiated an audit of Comcast's asset portfolio. Finding that data sources were not aligned, a need for a persistent identifier was recognized.

Energy Management Database was created to house and report on all assets and their respective energy consumption; as the data and the diverse identifiers from many systems were found to be dynamic, our internally generated Global ID was developed for all grid-tied, energy-consuming assets.

Global ID allows lifecycle management at a far more detailed level , provides the ability to track energy metrics, such as Electricity per Consumed Byte, at the facility level, and enables the creation and updating of dashboards for operational use to drive electricity consumption reduction.

Abbreviations

API	application programming interface
EDI	electronic data interchange
EMD	Energy Management Database
G-ID	Global ID
GIS	geographic information system
LOCUS	Locating Outside Plant Comcast-to-Utility Services
PSNB	Power Supply Notebook
SCTE	Society of Cable Telecommunications Engineers

Bibliography & References

Figure 1, SCTE Power Pyramid, https://www.scte.org/standards/development/energy-2020-powering-cables-success/
Figure 2, Figure 6 - Example Map View: No Power Supply at Pole, Richard Grivalsky
Figure 3, Figure 3 - Example Map View: Metered, Aerial Power Supply at Pole, Richard Grivalsky

