



The Identity Resolution Playbook

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Foreword by David Wells

Industry Principal, Media, Entertainment & Advertising at Snowflake

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This resource on Identity Resolution, a foundational concept in realizing a full view of the customer, is required reading for today's data leader."

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Foreword

Building a complete view of the customer has the potential to unlock incredible value for businesses. Whether you are looking to build better marketing attribution models, personalized recommendations, or churn prediction models, identity resolution is essential. It is not surprising that companies are willing to allocate large budgets to build what is often referred to as the "golden customer record." If you are a data executive looking to ship projects that move the needle, this guide is for you.

Introduction

Identity resolution on the modern data cloud



In the decades since Tom Siebel coined the term “Customer 360” in the 1990s, companies have spent billions of dollars on efforts to build a complete customer view. In more recent years, tremendous advancements in data infrastructure have made this tantalizing prospect of a golden customer record more achievable than ever.

Cloud computing made it easy to access and scale computing services as needed. The decoupling of storage and compute resources made storing large amounts of data and running queries against it significantly more cost-effective.

Moreover, the advent of the Snowflake Data Cloud brought these benefits to market as a service with no overhead and minimal upfront commitment. With this in mind, this resource on Identity Resolution, a foundational concept in realizing a complete customer view, is required reading for today’s data leader.”

David Wells

Industry Principal, Media,
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at Snowflake

Data leaders live in a world flush with both pressure and opportunity. In the current macroeconomic environment, the mandate for data teams to deliver business results is at an all time high.

At the same time, advanced tooling has created new possibilities for data teams. Collecting, storing, processing, and modeling incredible amounts of data has never been easier or cheaper.

Some companies are riding this wave of technology to drive revenue, but many data leaders still struggle to deliver value quickly. Nowhere is this struggle more prevalent than in the effort of data teams to build the coveted “complete customer view.” It’s not uncommon to hear about these projects taking multiple quarters – even years – and costing tens of millions of dollars. Why is this?

The answer is found in the story of customer data over the last decade, from the rise (and fall) of marketing technology to the fragmentation and consolidation of modern data infrastructure.

This playbook is written as a guide for data leaders and their teams. We start by providing historical context for the problem. Then we dive into practical guidance on how to collect first-party customer data, unify it to create a full view of the customer, and activate it to deliver bottom-line impact.

The cost of a complete customer view

- ▶ A large North American retailer has budgeted over \$40 million annually to solve identity resolution
- ▶ A global telecom company is spending \$30 million to build a customer journey map
- ▶ A large marketplace spent three years building a complete, usable view of their customer



Chapter 1

A brief history of identity resolution

Companies have been using customer data since the beginning of commerce. With the introduction of relational databases in the 1970s and 80s, businesses were able to unlock data at scale in a way never seen before, and they began to use it to drive significant competitive advantage.

At the turn of the century, commerce pushed into a new, online digital frontier, and data appetites increased exponentially. With the rich experience of Web 2.0, the modern online customer experience was born, and technological advancements made it possible to track all sorts of granular data points and stitch together a complete customer journey.

64% of teams today cite data centralization and unification as a top priority.

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The smartphone revolution, catalyzed by the launch of the iPhone in 2007, complicated the tracking landscape. The same user could now access a company's website on a desktop, laptop, or mobile device. Moreover, they might access both the company's website and mobile application.

A wealth of opportunity lay on the other side of this complexity, but the teams best suited to solve this identity resolution challenge, the IT teams, were consumed with other digital transformation projects and limited by primitive tooling. They didn't have the bandwidth to keep up with demand for innovation around data.

But with so much opportunity on the table, companies couldn't wait around. The software industry recognized this dilemma as an opportunity, and the SaaS explosion began. SaaS delivered many benefits, but it came with a major trade off. SaaS tools locked data in their own ecosystems and created a problem every company still struggles with today: data silos.

Identity resolution timeline

2004

Web 2.0

Internet adoption accelerates, websites become more interactive

2007

iPhone hits the market

Smartphone and mobile revolution begins

2014

SaaS explosion accelerates

Widespread adoption of SaaS tools including marketing CDPs

2016

Widespread warehouse adoption

Cloud data warehouses become a key piece of the data stack

2019

Warehouse as the source of truth

Companies focus on centralizing customer data in the warehouse

2021

Warehouse Native CDP

A new architecture emerges to enable the collection, unification, and activation of customer data





74% of teams say data silos impact their ability to ship key projects.

2023 State of Data Engineering Survey

With valuable customer data scattered across various SaaS products, it was impossible to build anything close to a comprehensive customer profile. This new, fragmented landscape created pain for teams company wide, but none felt it more acutely than marketing.

The market responded to this problem with yet another SaaS category: the Customer Data Platform (CDP). The CDP promised to automatically bring in data from every SaaS tool, unify it in a single location, and create a comprehensive customer profile. While these early CDPs did unify data from other systems, they created yet another data silo. There was no easy way for teams outside of marketing to access the data in the CDP.

So, the pain of a fragmented system persisted. But as business teams were feeling the impact of data silos, IT teams had already started implementing the right answer: the data warehouse.

Warehouse technology advancements meant the limitations of traditional CDPs could be overcome, but doing so would require a new approach: building the entire customer data stack around the warehouse.

Armed with new technologies and the necessary skill set, data engineers could provision infinitely scalable infrastructure from cloud providers and work with developers to centralize both relational and behavioral customer data in a modern data platform like Snowflake. But even with modern technology There are several unique and difficult technical challenges to building a complete, usable view of the customer.

Chapter 2

Why it's hard to build a complete view of your customer

Solving for identity resolution requires two primary ingredients: data collection and data unification.

Any attempt to construct a truly complete view of your customer requires using all of the available data about that customer. For data teams, this means ingesting data from a variety of sources to capture every customer behavior and attribute.

After collection, data must be unified to produce a clean, usable view of the customer. This requires cleaning, joining, and modeling on multiple levels – first building a basic identity graph, then computing user attributes based on behavior.

Data teams and modern data infrastructure are perfectly suited to solve this problem, but collection and unification still pose significant challenges for data leaders. Most teams are unable to focus on making their customer data useful because they're mired in the complexity of building pipelines and endless data modeling.

Data leaders cite “collection & centralization” as the number one roadblock to solving identity resolution.

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The data collection challenge

Customer data is unique and presents data teams with multiple challenges when it comes to building complete customer profiles:

- ▶ Customer data is naturally siloed
- ▶ Customer data is big and messy
- ▶ Customer data requires complex infrastructure

Customer data is naturally siloed

Front line teams use customer data every day, and they typically store the subset of data required for their use cases in their own tools, creating data silos. This problem is further exacerbated for businesses that produce both online and offline data. For example, retailers with eCommerce sites plus brick and mortar locations face the challenge of collecting and integrating point-of-sale data.

These natural silos create a significant collection problem for data teams who often have to deal with hundreds of different data sources. They come from marketing tools, CRMs, customer success platforms, payment systems, internal databases, and other systems. When you add first party, event-based behavioral data from multiple apps and websites to the picture, it gets complicated quickly.

Only 26% of data teams say that they have solved the data silo problem.

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Customer data is big and messy

Customer data comes in big quantities. Modern eCommerce and marketplaces, for example, are driven by online interactions and generate a massive amount of data every day. Moving data at these volumes has implications for cost, scale, and scheduling.

Customer data also changes often. Not only do user behaviors and attributes change, but new features in apps and websites create new kinds of behavior to track. Even data points that seem simple, like purchase price, can become complex when you layer in coupons, discounts, and margins.

Customer data also comes in many different formats, from structured (a CRM record) to completely unstructured (a chat transcript).

The inherent messiness of customer data means that every sequential step of the data lifecycle, starting with collection and storage, is more complicated than the last.

Customer data requires complex infrastructure

At scale, even basic pipelines can require orchestration across multiple tools like dbt, Airflow, and ETL jobs. This necessitates a monitoring layer to ensure continued operation through the lifecycle of the data flow and compute process.

Running such infrastructure at scale requires full time data engineering, and it quickly becomes a low-ROI use of resources because a majority of time is spent on plumbing not shipping projects.



The data unification challenge

Collecting every customer touchpoint is a significant undertaking, but it turns out that solving the initial problem of centralization is only half the battle. Modeling the data into complete, usable profiles presents multiple challenges:

- ▶ User identities
- ▶ Event semantics
- ▶ Metadata

User identities

The typical user journey begins with anonymous activity on a website or app before the user eventually signs up, logs in, or makes a purchase. This means each user generates data when they are anonymous, and then generates additional data after becoming known. In order to accurately construct a user journey, all of these activities must be logically combined into a single timeline of events.

Semantic user features like “number of products viewed before first purchase” must be computed on the logically combined user journey, not the raw events.

Managing these anonymous and known identifiers, then combining the raw data, is a massive undertaking.

Things get even more complex in multi-device scenarios where the same end user can be associated with multiple anonymous identifiers such as a cookie ID on a browser and a device ID on a mobile device. Multi-user household scenarios complicate the picture further when multiple users with different identifiers and devices are all associated with the same buying group.

Worse still, associations between unique identifiers are often discovered over time, meaning that stitching user identities requires maintaining an identity graph and computing transitive closure — a non-trivial task in SQL. Add in non-event data, and the modeling becomes even more complex... all for a basic deterministic identity graph.



Event semantics

Data points with timestamps (events) are fundamental to building a complete customer view, but user traits and features in the customer profiles table rarely map 1-1 to events.

For example, a feature like “user lifetime revenue” would require summing transactions from the website and mobile app, as well as any subscription revenue, and reconciling with financial transactions from the payment system. Even this simple use case requires working with multiple events from four different data sources and performing multiple mathematical operations.

Semantic features and events also need to take into account the output of the identity stitching step mentioned above: the raw events need to be associated with the anonymous and known identifiers, while features need to be computed over all events across all IDs belonging to a user.

Accomplishing this requires a significant amount of complex, repetitive SQL joins and unions across multiple events and identities.

Metadata

Once you compute semantic features, you need to keep track of important metadata related to those features. At a high level, you need a description of the metric (what it means), time of last update, provenance (e.g., who defined and built the metric), and any access/ownership requirements.

Tracking historic versions of the metrics is also important, especially for ML algorithms. For example, a churn algorithm may

model off of features like revenue and website activity in a 7-day period prior to the churn date. If the definition of revenue changes, the historic version of the metric must be marked as deprecated and the new metric recomputed.

Building out the models and pipelines required to manage event semantics and metadata based on an identity graph (that you are also managing) is an extremely complex undertaking. It's no wonder that data teams struggle mightily to scale the wall of identity resolution when they set out to build complete profiles.

Where there are challenges, there is opportunity

The key to any scalable solution is first understanding the underlying problems. While the challenges mentioned above often plague modern data teams, overcoming them can be a career-making achievement for data leaders. Next, we'll walk through the playbook that modern data leaders and their teams use to ship complete customer profiles quickly.



Chapter 3

The identity resolution playbook

The promised land

Data teams are uniquely positioned to build moats for their companies because their work can help drive competitive advantage across every business function. Still, while the potential is greater than ever, most teams are stuck doing low-level work in support of closing the next ticket in an endless data breadline. Far from delivering transformative change, these teams struggle to believe their companies have a positive ROI in data.

Less than ½ of data teams feel their ROI is positive or 52% of data teams feel their ROI is either negative or neutral.

However, there is proof that not only is the promised land within reach, but making the jump from focusing on low-level problems to confidently driving value doesn't have to be such a long-winded, herculean effort.

The vision

A thriving data team efficiently delivers accurate, reliable reporting, consistently shares novel insights, and regularly generates valuable data products and predictions to push their companies forward. They work with teams across the company to fuel innovative capabilities that drive transformative impact.

Instead of constantly fighting entropy and struggling to maintain brittle data stacks, they utilize a practical and effective toolset that feels enabling, not limiting. Because they've leaned on technology to automate, or at least streamline, low-level work, they can dedicate most of their energy to work on interesting projects that move the needle.

Plus, because they've established a tight feedback loop between data and impact, the rest of the business no longer looks at them as order takers – they're strategic partners who can ideate, plan, and provide a valuable perspective.

Making it a reality

The data team at Joybird, a La-Z-Boy eCommerce company, used to spend all of their time building brittle custom integrations and managing data pipelines. It took them weeks to respond to requests from their marketing team because they had to pass requirements back and forth multiple times and figure out how to triage a gigantic backlog of other stakeholder requests.



Adding a new dimension in our email platform used to take two to three weeks. With RudderStack, we have shortened that to an hour.

Brett Trani

Director of Analytics at Joybird



While they had made efforts to centralize data in their data warehouse, the data was unreliable, so they could not confidently use it for activation. Cleaning data made turnaround times even longer. Ultimately, the team was stuck doing mostly menial work and producing uninspiring results. Luckily, this is a far cry from where they are today.

Joybird's team now uses RudderStack to fuel an event-driven architecture that gives them full control of their customer data and unlocks the power of downstream business tools in their stack.

Moving beyond simply storing customer data, they transformed their Snowflake Data Cloud into a single source of truth with a modeling layer that drives consistent definitions throughout their entire stack. Because RudderStack now handles the data layer for them, their team can focus on driving impact instead of managing brittle integrations.

Today, the data team is able to capture every customer touchpoint, centralize, model, and enrich the data in Snowflake, then activate it across their entire stack. Engineers spend less time doing low-level work, and downstream teams can ship innovative use cases faster.



We didn't realize the power of RudderStack either in terms of saving engineering time or allowing our downstream teams to work and iterate faster. Our CTO is very excited about using RudderStack to realize our event-driven architecture vision."

Brett Trani

Director of Analytics at Joybird



Step 1

The very first step in Joybird's transformation, though, was to get complete, trustworthy data into Snowflake.

Step 1: Collecting the data

Collecting every customer touchpoint in order to build a complete customer profile makes sense, but in addition to being complete, that data also needs to be trustworthy. The old adage "garbage in, garbage out" is painfully true for data teams.

Here are best practices on how to collect clean, usable data without the headache of low-level engineering work.

Buy, don't build

Data leaders today should prioritize buying pipelines for data collection instead of building them in-house. Building pipelines is time consuming and resource intensive. It also inevitably forces teams to focus on maintenance and scale, not data quality, which compromises the entire effort of building complete customer profiles.

Equally as important, though, is avoiding the hidden cost of building pipeline and collection features that vendors offer out of the box. A prime example is schemas. Schema management, especially when it comes to handling new or changing data, is complex. Tools like RudderStack automate schema creation and management. Automation guarantees graceful handling of updates because it syncs changes with the schema in the data warehouse using the same rules every time.

Pipeline playbook: Everything you need for modern data collection

Modern data teams have the benefit of modern tooling, especially when it comes to data pipelines. The needs of every business vary, especially by industry, but the following set of data sources is typical of an enterprise organization collecting customer data.

First-party user behavior data sources

- ▶ Website events: Events generated by users accessing your site on a web browser
- ▶ Mobile events: Events generated by users accessing your mobile application(s)
- ▶ Server-side events: Events generated by your server-side code that represent user actions (i.e., user invited)
- ▶ Events from business tools: Events generated by users as they interact with a business tool (i.e., email open and click events, SMS)

First-party batch data sources

- ▶ CRM & sales: The primary tool used by operational teams to access and act on customer records
- ▶ Marketing automation, email, & messaging: The tools used by marketing teams to build customer experiences and send messages
- ▶ Customer success & support: The tools used by customer-facing teams for communication, ticketing, and collaboration
- ▶ Payments and transactions: Events, entries, and subscription data from third-party and internal payments and financial systems
- ▶ Offline & point-of-sale data: Data generated by users when they interact with your business offline (i.e., in-store purchases or returns)
- ▶ ERP & inventory: SKU, stock and fulfillment and financial data



Seamless second and third party data integration in the modern data cloud

Data leaders running on the modern data cloud with tools like Snowflake can significantly decrease the amount of work it takes to acquire and integrate second- and third-party data. Snowflake's data marketplace makes it easy to access data from a variety of second- and third-party sources and pull it directly into your data cloud environment, giving you the ability to ship enriched data sets faster.

Second-party data sources

- ▶ Ad platforms: Any ad platform where users see or click on your ads (this data can be extremely helpful in building attribution models)
- ▶ Shipping data: Data related to the shipping and delivery of purchases made by your customers

Third-party data sources

- ▶ Browsing and interest data: Data from media and content networks on what kinds of content and topics your customers view
- ▶ Intent data: Aggregated behavioral, search, browsing, and purchase data that represent user intent to purchase
- ▶ Purchased demographic, firmographic and technographic data: User and company attributes purchased from a data vendor



Step 2

Step 2: Modeling the data into complete profiles

Migrating pipelines from in-house builds or legacy tech to modern vendors frees resources and enables you to focus on solving the critical next step of modeling your customer data and producing the coveted complete customer view.

Building complete profiles is complex, but the process requires four steps that build on each other sequentially. When implemented correctly, the completeness and accuracy of each step makes the next step significantly easier. But data teams often create unnecessary complexity by executing multiple steps at the same time, often due to time pressure from the business.

In this section, we will walk through the key components of complete customer profiles:

- ▶ Profile schema design
- ▶ Identity resolution
- ▶ User features
- ▶ Methodologies: config-based vs query-based methodologies

We'll also include a breakdown of methodologies that will help you minimize heavy modeling work and ship your identity resolution project faster.

Profile schema design

Before we break down the details, let's define what a complete customer profile actually looks like in your data warehouse. On a basic level, your customer 360 exists as a table with one row per user and a set of columns that represent everything you know about that user. Those columns are often called user traits or attributes and represent the schema of your customer profile table. There are four key types of traits in this schema:

- ▶ **Unique identifiers:** Unique identifiers are all of the unique IDs you have for your user from every data source. As we detail below, stitching all unique identifiers into an identity graph is a critical first step in building customer profiles.
- ▶ **Known user attributes:** Known user attributes are all of the additional, non-ID data points about a customer that live in

various tools and data sources. These are often demographic, behavioral, and stage/state related.

- ▶ **Computed traits (user features):** Computed traits are calculated by combining data sets that contain information related to the user. These are also called user features. User features are often related to key business metrics and are used to drive all kinds of insights, optimizations, and customer experiences.
- ▶ **Predictive traits:** Predictive traits, like customer lifetime value, are computed on top of the three types of traits above using predictive machine learning algorithms.

All of these features change over time, and sometimes in real-time, so the schema must be updated frequently to ensure all customer profiles are up to date with the latest data.



Identity resolution

Solving identity resolution requires stitching unique identifiers, establishing a canonical identifier, and ultimately building an identity graph that includes every unique identifier associated with a user.

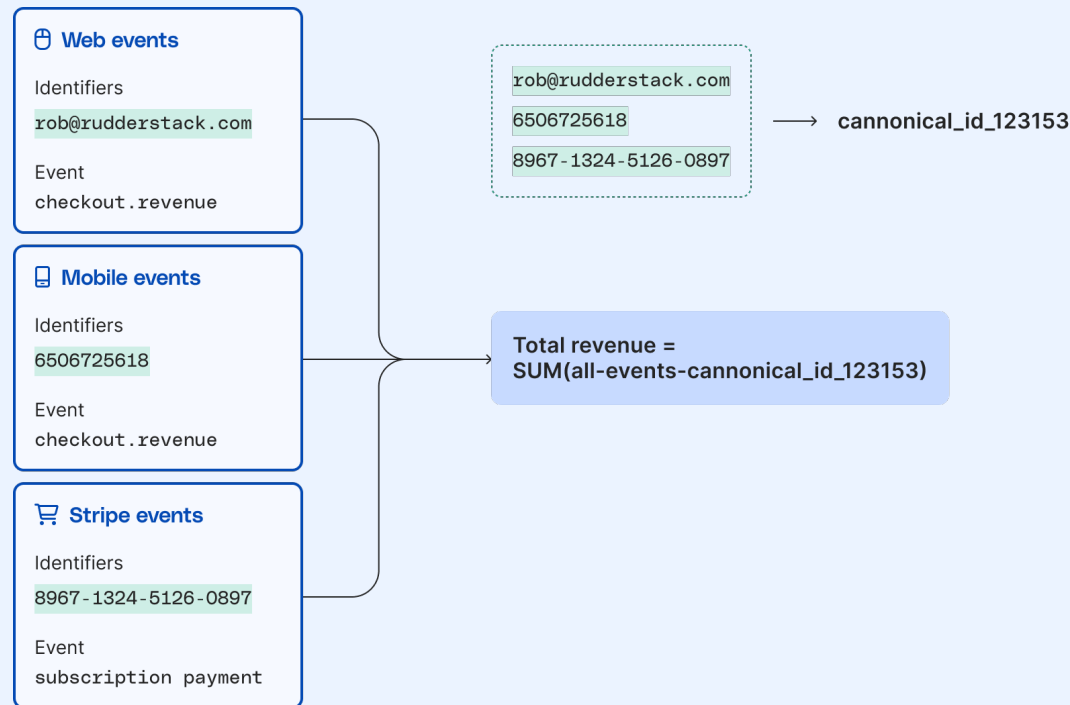
Identity stitching

The first step in building a complete customer profile is ensuring you have a comprehensive set of unique identifiers that represent the customer. This is called identity stitching.

Even simple user journeys can make identity stitching complex. For example, a user might make a purchase on your website with their email, `rob@rudderstack.com`, as their unique identifier. Later, the user downloads your mobile app and makes a purchase using a mobile number, `650-672-5618`. Finally, after trying the products, the user buys your subscription service. This transaction is tracked through a payments system with an opaque UUID, `8967-1324-5126-0897` (let's call it `payments_id`).

Without stitching each unique identifier to the user, systems and teams will wrongly assume that these three transactions are from three distinct users. Worse, you are unable to calculate — or inaccurately calculate — important computed traits like `user_total_revenue` because of the fragmented user identities.





Establishing a canonical identifier

In order to stitch this user's identity, you must map the three identifiers, email (`rob@rudderstack.com`), mobile (`650-672-5618`), and payments_id (`8967-1324-5126-0897`) into a single canonical identifier (let's call it `canonical_id`). This step is called identity mapping, and it's foundational to computing traits like `user_total_revenue`. In this case, you would sum all purchase events associated with the user's `canonical_id`.

The output of associating these IDs to a single canonical ID should be an identity graph. The work of building an identity graph is a complicated, time-consuming endeavor for data teams. It typically involves a sequence of complex joins in SQL that are often painful to troubleshoot and update as new data sources get introduced — but it doesn't have to be that way.

Identity resolution best practices

Start simple

Remember, the process of building an identity graph is just that — a process. Start with a set of stable identifiers that you have confidence in and that can provide value in a specific downstream use case like providing more visibility to your customer support team, then augment the graph over time.

Though the final result can be complex, building a deterministic identity graph simply requires you to repeat the process of establishing known edges between nodes (connections between unique identifiers) until you've covered all known identifiers.

Mind your query complexity

Inevitably, you will face the challenge of growing query complexity as queries increasingly represent the actual identity graph — especially when dealing with hundreds of identifiers across many data sources. In the methodologies section below, we outline a configuration-based approach (as opposed to a raw query-based approach) that can help you automate and scale your identity graph without enormous amounts of SQL.

Building user features

User features might be a term more common to data science, but features are a key part of any warehouse-based analytics project. Many analytics teams simply call them metrics because they are generally grouped with other KPIs that are used to run the business.

Features fall into the trait types covered above:

- ▶ Known user attributes
- ▶ Computed traits
- ▶ Predictive traits

The methodology of user feature development with SQL queries is a fairly standard practice for business intelligence. The most common approach is to define each feature (and other closely related features) as a model. Using this approach the same model generates features like `total_revenue_last_7_days` and `total_revenue_last_14_days`, while a separate model generates features focusing on recent activity.

Though the individual pieces of the process are straightforward, and data teams are well-versed in how to derive individual features, scaling the system in the context of complete customer profiles remains a significant challenge as complexity increases. To overcome these challenges, data leaders must both anticipate the issues that arise at scale and revisit their underlying methodology.



Data leaders cite “cost of time and modeling (and maintenance of models)” as the second most common roadblock to solving identity resolution.

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Feature development best practices

Don't build user features without an identity graph

You need to build your identity graph before you start building user features. Many data teams run into trouble because they attempt to build their identity graph while simultaneously building features. When a certain feature is needed, the team will solve for the nodes and edges related to that feature within the feature model itself.

Solving identity resolution as you go like this creates significant problems at scale. This is because the queries for individual features become increasingly complex as data changes and new data sources are added. Further, the nature of the features themselves obfuscates a complete view of the customer instead of providing more clarity.

A comprehensive, globally referenceable identity graph separates concerns, making it easier to maintain complete customer profiles and develop user features.

Beware of repetitive and complex identity mapping within features

Even with an identity graph, there are pitfalls of complexity and management to avoid. Ironically, these challenges relate to the identity graph, but the graph itself isn't the problem. The challenges arise from SQL and the underlying query-based “DIY” methodology for developing features (we'll outline a configuration-based approach that solves these issues in the next section).

Even for highly normalized tables, it's not uncommon to have three to four layers of joins for simple user features — and that's assuming you have an identity graph established. At scale, the result of a DIY, query-based approach results in hundreds of models and an excessive amount of SQL.

Beware of pushing SQL beyond its limits with funnels

Another problem data teams encounter when building user features has to do with using SQL to construct funnels. Funnels are common for user journey analysis and marketing retargeting.

A funnel captures whether a user has done (or not done) a certain sequence of events with some constraints. For example, `abandoned_cart` identifies if a user has visited the checkout page but hasn't purchased anything within a certain time window. This feature can be used to identify users who are good targets for ads or promotions recommending the same or related products. But funnel features are difficult to write in SQL, and the queries are notoriously brittle.

Managing complex SQL is only half of the equation... you are building a feature store

Developing features in SQL (or Python, for that matter) is the first part of the equation. Ultimately, a complete customer profile table is a user feature store. Within that feature store, traits and features change, meaning you need to manage additional metadata about those features to give teams context and understand how features change over time. Metadata should include:

- ▶ A user-friendly description of the trait
- ▶ The point in time at which the trait or feature was computed
- ▶ Definition signatures for validity
- ▶ Time-based validity to inform compute scheduling

Methodologies:

Query-based vs. configuration-based

Considering identity in the models that build up to features isn't rocket science, but maintaining the logic becomes repetitive and error-prone. Beyond the layered joins, you have to take into account edge cases like NULL and INVALID values and often apply transformations like lower-casing email addresses, removing special characters from phone numbers, and standardizing address formats. There is no easy way to abstract these requirements out of the model.

Building funnels involves the same challenge – it's possible, but doing surgery on a massive funnel query is laborious.

These challenges often push data leaders to realize they need to solve for complete customer profiles at the source, but migrating such a large and complex system takes years.

Thankfully, there are new methodologies for building and managing identity graphs and user features that overcome the pitfalls of the query-based DIY approach.



Benefits of the configuration-based approach

Modern data leaders are adopting a configuration-based methodology that abstracts away the complexity of intricate SQL. Tools that generate SQL based on maps and definitions make this possible.

Understanding the map of tables and relationships is one of the key drivers of unmanageable complexity. If you provide that index up front, however, modern tools can use the map to generate the required joins and queries to unify data.

The process becomes even easier when all of the schemas are known because it's possible to infer the map based on collected data. Tools like RudderStack's Profiles leverage this concept to automatically generate identity graphs and user features. RudderStack's pipelines leverage standardized schemas that include established user identifiers, so the baseline map of nodes and edges is already known, and all of the SQL can be inferred.

Augmenting the graph with new data sources and identifiers is as simple as adding input components and column names to the existing config file. Feature development works the same way.

This approach delivers many benefits:

Benefits to the business:

- ▶ Data leaders can reduce the cost of building and maintaining an identity graph with mountains of SQL.
- ▶ More importantly, they can drive revenue faster by building on an existing graph and feature set.

Benefits to the data team:

- ▶ Developing features in a config file is much easier, but the generated SQL is still auditable.
- ▶ The config-based approach enables teams to use one feature to define other features, which significantly speeds up development.
- ▶ A metadata registry can be generated based on the run-time metadata when the customer profile table is generated.

SQL isn't going anywhere, but with a configuration-based approach, data leaders no longer need to waste valuable engineering time on low-level work that doesn't move the needle.



Step 3

Step 3: Delivering business value with customer data

Once you've done the work of collecting data from every touchpoint and unifying it in your warehouse, it's time to make it useful. Your customer profiles are a significant competitive advantage, but how much impact they drive depends on how you use them. When every team has access to profiles in the tools they use every day, every team can move the needle.

Analytics

Analytics lay the foundation for powerful activations across the data stack, but quality analytics cannot be produced without good data. Richer, more accurate inputs lead to better analysis and more powerful activation.

With all of your company's data, including traffic data from your websites and apps, centralized and unified in a single location, you can build efficient analytics on large, diverse, high-quality datasets to answer questions that siloed analytics tools cannot answer on their own.



There's this huge movement going on, that's been enabled by cloud data warehouses, to invest in centralizing, validating, cleaning, and joining customer data. As an analysis tool, data is our input, our grist for the mill, so the better, richer, and more trusted the data we have for input, the more value we can create.

Neil Rahilly

VP of Product and Design at Mixpanel

With a complete customer view, not only can you create trustworthy business reporting to answer top-level questions relating to what happened, you can drill down into every next question to discover how and why things happened. Combine this richer understanding with ML capabilities, and you can move from descriptive analytics to predictive analytics, unlocking a new world of innovative capabilities.

Customer profiles enable you to build accurate and robust user journeys that paint the picture in full color, allowing you to answer complex questions like:

- ▶ What behavior in a user's first day indicates they're likely to sign up for a paid plan?
- ▶ How does lifetime value vary by paid advertising channel?
- ▶ What patterns lead to an increase in purchases of our products?
- ▶ What products should we recommend to specific users to increase revenue?
- ▶ How should we price our product based on the cost of acquisition or cost of resources per customer?



Business tools

Perhaps the most exciting thing about modern infrastructure is that it's never been easier to get data to frontline teams. With complete customer profiles in the warehouse and the power of Reverse ETL, you can easily share enriched, post-analysis data from the warehouse with every team and every tool. Not only does this give frontline teams a competitive edge, it's also a concrete way to position the data team as a partner within the company, not just a service organization.

Marketing

Marketing is perhaps the most data hungry business unit of all and for good reason. With incomplete or bad data, marketing budget gets wasted on inefficient campaigns at best and totally off target campaigns at worst.

But when marketing is armed with a complete customer view, they can truly understand and respond to the customer. They can optimize campaigns across every channel and enable previously out of reach use cases:

- ▶ Improved ad targeting
- ▶ Advanced personalization
- ▶ Better segmentation for more sophisticated nurturing
- ▶ More effective messaging

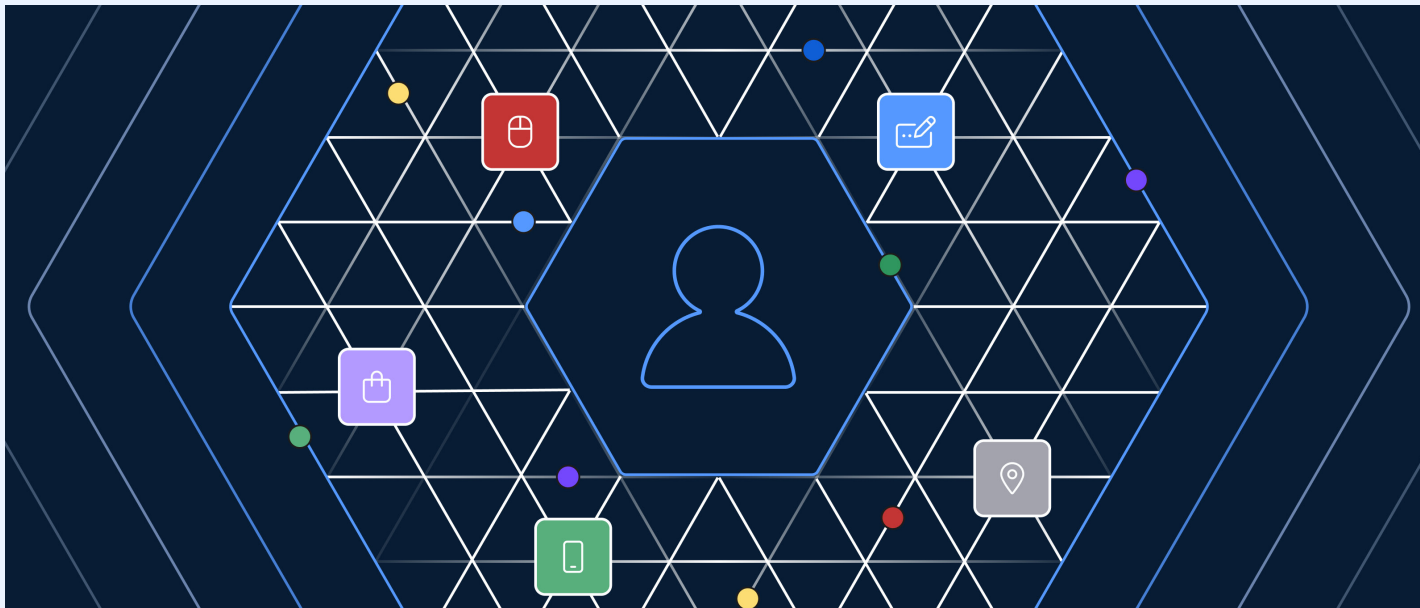
Sales

A sales team with access to rich customer profiles can close more deals faster. First, customer profiles enable detailed lead scoring to help sales understand which accounts are ready to buy. This allows them to prioritize efforts for maximum productivity. The granularity of the information available also allows them to go beyond the account level and gain insight into which individuals at those accounts they should target and when.

After identifying leads for outreach, customer profiles enable salespeople to communicate more effectively with every lead. With every bit of relevant customer information from the warehouse readily available in the CRM, sellers can have more productive conversations and close deals faster.

Detailed information from profiles also allows sales teams to identify opportunities for upselling and cross-selling that might otherwise be left on the table.





Customer success

Customer success teams can leverage the data from customer profiles to increase retention. Customers don't always share every issue with their vendors. Sometimes churn can seem to come out of nowhere because of hidden dissatisfaction. CS teams can combat this by identifying signals that might indicate churn risk, allowing them to proactively engage their accounts to address underlying issues. CS teams might also utilize data from customer profiles to identify accounts that are primed for expansion.

Machine learning

Data from complete customer profiles gives data science teams the ability to build new innovative capabilities. The sophisticated and creative nature of these applications means they have the power to drive transformative change and establish wide moats against the competition. Data from customer profiles can fuel machine learning models for:

- ▶ Recommendation engines
- ▶ Churn prediction algorithms
- ▶ Fraud detection
- ▶ Advanced lead scoring

The stack: How to build a customer data platform

Different customer data platform approaches

There are many approaches to delivering the promise of a complete customer view. But until now, every solution has come with significant drawbacks. The constraints of legacy SaaS CDPs led many companies to try to build out their own capabilities in-house, but most were slowed down by the engineering capital required to build and maintain these systems. More recently, the Composable CDP emerged as a sort of happy medium between these options, and while it's a step in the right direction, it doesn't address the full picture.

The Legacy SaaS CDP

The legacy CDP was born in response to the SaaS boom as a way to aggregate data from data silos into one place. But these systems were black boxes that ultimately created another data silo. Early products did succeed in building a more comprehensive customer view, but they still provided incomplete data and were largely useful only to marketing teams for specific use cases.

Today, the Customer Data Platform Institute defines a CDP as “packaged software that creates a persistent, unified customer database that is accessible to other systems.” Today's CDPs are more flexible than their predecessors. However, packaged SaaS CDPs are fundamentally limited by their architecture, and they are still made primarily for marketing users.

Because legacy CDPs are geared towards marketing, they don't expose customer data in a manner conducive to building applications for more sophisticated use cases like user journeys, attribution, ML models for churn prediction, and product recommendations.

The in-house build

With inflexible and limiting off-the-shelf solutions, a tempting option for companies with engineering resources is to build CDP capabilities in-house. This option may seem like a good one, but in reality, most companies get overwhelmed by the magnitude of the project and its ongoing maintenance. An MVP solution may be easy enough to hammer out, but these projects seldom scale, and if they do, they become a significant resource drain. As growth accelerates, data volume grows, integration requirements expand, privacy regulations become harder to meet, and error handling gets increasingly complex. Building an internal system at scale can take years, and the maintenance overhead is enormous. Because of this, building in-house is not a viable option for most companies.

The Composable CDP

The Composable CDP emerged in 2022 as an alternative to inflexible, packaged systems and cumbersome in-house builds. While not a foolproof solution, it does get one foundational element right – it places the data warehouse at the center of the customer data stack. But the premise of the composable CDP is essentially a wholesale unbundling, and it goes too far. The composable CDP separates and isolates each major component of a CDP:

- ▶ Streaming (and real-time transformations)
- ▶ ETL
- ▶ Warehouse transformations
- ▶ UI/Segmentation
- ▶ Activation/rETL
- ▶ Storage

This delivers on flexibility, but it does come with a few critical drawbacks. The fragmented nature of the system means you still have issues with incomplete and incompatible data. Plus, managing data quality across a significant number of separate vendors can become problematic. More importantly, the composable system requires the data warehouse as an intermediary, so it cannot support real-time use cases.

The Warehouse Native CDP

The Warehouse Native CDP is a packaged platform that runs directly on the data warehouse and helps data teams deliver value at every stage of the data activation lifecycle: collection, unification, and activation. Like the composable approach, The Warehouse Native CDP solves the data silo problem by building around the warehouse, but it deploys the integration, real-time transformation, and activation layers as a connected, governable, and observable end-to-end system.

Leveraging the data warehouse as the central, transparent source of complete customer profiles eliminates data silos and allows

marketing (and every other team) to use their tools of choice. More importantly, downstream teams can use these data activation tools to their full potential because they have access to complete, enriched customer profiles.

Because the Warehouse Native CDP is an end-to-end system, data leaders don't have to invest time and money building infrastructure or bridging the gaps created by siloed legacy CDPs. Moreover, they still have full control over both pipelines and the modeling of customer profiles in their own warehouse.

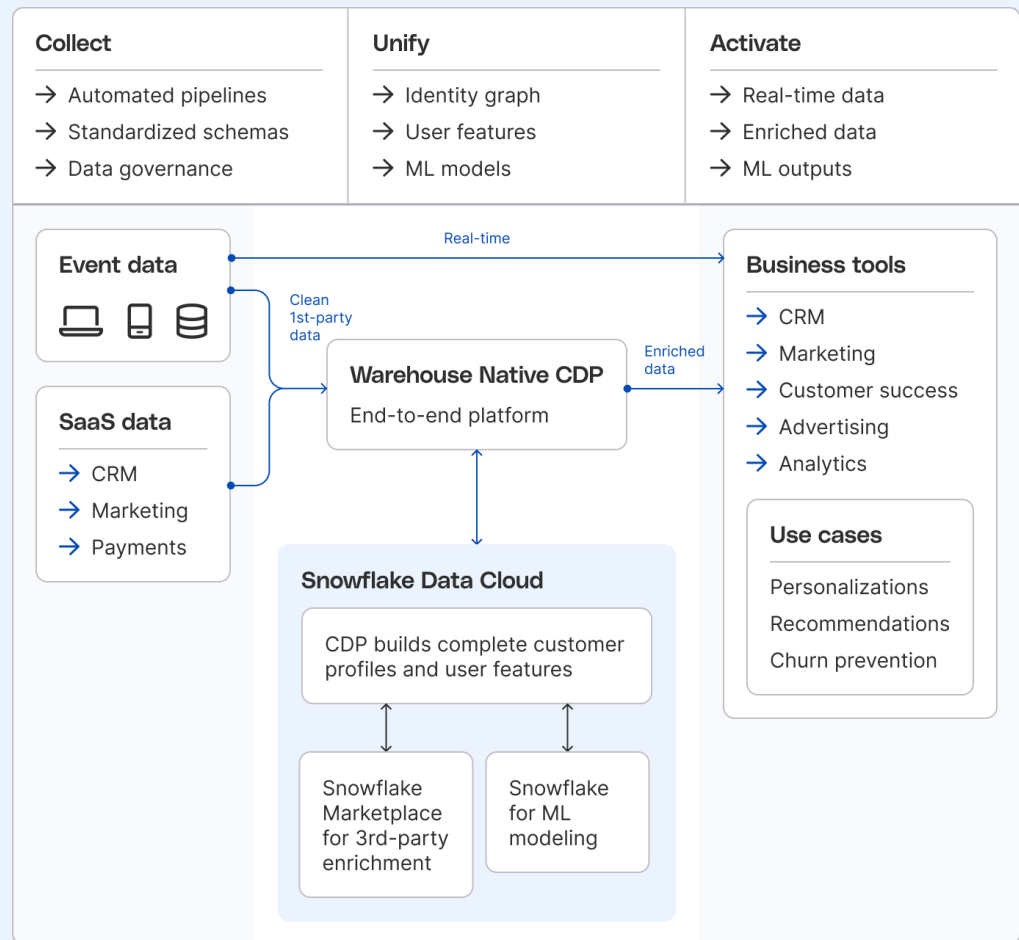
The Warehouse Native CDP provides flexibility without compromise and delivers:

- ▶ Seamless integration with every tool in the stack
- ▶ Support for real-time and batch
- ▶ Automated identity stitching and customer 360
- ▶ Single observability plane

Architecture guide: The Warehouse Native CDP

The Warehouse Native CDP provides data teams end-to-end tooling that helps them drive value at every point in the data activation lifecycle:

- Collection
- Unification
- Activation





Move seamlessly from identity resolution to machine learning on the data cloud

Building your CDP on the modern data cloud allows you to bridge the gap between traditional analytics workflows and data science workflows. A platform like Snowflake makes it easy to push the identity graph in your warehouse directly to machine learning infrastructure like Snowpark to significantly speed up the development of powerful use cases like lead scoring and churn prediction.

Collection

- ▶ Real-time event streaming pipelines
- ▶ Batch ETL pipelines
- ▶ Data governance

The Warehouse Native CDP delivers value beyond the simple utility of data pipelines. Transformation and data governance features allow you to ensure data quality at the source. It also ensures that data collection follows standardized schemas designed to populate the identity graph.

Unification

- ▶ Identity stitching
- ▶ User features
- ▶ Machine learning models

As an end-to-end solution, the Warehouse Native CDP can leverage the power of known schemas to automate complex modeling for building identity resolution and user features.

Activation

- ▶ Real-time integrations
- ▶ Reverse-ETL
- ▶ ML outputs

Not only does a warehouse native approach enable data leaders to create value from data faster in their data store, activation pipelines also make it easy to push that value to every team and tool across their organization to drive bottom-line impact.



Built to help you deliver on your data strategy

Modern data leaders are rapidly adopting warehouse native architecture because it leverages the best ideas from both legacy CDPs and in-house builds for identity resolution to deliver a combination of benefits that no other approach can.

Complete, trustworthy data

With automated pipelines and the warehouse as the central, transparent data store, data leaders can eliminate silos and the low-value engineering work of building custom infrastructure.

Flexibility and control

Solving identity resolution with dedicated tooling on the data warehouse makes it easy for data teams to update their identity graph and user features to keep pace with the changing needs of the business while maintaining full control and visibility.

Privacy and security

It has never been more critical to protect sensitive customer data, and your identity graph will be full of it. Building on the modern data cloud allows you to leverage your own data store and all of its world-class security features.

Machine learning ready

Having a ready-made identity graph and rich set of user features in your data warehouse is a force multiplier for AI and ML teams, especially when they can immediately operationalize those in ML tools that are directly integrated in the same data cloud environment.

Conclusion

Bringing it all together

In a challenging economic climate, understanding customer data is one of the most important initiatives for any business. Marketing attribution and product recommendations are key sources of insight that can help guide strategy for cost savings and growing existing customer relationships. Additionally, better churn prediction ensures that businesses have a clearer understanding of when customers may leave so they can devise strategies for retention. Accurate analysis and modeling of customer data gives businesses an edge over their competitors — particularly in a downturn.

Snowflake's Data Cloud and RudderStack's CDP are purpose-built to address the data infrastructure challenges that arise from attempting to build a full view of the customer. RudderStack enables companies to collect clean data they can trust, Snowflake Data Cloud offers the compute and storage infrastructure to unify this data around an identity graph, and the two tools work in concert to activate it with best-in-class third-party tools that drive exceptional customer experiences.

When data leaders enable their business teams to unlock these use cases built upon identity resolution, their companies are well on their way to delighting their customers and driving outstanding results.

