



Contactless Fare Payments Data: Lessons Learned

Summary

This document identifies lessons learned and best practices from implementation of contactless fare payments data dashboards by Caltrans' California Integrated Travel Project ([Cal-ITP](#)) for transit agencies in the state of California. Overall, the Cal-ITP data dashboards were found to:

- (1) save transit agencies time and resources,
- (2) allow flexibility to display and use data in different ways, and
- (3) allow agencies to do benchmarking across similar transit systems.

How data—and Cal-ITP—can help California transit providers

The objective of Caltrans' California Integrated Travel Project (Cal-ITP) is to make travel simpler and more cost-effective, starting with transit. In 2021, the program initiated four demonstration projects to implement contactless open-loop fare payments—allowing customers' debit/credit cards and mobile wallets to be tapped for fare payment—with Monterey-Salinas Transit, Santa Barbara County's Clean Air Express, the Santa Barbara Metropolitan Transit District, and Sacramento Regional Transit.

As part of these demonstrations—and for any transit provider that wants to add easy, app-free acceptance of debit/credit cards and mobile wallets to its fare collection options—Cal-ITP assists¹ transit agencies in aligning with the [California General Transit Feed Specification \(GTFS\) Guidelines](#). GTFS data can be used for an agency's reporting purposes and complements contactless fare collection data, plus GTFS can help customers see real-time vehicle location and fare information on journey-planning smartphone maps and apps, increasing the customer experience.

Through these projects, transit agencies and Cal-ITP identified metrics to assess the progress and success of the demonstrations via interactive dashboards and data visualizations that show accessible summary statistics. These dashboards and visualizations provide insights from the data that are valuable to transit agencies and to Cal-ITP for future implementations.

The successful implementation of four contactless open-loop fare payment demonstrations—as well as Cal-ITP's work with California's Department of General Services (DGS) to establish Master Service

¹ For free technical support, California agencies can reach out to hello@calitp.org



Agreements (MSAs) that enable transit agencies to mix and match their purchase of contactless payment acceptance hardware and software at state-negotiated rates—demonstrates a new role for Caltrans in fare payment technology. This is the first instance of a state-level organization establishing a clearinghouse that both enables and encourages the development of a statewide system through standardization and organization.

To assist transit agencies in accepting debit/credit card and mobile wallet payments like any other merchant, Cal-ITP launched the [California Mobility Marketplace](#), a website where agencies can browse and select a customized fare payment system that suits their individual needs, using the above-referenced DGS MSAs for purchasing. These contracts were awarded by DGS via a competitive selection process and therefore reduce an agency's administrative burden by eliminating the need for a separate RFP (request for proposals) process. Looking ahead, Cal-ITP expects that more agencies—in California and across the United States—will implement contactless payments by buying the needed technological building blocks via these DGS-managed MSAs.






To assist transit agencies in thinking through their data needs for contactless payments, this document identifies methods, limitations, lessons learned, and example results and visualizations from the four demonstration projects, information that will also inform Cal-ITP's expansion of these efforts with subsequent agencies.

Dashboard Metrics



As part of the process of setting up contactless payment demonstrations, Cal-ITP and partnering transit agencies identified measurable goals for each demonstration. Each goal contained questions that Cal-ITP and the agencies hoped to answer and the measurable metrics to assess progress. These questions ranged from agency-specific—such as revenue questions—to Cal-ITP's overall goal of increasing transit ridership. From the questions developed, Cal-ITP selected several metrics that aimed to answer the selected questions, both for each agency and the demonstration as a whole.

The metrics are categorized into: Rides, Revenue, and Riders.




Rides:

-  Number of Rides per Week, grouped by Fare Adjustment Type (including any age-based fare discounts and/or distance- and time-based fare caps)
-  Number of Adjusted-Price Rides per Week, grouped by Product Code (one-day fare cap, multi-day fare cap, etc.)
-  Number of Adjusted-Price Rides per week, grouped by Fare Payment Method Used (Card vs. Digital Wallet)
-  Number of Rides per Route, grouped by Ride Type (Tap On/Off vs. Single Tap)
-  Number of Adjusted-Price Rides per Route, grouped by Adjustment Type







-  Number of Rides per Route, grouped by Fare Payment Method Used (Card vs. Digital Wallet)
-  Median Ride Duration per Route (only for Tap On/Off rides)

Revenue:

-  Total Revenue per Day
-  Total Change in Revenue Due to Adjustments per Week
-  Total Revenue per Route

Riders:

-  Number of Riders per Month
-  Number of Riders receiving Fare Adjustments per Month, by Adjustment Type
-  Percent of Riders receiving Fare Adjustments per Month, grouped by Adjustment Type
-  Number of First-Time Customers

Dashboard Utilization

Using data obtained from Littlepay's Data Feed API, Cal-ITP created a data dashboard with Metabase, an open-source data tool, to allow Cal-ITP and each demonstration agency to view their contactless payment demonstration results over time. Metabase allows users to toggle the contents of each dashboard, filtering to the individual agency and adjusting the time period being reviewed.

In this interactive Metabase dashboard, agencies can analyze the data beyond the set metric, such as further filtering the data or adding additional metrics within each metric. If desired, agencies also have the option to download the raw data for applied uses in other data analytics platforms, such as ArcGIS or Tableau.

Most Used Metrics

Through conversations with demonstration agencies, Cal-ITP learned which dashboard metrics best meet agencies' needs, what agencies would like to see in the data, and how the data is being used.

Agencies interacting with these dashboards stated that the dashboard metrics are helpful, particularly when looking at the progression of their contactless payment demonstrations over time. While the favorite metrics vary from agency to agency, the following stood out:

Number of Rides per Route

Viewing the data by route provides agencies with more specific data that can help inform route planning. The Number of Riders per Route, **Figure 2**, is just one route-centered metric available—other metrics include Median Distance, Median Duration, Adjustment Types, Payment Types, and Revenue by Route. These route metrics, especially the Number of Riders per Route, can be used to determine

popular routes within the agency’s network, and where riders are spending the most time. Agencies noted that this metric can be useful for reporting numbers not captured by current boarding systems.

It is important to note that this metric is dependent on the type of data collected and the nature of the agency’s service. For instance, if an agency’s fare structure includes asking riders to both tap on and tap off, then more detailed stop-level data will be available, including ride distance and ride duration by route.

Likewise, having GTFS Realtime adds stop-level analysis that otherwise would not be displayed if an agency does not have GTFS data. (Vendors selected from the DGS-managed MSAs can help agencies use GTFS data for additional reporting purposes that integrate with payments data.) It was also noted that agencies’ GTFS feeds improved as a result of gathering payments data, in part due to increased visibility of any errors that may arise.

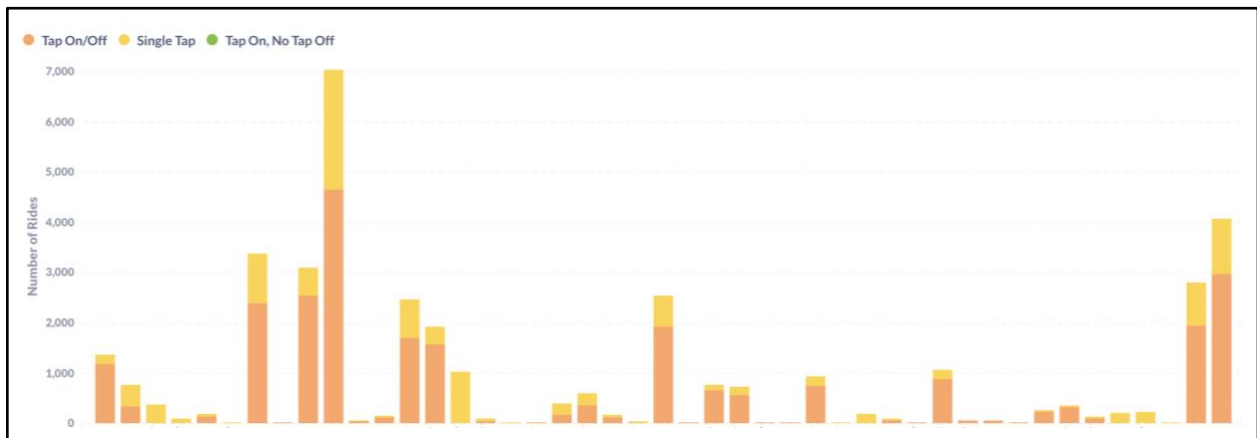


Figure 2: Number of Riders per Route

Number of Fare-Adjusted Rides

Looking into the number of rides, agencies can view how payment types vary over time, as seen in **Figure 3**. This data can also be displayed by route, to determine which routes have the most and least riders utilizing the available discounts; and by riders, to see the percent of riders receiving fare adjustments.

Figure 3 accounts for Discount Fares, Daily Caps, and Monthly Caps (see key for each category’s corresponding color). Each discount type has a week in which they were the most prevalent, with Discount Fares remaining the most consistent discount type from January 2022 on. This particular Discount Fare is applied based on the user’s age. The first week of January and March included the most fare capping, both for Daily and Monthly Caps.



Figure 3: Number of Riders that are Fare Capped by Adjustment Type

Number of Riders Receiving Fare Adjustments

Similarly to viewing fare adjustments by ride, agencies can see fare adjustments by riders, as seen in **Figure 4** below. Figure 4 shows the differences between the types of fare adjustments riders use by month. Using this metric, agencies can identify which Fare Adjustment Type is popular with their riders each month, week, or day, and how many riders are using each adjustment type.

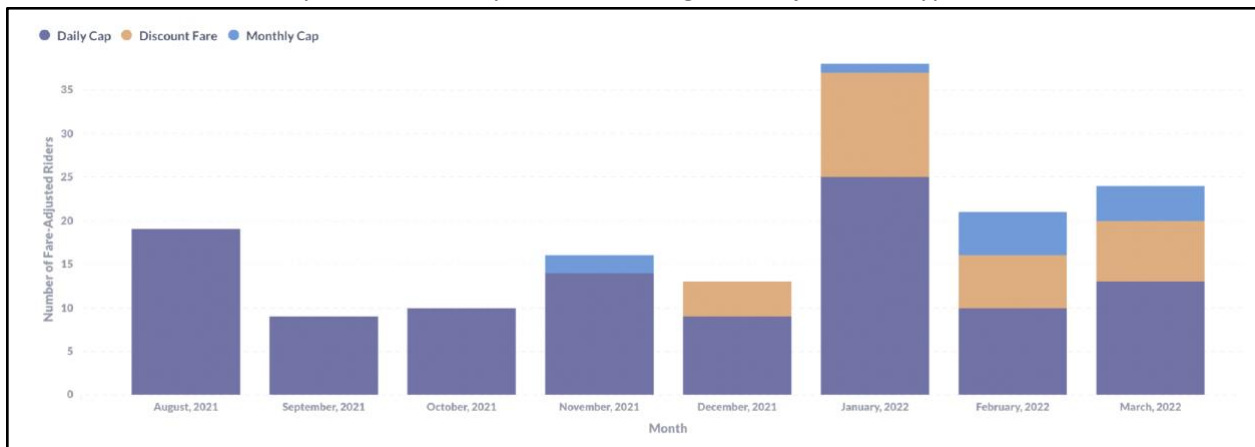


Figure 4: Number of Riders receiving fare adjustments per month by adjustment type

What Day Is Popular with Riders

Agencies were also curious to see if this data can show which day, or days, were the busiest for their system. Using the Number of Riders per Month metric, we can change the view to a daily cadence. Other views include by hour, month, and quarter. This information is helpful to agencies to potentially increase service if a particular trend emerges.

For example, **Figure 5** (directly below) shows the number of riders by day for all demonstrations over late 2021 Q4 and 2022 Q1. A decline in ridership over the holidays in 2021 is visible across the partaking



agencies, as is an increase as 2022 progresses. Weekdays are the busiest, with ridership slowing down on weekends.

By slightly altering the Number of Rides Per Day, agencies can aggregate the data to get the Number of Riders per Day of the Week, as seen in **Figure 6**. This allows agencies to discover which day is the busiest, which can also inform route planning.

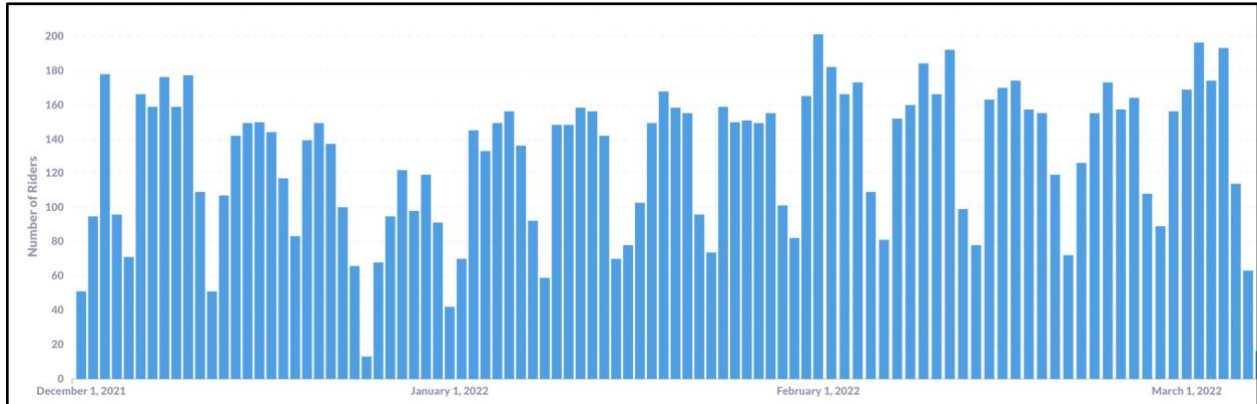
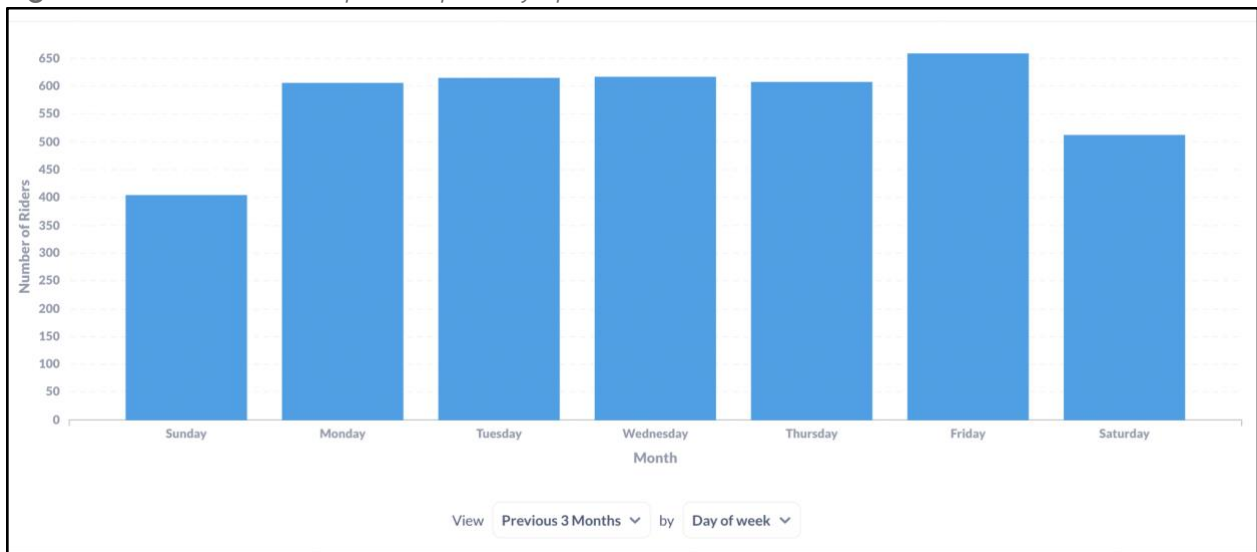


Figure 5 (above): Number of Riders by Day

Figure 6 (below): Number of Riders per Day of the Week



Revenues by Day

The dashboard also includes revenue metrics to see total contactless payment revenue, as well as total amounts that customers save when using Fare Adjustment Types (fare capping and other discounts). While customer savings can be interpreted as a loss of revenue, it can also be interpreted as the how much customers save by discount type, as seen in **Figure 7**. These revenue metrics can be of use to agencies for accounting and marketing purposes.

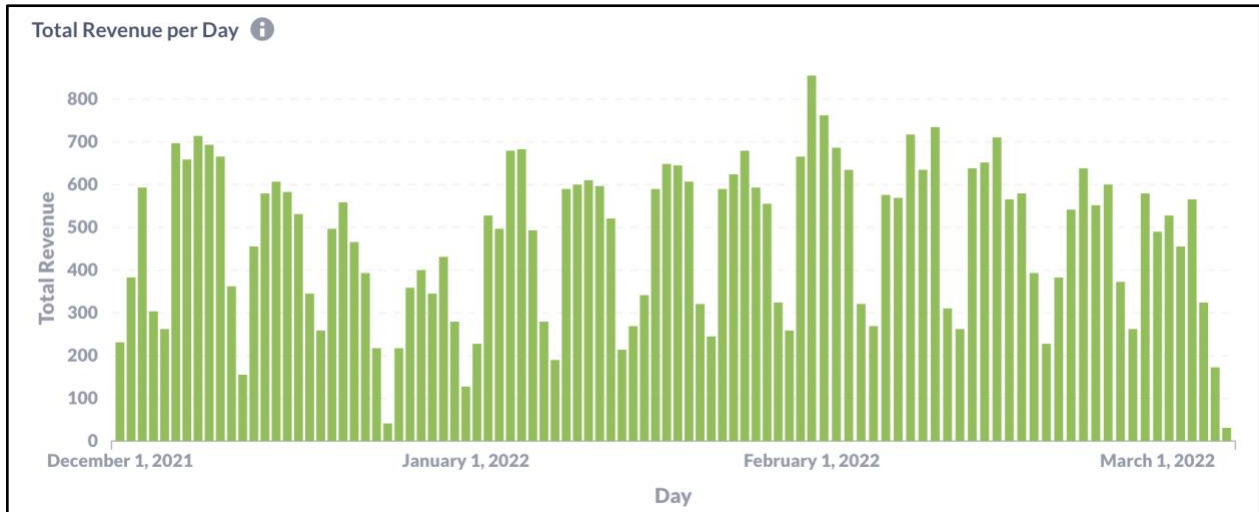


Figure 7 (above): Total Revenue per Day

Figure 8 (below): Total Revenue Saved by Riders per Week



Future Dashboard Metrics

In addition to the metrics included in the Metabase dashboard, agencies noted that being able to see all ridership data, not just contactless payments data, would be helpful in understanding what proportion of their total customers are tapping to pay their fare. At the moment, Cal-ITP only ingests data from the contactless vendors, not the agencies themselves, which limits comparisons with the other ridership data that agencies collect.

Another view that agencies are interested in is the split between contactless payment media types—particularly physical contactless bank cards vs. mobile wallets. The vendor data has the potential to display this difference. However, it is not currently applied consistently, so this level of information is not yet shown in the dashboard. This issue is being addressed and should be available in the near future.



Finally, agencies would like the ability to track the number of new customers using a contactless payment method over time. In addition to measuring the success of the demonstration, this metric provides insight into the attractiveness of contactless to riders and gauges riders' speed of transition from other methods of fare payment (such as exact change or closed-loop farecards). Having this information helps agencies to rate performance by week, month, or day, and to learn more about how customers are using their system. We are working to provide this metric as accurately as possible while recognizing that—without account-based ticketing—the system cannot reliably distinguish between a regular customer who switches to using a new method of contactless payment and a customer who is completely new to the transit service and chooses to use contactless on their first ride.

Limitations

Data Collection

The primary limitation is that currently Cal-ITP ingests only the data that demonstration vendors supply. The Cal-ITP dashboard does not include data from the agencies themselves, such as farebox or ridership data from automatic passenger counters. The dashboard only accounts for contactless open-loop transactions. Therefore, we cannot analyze broader patterns. While additional farebox and revenue data sources could be crosswalked, or connected, to create that broader picture, the structure of fares in use by agencies can vary significantly (e.g., fare capping being available with open-loop contactless transactions but monthly prepaid passes only accessible via closed-loop farecards)—so there will still be limitations in the analyses we are able to create.

In addition, the fare products and policies of an agency's transit system determine the type of data collected, which in turn impacts which data metrics are available to the agency. For example, if an agency has a tap on/tap off option, greater insights are available at the route level. Or, if an agency has GTFS Realtime data in addition to GTFS Schedule (aka Static) data, stop-level analyses are available.

Data Errors

Occasionally, errors may arise due to a lack of connectivity or how the data is collected, ingested, or produced. Other errors, more technical in nature, range from route IDs to digital wallet vs. card transactions, all of which can be tracked through the dashboard. For route ID errors, route numbers appear as "Route Z" or "Stop A" in the Metabase dashboard, illuminating the issue so that it may be fixed. The "Route Z" error, indicating an incorrect route name or ID, is a temporary label that gets resolved after the transaction is made. For tracking errors like these, Cal-ITP also has a Data Validation Dashboard, which also can also be viewed by respective agencies. Some errors arise due to inconsistencies in data management techniques across stakeholders.

Similarly, software issues make it difficult to distinguish between digital wallet and physical bank card payments data. However, the vendors are working toward identifying the difference between these



payment types, which is of special interest to agencies. Some agencies have worked to differentiate this on their own by bringing in external data sources, which cost agencies time and resources. Other internal dashboards within Metabase help to track these data issues, with documentation of said issues in GitHub.

Lessons Learned

Template dashboards save agencies time and resources.

While creating a data dashboard is certainly something that agencies can do with payments-related data, utilizing Cal-ITP's universal dashboard with standardized metrics already in place saves agencies time and resources. This is particularly important for smaller agencies that may have fewer resources than larger agencies. The dashboard's metrics aid agencies in creating benchmarks within and across systems, helping to create data-driven goals.

Flexible dashboard tools increase value to agencies.

Using Metabase allows Cal-ITP and agencies to analyze the data and find the best ways to communicate it. Metabase's features allow all parties to select and interact with the data to modify the timeframes, columns, and analytical methods to best suit their needs. Cal-ITP collaborated with agencies to determine which dashboard metrics are the most useful to agencies' needs, as well as which metrics to include in the future.

Agencies can use this data in a variety of ways.

Dashboards allow the data to be accessible to agency staff to not only determine the progress of the demonstrations, but to inform their boards of directors and transit planners as to how their transit system is performing—from ridership to revenue—to make more data-driven decisions. With this data visible and readily available, agencies can use the data findings more easily than having to create new analyses—and can hopefully use this data to glean additional agency insights beyond contactless payments. Alternatively, if an agency wishes to create new analyses using the payments data, Metabase has user-friendly tools that allow a user to quickly modify existing visualizations prepared by the Cal-ITP team or to create their own analysis from the data sources loaded in Metabase. If an agency prefers to use their own tools for analysis, the raw data is available for download.

Dashboard is currently best suited to measure the success of contactless payment adoption.

With the dashboard, we can conclude that contactless payments have steadily increased over the course of each demonstration. However, without additional rider and payments data at the agency level, we



cannot determine the overall performance of an agency. Rather, the metrics defined here can augment agency's data and provide analyses on the adoption of contactless payments.

Open-source dashboarding tools offer more access and viewing options.

An open-source dashboarding tool like Metabase allows administrators to add users without having to worry about additional costs per seat and to grant access quickly. This access option gives users the ability to not only view the dashboard but also use the tools provided and further filter or analyze the data within Metabase. Metabase also allows developers to include subscription links, access accounts as well as sharing links to dashboards, allowing greater access.

Conclusion

This document is a six-month snapshot of contactless payment demonstration projects with four transit agencies—all of which are now in the process of purchasing contactless open-loop hardware and software services via the California Department of General Services' Master Service Agreements, contracts that are available to all U.S. transit agencies via the [California Mobility Marketplace](#). While these four transit agencies are rolling off their Cal-ITP demonstrations and onto longer-term use of their MSA-purchased contactless fare payment systems, Cal-ITP's data dashboards remain active for these agencies and continue to provide them with instant measurable metrics and visualizations that otherwise would cost agency staff time to create.

Further, the demonstration projects have shown that payments data and GTFS data can be used to gain better insights into transit systems. By working toward the standardization of contactless payments in transit while benefiting transit agencies, Caltrans can help to create a more efficient transportation network.

Connect with Cal-ITP

Caltrans' Cal-ITP team can be reached at hello@calitp.org. Public transportation providers that would like to tap Cal-ITP's technical assistance—on data standards, accepting bank cards and digital wallets, cellular data plans, or anything else—can indicate interest via this [Cal-ITP Support Request Form](#) or by reaching out to hello@calitp.org.

Learn more about Cal-ITP at calitp.org and on [@California_ITP](#) on Twitter, or by subscribing to the [Caltrans Mobility Newsletter](#).



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