

INTRODUCTION PRESENTER



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Sathish heads the engineering at Zeotap. His responsibilities also include engineering strategy and technical architecture. He comes with 18+ years of experience and has been building big data stacks for various verticals for past 8 years.

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Chaitanya Bendre, Lead Data Engineer

Chaitanya is a Lead Data Engineer at Zeotap. He is a member of the data engineering team where he leads the Insights product suite and ML engineering. He is responsible for the architecture, design and delivery of the product and ML/Data science pipelines. He has spent the last 5 years in building big data systems.

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INTRODUCTION ZEOTAP

- Customer Intelligence Platform SAAS + DAAS offering
- Enables Brands to better understand their customers
 - 360 View
 - Identity resolution
 - Activation
- Data Assets People centric
 - Identity Data
 - Profile Data
 - Deterministic
 - Probabilistic
- Full Privacy/GDPR compliant
- 150+ partners Southbound and Northbound including Telcos
- Catering to Ad-Tech and MarTech



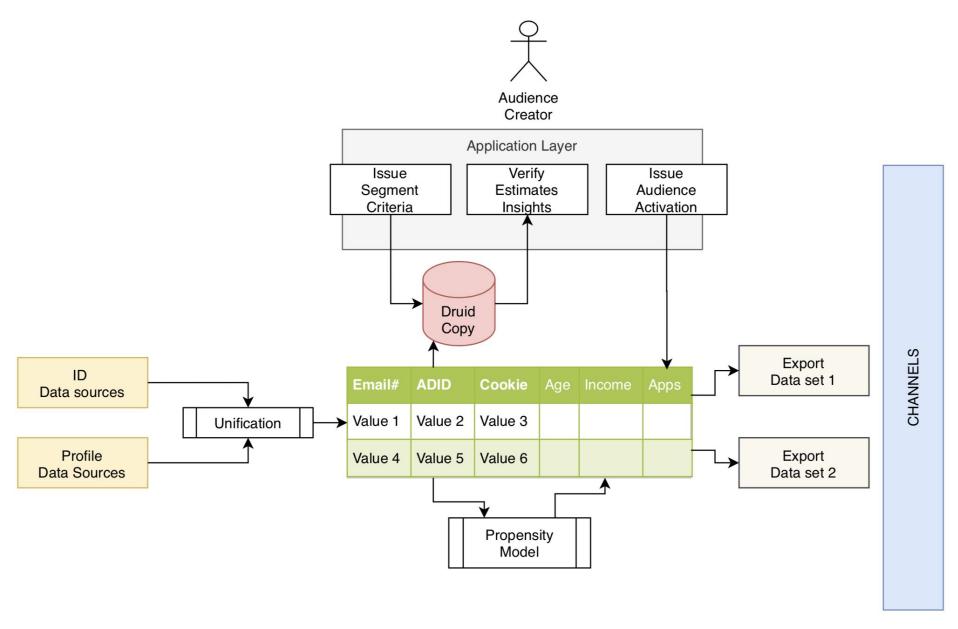
INTRODUCTION ADTECH & MARTECH BUSINESS CASE

- Understanding User scale for Reach purpose
- Qualitative understanding of Audience composition
- Data collected would be skewed bias of their data collection capabilities
- Near real-time corrected to their population for representative insights
- Marketing ROI



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AUDIENCE PLANNER





Use case 1 - Audience Insights





INSIGHTS

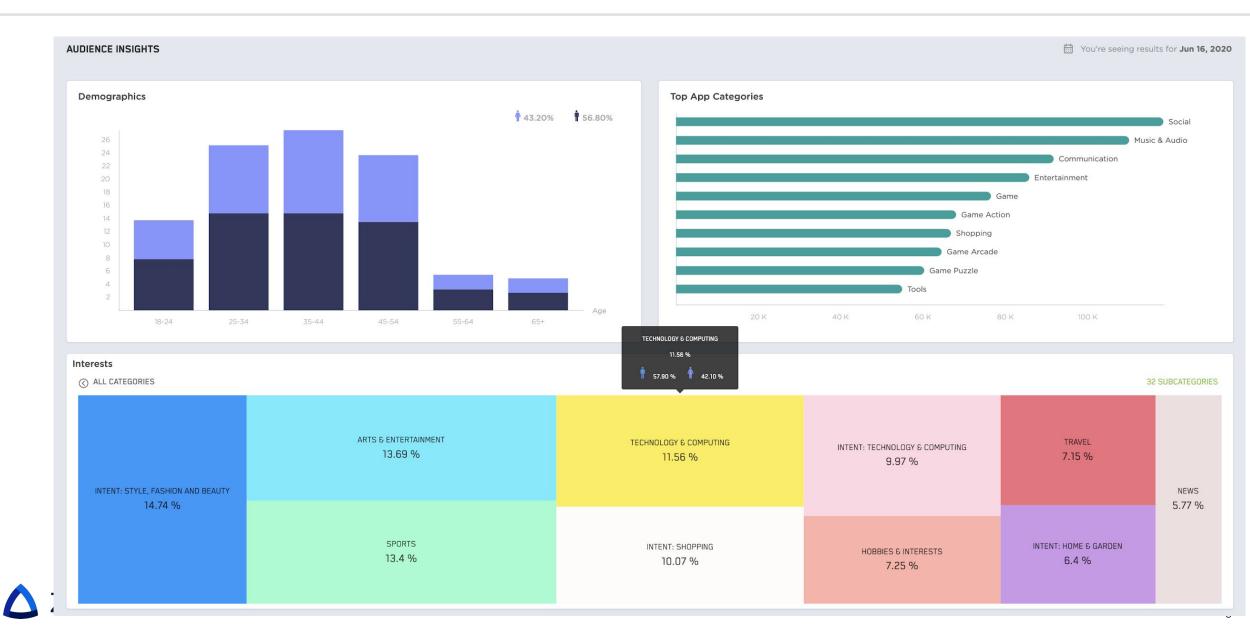
Use case

- Need insights on client's audience data
- Audience consists of user identifiers + profile at particular point in time
- Snapshot data (Non-temporal data)
 - Ingestion timestamp as a proxy for timestamp field
- Interactive OLAP analytics on audience data
 - Flat columns Ex gender, age
 - Nested columns Ex apps



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INSIGHTS Insights Interactive UI



DATA ACCESS PATTERNS

- Top N style queries
 - GroupBy + Limit
 - Multiple columns present in GroupBy clause
- Only query latest data
- Queries on nested columns like interests, apps
- Count(distinct) rollup required
 - Can use HyperLogLog or ThetaSketch in metricsSpec

```
"app_category": "Music",
"app_names": [
  "spotify",
  "prime music",
  "apple music"
"app_category": "Social",
"app_names": [
  "facebook",
  "twitter"
```



INSIGHTS DATA MODEL

- Option 1 Create new dataset for each audience
- Option 2 Assign unique time interval for each audience and ingest newer data with same time interval.
 - Druid will create new version of the segment with latest data if ingested with same time interval
 - Need 1:1 mapping between audience_id and segment time interval
- Option 3 Use ingestion timestamp as timestamp column and metadata to store version mapping
 - Ingestion timestamp considered as version
 - Use metadata to fetch latest version available and query



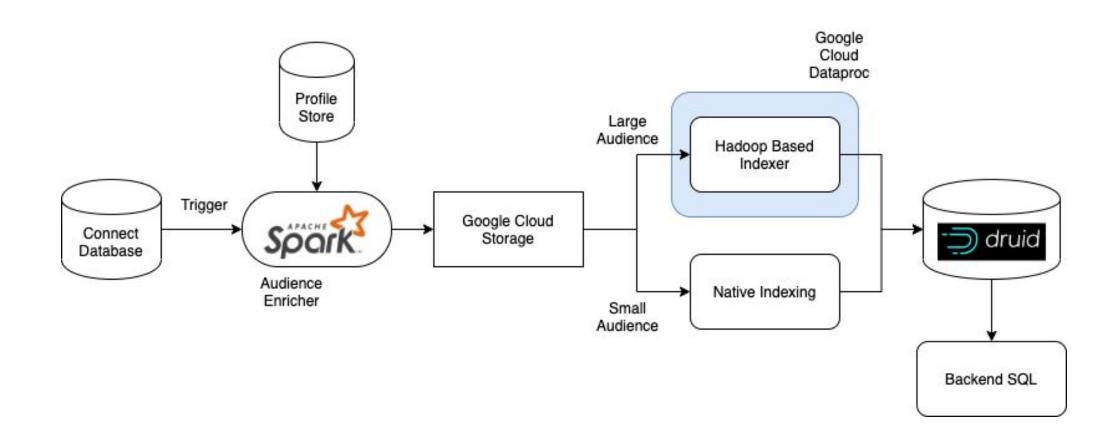
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DATA MODEL: Pros and Cons

Data Model choice	Pros	Cons
Option 1 - Create new dataset for each audience	 Each audience data can be maintained independently Easy to keep latest data for each audience Queries will be faster 	 Consumers of datas needs to know which dataset to query Very large number of small datasources.
Option 2 - Assign unique segment time interval for each audience	 Each audience has its own partition within a shared datasource Keeping latest data for each audience is easy 	 Have to map audience_id to unique time interval through application logic Difficult to ensure no collision
Option 3 - Use proxy timestamp version column and store latest version in metadata	 Single datasource partitioned by audience_id for better query performance Batch indexing of many audiences within a single job 	 Increased datasource size on disk Need to maintain latest version / timestamp for each audience externally



ARCHITECTURE





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Use case 2 - Audience Estimator





ESTIMATION USE-CASE & CHALLENGES

USE-CASE

- Dynamic Audience Segment Size Estimation
- Count of Audience
 - Profile Filter
 - ID Filter
 - ID groups
- Interactive in UI
- Update in sync with ID and Profile Store changes
- Agreed on approximate count

CHALLENGES

- Dimensions 600+
- Number of entities US ~ 8 Billion
- Dimension can have nesting
- Mixed cardinality Gender, Apps
- UI implies sub-second latency
- Store used for data extraction latency 10+s
- Precomputing would be super expensive
- Storing all data would require big Druid cluster



Sample data model

zuld Country Gender		Our day Are	A -4 -	Apps Usage			
		Age	#	Category	Bundle Id	Recency	
				1	Communication	com.whatsapp	10
z1	z1 GBR Female		20	2	Entertainment	com.play.games	15
				3	Communication	com.whatsapp	120
z2	ITA	Male	35	1	Productivity	com.calculator	179
-2	ECD.	Mala	22	1	Tools	com.kuaiya.play	20
z3	23 ESP Male		22	2	Productivity	com.flashlight	150
z4	GBR	Female	28	1	Game Adventure	com.classic.bounce	130
z5	FRA	Male	NULL				



ESTIMATOR SAMPLING

- Original data is sampled by multiple sampling strategies
 - Uniform sampling 1-5 percent sampled data
 - Stratified sampling sampling done based on weights and proportions of different attributes with each other

Metrics

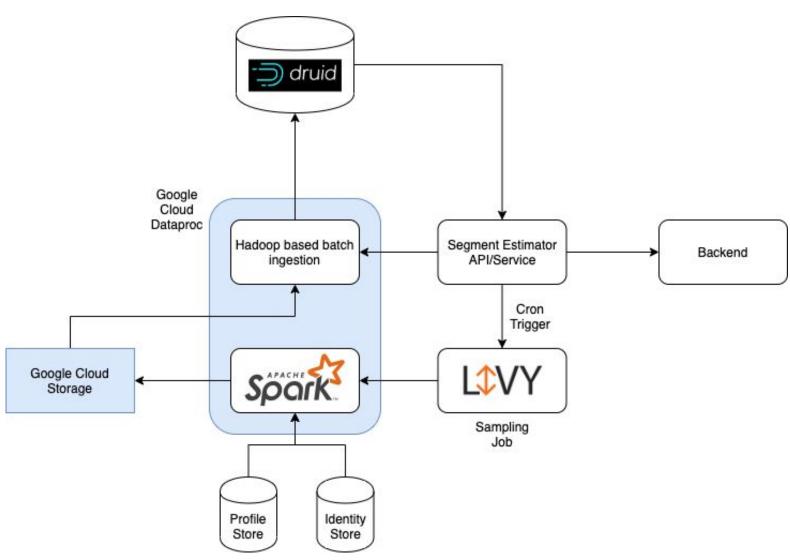
- HyperUnique (HyperLogLog) rollup
- Count of rows

Dimensions

- All profile attributes including nested data column like AppsUsage
- Nested columns are flattened with flattenSpec.



ARCHITECTURE & DATA FLOW





ORIGINAL DATA – MULTI VALUE DIMENSIONS

	Apps Usage				
zuld	# Category		Bundle Id	Recency	
z1 2		Social	com.facebook	10	
		Entertainment	com.play.games	15	
	3	Communication	com.whatsapp	120	

Constraints

- Array of struct => Association between category and bundleld
- Druid only supports "multi-value" *string* dimensions. For ex, ["Social", "Entertainment",
 "Communication"]



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DATA MODEL – CHALLENGES

- Only Array of strings support as complex type other than trivial type
- Queries on Nested data
- Samples
 - Distinct count of users that are using apps belonging to category Social OR Finance
 - Distinct count of users that are using apps belonging to category Social AND Finance
 - Distinct count of users that are using app with bundleld com.facebook that has category as Social



DATA MODEL – CHECK1

zuld	AppCategory	AppBundleId	
z1	Social	com.facebook	
z1	Finance	com.finance	
z1	Communication	com.whatsapp	

■ Count of users with category **Social OR Finance**

```
O AppCategory = 'Social' OR AppCategory = 'Finance'
```

■ Count of users with category **Social AND Finance** - Not possible



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DATA MODEL – CHECK2

zuld	AppCategoryList	AppBundleIdList	
z1	[Social, Finance, Communication]	[com.facebook, com.finance, com.whatsapp]	

- Count of users that are using apps belonging to category Social OR Finance
 - O AppCategoryList in ('Social', 'Finance')
- Count of users that are using apps belonging to category Social AND Finance
 - O AppCategoryList in ('Social') AND AppCategoryList in ('Finance')
- Count of users that are using app with bundleld com.facebook that has category as Social -Not possible



DATA MODEL – CHECK3 and FINAL

zuld	AppCategory	AppBundleId	AppCategoryList AppBundleldList	
z1	Social	com.facebook	[Social, Finance, Communication] [com.facebook, com.finance, com.whatsapp	
z1	Finance	com.play.games	[Social, Finance, Communication] [com.facebook, com.finance, com.wl	
z1	Communication	com.whatsapp	[Social, Finance, Communication]	[com.facebook, com.finance, com.whatsapp]

Count of users that are using apps belonging to category Social OR Finance

```
O AppCategory in ('Social', 'Finance')
```

Count of users that are using apps belonging to category Social AND Finance

```
O AppCategoryList in ('Social') AND AppCategoryList in ('Finance')
```

Count of users that are using app with bundleld com.facebook that has category as Social

```
O AppCategory = 'Social' and AppBundleId = 'com.facebook'
```

 Count of users that are using (an app with bundleld com.facebook that has category as Social) AND (an app with bundleld com.whatsapp that has category as Communication)

```
((AppCategory = 'Social' and AppBundleId = 'com.facebook') AND ( AppCategoryList in
('Social', 'Finance') AND AppBundleIdList in ('com.facebook', 'com.whatsapp')) OR
((AppCategory = 'Finance' and AppBundleId = 'com.whatsapp'') AND ( AppCategoryList in
('Social', 'Finance') AND AppBundleIdList in ('com.facebook', 'com.whatsapp'))
```



Use case 3 Audience skew correction





SKEW CORRECTION

CHALLENGES

- Data is highly skewed in demographic distribution
 - Gender skew
 - Age skew
- Need ratio correction wrt to census data
- Interactive queries with rollup of corrected ratio
- Augmenting original schema with corrected ratio



DATA AND QUERY PATTERNS

user_id	gender	customer_type	location_city	f/m ratio_city
1	M	Enterprise	BLR	0.8
2	М	Consumer	MUM	1.1
3	F	Consumer	BLR	0.8
4	М	Consumer	MUM	1.1

- F/M ratio is calculated for each location offline
- When querying, need to know rolled up f/m ratio for a given clause. For ex, f/m ratio for customer_type = Consumer
- Average is not available directly in metricSpec for preAggregation / rollup
- But we can store doubleSum(ratio_city) and HLL for count(distinct) as two separate metrics
- At runtime, we query sum(ratio city) / count(distinct users) for getting aggregated ratio



Production configs and scale

- At Zeotap, we use open source Druid. Currently version 0.18.0
- Deployed in GCP
 - Dataproc cluster for Hadoop batch indexing
 - GCS as deep storage
 - Cloud SQL for metadata
- Cluster size
 - o 3 regions. Per region -
 - 1 coordinator + overlord node
 - 6 historical + middleManager nodes (with 3 month retention period)
 - 2 broker nodes
- Monitoring via GraphiteEmitter + Custom Grafana dashboards. Have setup alerts on top of Grafana
- All queries through Druid SQL. In some places, use native queries for better performance



Challenges

- Monitoring not out of box for Druid open source. We setup monitoring by using GraphiteEmitter and Grafana dashboards
- Migration from AWS to GCP
- Not wise to launch all jobs as Hadoop Indexing on YARN cluster. Choice depends on size of input data
 - Smart indexing
- Data duplication for non-temporal data which does not have natural time dimension
- Long running queries. Some queries like GroupBy are long running and block entire resources for historical and broker.
 - Query laning released recently





Thank you!

Time for questions

@zeotap



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Dates: TBA

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