To address the challenges outlined in the AdvertiseX case study scenario, we can design a comprehensive data engineering solution. Let's break down the solution into different components based on the requirements provided:

1. **Data Ingestion –**
2. Implement a scalable data ingestion system capable of handling high volumes of data in real-time and batch modes.
3. Utilize Apache Kafka for real-time data streaming and Apache NiFi for batch data processing.
4. Configure Kafka Connect to ingest JSON data (ad impressions) from various online platforms and websites.
5. Use NiFi processors to ingest CSV data (clicks/conversions) and Avro data (bid requests).
6. Scale Kafka and NiFi horizontally to handle increased data loads.
7. **Data Processing –**
8. Develop data transformation processes using Apache Spark or Apache Flink to standardize and enrich the data.
9. Implement logic to correlate ad impressions with clicks and conversions, using unique identifiers such as user IDs or ad creative IDs.
10. Perform data validation, filtering, and deduplication to ensure data quality.
11. Use Apache Beam for unified batch and stream processing, enabling efficient data processing across different data formats.
12. **Data Storage and Query Performance –**
13. Select Apache Hadoop Distributed File System (HDFS) or Amazon S3 as the primary data storage solution for processed data.
14. Utilize Apache Hive or Amazon Redshift for data warehousing and fast querying of campaign performance data.
15. Optimize storage systems by partitioning data based on time or campaign IDs for efficient data retrieval.
16. Implement columnar storage formats like Apache Parquet to improve query performance for analytical queries and aggregations.
17. **Error Handling and Monitoring –**
18. Implement a robust error handling and monitoring system using tools like Apache Airflow or Apache Oozie.
19. Set up data quality checks and validations within the data pipeline to detect anomalies or discrepancies.
20. Utilize monitoring tools like Prometheus and Grafana for real-time monitoring of data pipeline health and performance.
21. Implement alerting mechanisms using tools like PagerDuty or Slack to notify stakeholders of data quality issues or delays in data processing.

By implementing the above data engineering solution, AdvertiseX can effectively handle data from multiple sources and formats, process it efficiently, store it securely, and monitor data quality in real-time to ensure the effectiveness of ad campaigns. Additionally, using open-source technologies provides flexibility and scalability to adapt to changing business requirements and increasing data volumes.