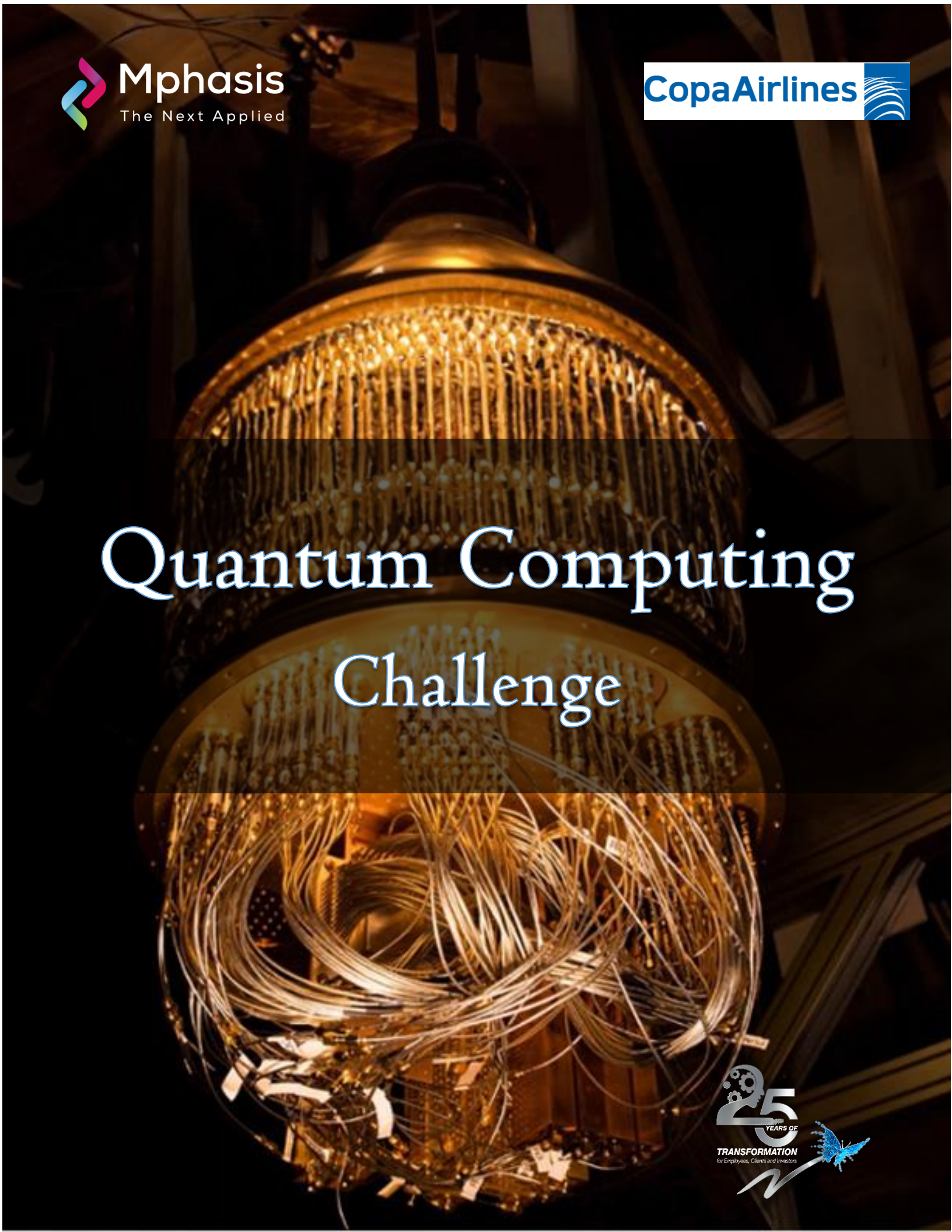
Mphasis
The Next Applied

CopaAirlines

Quantum Computing Challenge



25 YEARS OF
TRANSFORMATION
for Employees, Clients and Investors

Table of Contents

Passenger Re-accommodation for a Flight Schedule Change

1.0. Background / Context

Airlines, through their Network operations team (NOC), routinely change their flight schedules for reasons such as changes in demands due to seasonality, picking up new routes, changes in flight timings, flight cancellations, changes to flight numbers, operating frequency, etc.

Due to these schedule changes, impacted passengers need to be re-accommodated to available alternate flights. Airlines need a solution to analyze the impact on the passengers due to the schedule changes and automatically identify the suitable alternate flights for the impacted passengers. Due to the scale and complexity of the problem, mathematical optimization-based solutions are routinely used in the Airline Industry to solve the problem.

COPA, Panama's flagship airline, along with Mphasis, is hosting this challenge to build a Quantum computing driven solution to address the passenger re-accommodation problem. The challenge would require the participants to build a solution consisting of the following modules:

- Identification of impacted flight segments and passengers
- Passenger (CVM – Customer Value Management) score calculation (pre-calculated as part of the input data)
- Ranking of alternative flights
- Optimal assignment of impacted passengers to available alternative flights
- Benchmarking of results

The solution would identify optimal / best alternate flight solutions for all the impacted passengers based on the provided rule sets.

2.0. Requirements

Requirement 1

Identify impacted flight segments and passengers based on the proposed schedule changes for flight cancellations.

Requirement 2

Identify a set of suitable alternate flights based on the impact of proposed schedule changes at flight and passenger level.

- If any current active flights are marked as cancelled flights in the proposed schedule changes, it should not be considered an alternate flight solution.
- If there are any route changes considered for any of the active flights while considering the alternate flight solutions, then the proposed new route should be considered for that flight.
- While calculating the availability of alternate flights, only the available capacity should be considered for re-accommodation. The alternate flight solutions should be considered at PNR level and not at the individual passenger level.
- If the flight level solution is not possible for a specific PNR, journey level solutions should be provided.
- Journey based solutions should cover one-to-multi, multi-to-one, and multi-to-multi by covering the upline and downline connections from the PNR.

Requirement 3

Rank alternate flight solutions based on factors such as delay in reaching the destination, impact on the purchased ancillary services, number of stop overs among other factors (Please refer to the rule sets).

- If single PNR are mapped to multiple alternate flight solutions, the highest ranked alternative flight option based on inventory availability should be considered for re-accommodation.

Requirement 4

Optimal assignment of impacted passengers to alternate flights.

- If multiple PNRs have same alternate flight mapping, based on the "CVM" score the re-accommodation priority is defined. The higher CVM value passengers should be considered for re-accommodation before the lower CVM value passengers for the alternate flight.
- The passengers from a single PNR should not be divided and moved to different alternate flights. Once the specific seat is blocked for any alternate solution, the same seat should not be allocated for the next passenger, who needs re-accommodation.
- There should not be any overbooking on the alternate flights.
- The optimization solution should have minimum deviation from the previous itinerary.

Requirement 5

Solution customization

- Flexibility to alter the parameters in the business rules mentioned in rule sets excel shared as part of the documentation.
- Provide ability to the airline to change the business rules and run multiple simulated solutions for the same proposed schedule change plans.
- Capability to generate simulated network reports after applying the solution.
- Capability to show the list of passengers left without any alternate solutions, over bookings, broken journey, etc.

3.0. Rule Sets

- Please refer to the rules list - ***Quantum Solution - Passenger Re-accommodation-Rules Set - Level 2.xlsx***
- The file contains the rules that are required to be applied for ranking of alternate flights, journey identification and grade Change, etc.
- These rules should be configurable (flexible to enable/disable the rule, modify the score) via a Business rule profiling engine.

4.0. Data Catalog, Glossary, and Datasets

Refer to the attachments as below.

S.No.	Category	File Name
1.	Data Catalog and Glossary	***Glossary and Data_Catalog.xlsx***

2.	Datasets (Input Data)	***PRMI_DM_ALL_PNRs.csv*** ***PRMI-DM_TARGET_FLIGHTS.csv*** ***PRMI-DM-AVAILABLE_FLIGHTS.csv***

5.0. Optimization Algorithms under consideration

Given the current technical maturity of quantum computing-based optimization algorithms to solve problems at scale, participants are encouraged to use hybrid quantum classical systems. The class of solvers to be considered may include but are not limited to variational quantum algorithms (VQAs), hybrid quantum annealer based solvers, quantum inspired digital annealers etc.

6.0. Expected Outcome

Participants are required to submit the following artifacts as part of this challenge:

- Output solution file generated with the fields mentioned in the "sample output" excel shared as part of the file pack (***Sample Output Format.xlsx***).
- Whitepaper detailing the solution approach and benchmarking of quantum and classical solutions.
- Summary PPT of the solution
- Codebase
- UI for customization of business rules and demonstration of results*

* Note: *Good to have*

Following details and reference KPIs were provided by the customer for the solution obtained via classical optimization methods:

- Software: Gurobi
- Reference KPI:
  - Approx. Solution Run time: 10 mins.
  - % Re-accommodation: 60%

The quantum computing driven solution would be benchmarked against the reference KPIs. Participants are expected to provide further analysis beyond the reference KPIs provided here.

7.0. Evaluation Criteria

- Validity, flexibility, and innovativeness in application of business rules (20 Points)
- Solution file outcome and effectiveness (80 Points)
  - **Quality of the solution**: Percentage of impacted passengers ending with no alternate solution (20 Points)
  - **Run Time**: Overall run time of the solution (20 Points)

- **Solution Approach**: Quantum and classical optimization approaches (20 Points)
- **Quality of output artifacts** (15 Points)
- **Flexibility to accommodate customization options mentioned in Requirement 5** (5 Points)