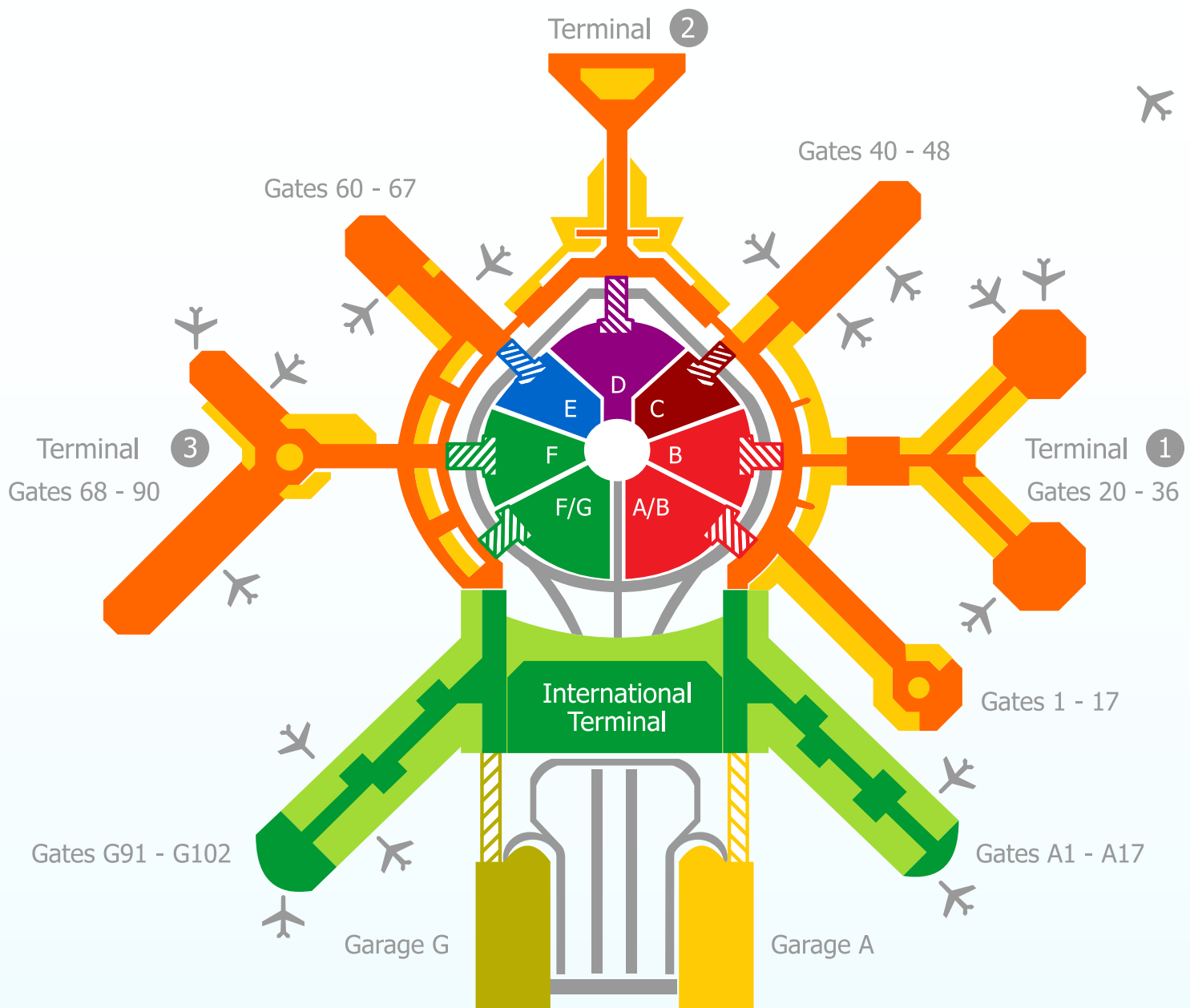


Plan Ahead

New Gate Planning Optimizer Perfects Gate Assignment Process

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A new gate planning optimization engine perfects the process of assigning flights to gates and saves airlines significant time and money. In addition, leading technology is on the horizon to integrate numerous hub-centered activities.



Airports around the world operate a full schedule with limited gate resources to maximize revenue. They have unique gate resource and traffic constraints that need to be considered during the planning process. Airlines also must take into account the cost of operating a gate and unique passenger service challenges during gate planning. This presents unique challenges to both airline and airport resource planners. Airports and airlines need a flexible solution to help them achieve optimum gate planning as well as maximize revenues.

Sabre® AirCentre™ Gate Planner provides automation and optimization to gate planners, enabling them to make fast, optimal planning decisions regarding the number and efficiency of flights that can operate from the airport. The system offers a new optimization tool that can:

- Gate the flight schedule into gates based on airport constraints,
- Provide multiple what-if scenarios,
- Deliver information to assist in marketing the airport for increased traffic and precise segments of the day.

Flight schedulers use *Gate Planner* to validate and verify that proposed schedules work at a given airport for the available gates and airport layout. Additionally, by validating the schedule during the planning stage, changes and improvements can be made prior to publishing production schedules.

Airport resource planning is typically constrained by various factors that are categorized into hard and soft constraints. The new *Gate Planner* optimizer, or optimization engine, helps airlines and airports optimize gate planning using hard and soft constraints based on multiple objectives for the best possible outcome.

Hard Constraints

Hard constraints cannot be violated in an airport. They are:

- GateMix constraint — This includes aircraft types that are valid for a specific gate based on the physical layout of the airport. The typical gate can accept wide-body, narrow-body or commuter aircraft.
- Adjacency constraint — This ensures the wings of the aircraft parked in adjacent gates do not come in contact with each other.
- Hard gate buffer — This is where a hard buffer must be maintained between a scheduled departure and the next arrival at a gate. The optimizer cannot violate the hard gate buffer during the gate-planning process.

Soft Constraints

Soft constraints can be violated while gating flights at the airport. However, the number of violations should be kept to a minimum. Soft constraints include:

- Market gate constraint — This constraint is used to assign flights departing or arriving from a particular station to a set of specific gates based on set business needs.

- Soft gate buffer — This applies to the buffer between a scheduled departure and scheduled arrival at a particular gate. The buffer between a scheduled departure and arrival would be maximized within the soft gate buffer.

Analysts using the gate planning solution can choose the type of constraint — hard or soft — and specify a penalty for their violations using a special dialog window. Relative sizes of those penalties guide the process toward the desired solution in case a conflict occurs and the system needs to determine which constraint to violate.

New Optimization Engine

The new optimization engine within *Gate Planner* uses a mixed integer program formulation, which:

- Substantially improves performance,
- Gives planners more control over the search direction,
- Simplifies future product development,
- Promotes airport resource-management integration.

The main objective of the gate assignment remains the same: assign as many flights to gates as possible. However, instead of a heuristic approach, *Gate Planner* uses an exact algorithm that guarantees the best possible solution. The new optimization engine also introduces a concept of soft constraints that allow an analyst to specify desired characteristics of the solution and a concept of secondary objectives that are useful in specific situations.

In practice, flights are assigned to gates in a way that numerous requirements and restrictions are satisfied.

With soft constraints, analysts can assign gates to flights in a single run. This significantly saves time during the planning process and avoids multiple cycles to determine final gate assignments.

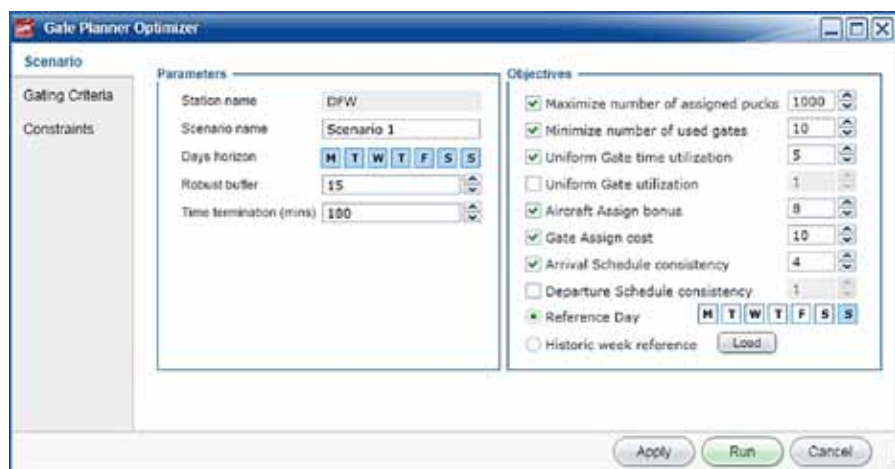
In addition to minimizing violations of business requirements formulated as soft constraints, the new optimization engine also allows planners to specify additional objectives that might help steer the solution process toward a gate assignment with desired characteristics. These include:

- Schedule consistency,
- Uniform gate utilization,
- Aircraft assignment bonus,
- Gate assignment cost.

Schedule Consistency

A repeatable schedule is critical for several reasons:

- Day-to-day consistency of a weekly schedule improves customer experience and, therefore, might increase airline market share. Frequent business travelers greatly benefit from a “memory schedule.” Flights arriving and departing at the same gate contributes to this convenience. In addition, crewmembers and ground staff have stable, predictable working conditions. It is also much more convenient for schedule planners to manage schedules for different days of the week that are similar to each other.
- Solution consistency is important when schedule changes happen. Minor schedule changes are quite frequent in the planning process and might be caused by demand fluctuation, crew restrictions, maintenance requirements, etc. Once a gate assignment for a future date is completed and transferred to other planning departments, it is not practical to run a new optimization and completely change it to accommodate the schedule update.
- On the day of operations, schedule changes caused by disruptions might affect gate assignments. In this case, the assignment should be adjusted with as many flights staying at the



Optimizer Objectives The Gate Plan Optimizer run dialog allows planners to select appropriate parameters and optimizer objectives. Using the dialog, planners can select weights for specific objectives to be used in the optimizer run.

original gates as possible so other airport processes are not disrupted.

To introduce schedule consistency into the optimization process, planners can specify a base schedule with flights that have already been gated. For example, an analyst who is working on a Tuesday schedule might use Monday's schedule as a base. Or, a previous schedule for the same day could be used if Monday's schedule had been changed and flights need to be re-gated.

When determining an optimal gate assignment, the system adds an incentive, or bonus, for every flight that is assigned to the same gate in the new schedule as it appears in the base schedule.

The assignments made to other gates would have an associated penalty or negative impact, which would be considered during the overall optimization of the solution.

Uniform Gate Utilization

A basic gate planning algorithm, which maximizes the number of assigned flights, produces a highly unbalanced schedule. Some gates have several flights assigned to them while other gates are mostly open. This produces a schedule that is very sensitive to even minor disruptions. It also makes it difficult to create a reasonable plan for ground crews.

Using the new optimization engine, analysts can choose an additional objective of balancing the workload among all available gates. This type of gate utilization is defined as the number of flights assigned to a particular gate or the total time that gate is occupied. The number of

assigned flights would still be maximized, but now the system would try to spread them among all available gates.

Aircraft Assignment Bonus

The *Gate Planner* optimization engine improves the assignment of constrained aircraft types, such as wide-body aircraft, early in the gating process. It gives a higher priority to flights that have higher aircraft assignment bonuses. This enables planners to give high priority to the handling of highly constrained aircraft types at an airport.

Gate Assignment Cost

Airlines sometimes lease gates from airports or other airlines at a premium cost. They prefer to minimize the usage of those expensive gates during the planning process. *Gate Planner* allows planners to assign costs for every gate. The optimization engine gates the flights to low-cost gates to avoid using more-expensive leased gates, when possible.

New Optimization Engine Benefits

The new optimization engine offers many benefits to airlines, including:

- The right mix of hard/soft constraints and objectives would produce a fully gated solution in a single optimizer run. This significantly reduces the planning duration by 90 percent.
- The introduction of soft constraints would allow analysts to produce a gated solution that would abide by business constraints as defined by the planner. This would improve internal business processes such as:

- Gate buffers,
- Market gates,
- Simultaneous operations,
- Market buffers.
- Gating costs would be minimized because the optimizer honors gate assignment costs as defined by the planner.
- Schedule gating consistency would greatly enhance customer satisfaction by operating flights from a specific gate across multiple schedules.
- Aircraft assignment bonuses allow highly constrained aircraft types to be gated first during the optimizer run. This reduces the chances of flights with highly constrained aircraft types to remain unassigned at the end of the planning process.
- Simultaneous operation constraint allows planners to handle traffic in a congested alleyway associated with aircraft lead-in and push-back.

Future Growth

The new optimization engine is flexible and well suited for introducing new gating requirements and objectives that might be proposed in the future or required for a particular airline. Similar to the secondary objectives, it is possible to minimize total passenger walking distance within an airport to:

- Improve the connection quality for passengers,
- Slightly retime arriving and departing flights to achieve a better assignment,
- Produce a back-up assignment plan that would increase schedule robustness.

In addition, *Sabre Airline Solutions®* is currently working on a hub management concept that would integrate gate and staff planning, aircraft turn-around process control, passenger and cargo connections management, and other hub-centered activities.

The new gate-assignment approach is the first step toward developing a unified optimization for all hub operations that would improve consistency of the decision-making process and boost efficiency of planning and operational procedures. **F**

Description	Show	Alert Priority	Penalty Type	Penalty
Assigned to a Closed Gate	Alert	1	Hard	1
Equipment Type Invalid for Gate	Alert	1	On	1
Adjacent Parking conflict	Alert	1	On	1
Gate Buffer violation	Alert	1	Hard	50
International Arrival Not Assigned to Customs Gate	Alert	1	Hard	1
International Departure Not Assigned to Customs Gate	Alert	1	Hard	1
Domestic Arrival Not Assigned to Domestic Gate	Alert	1	Hard	1
Domestic Departure Not Assigned to Domestic Gate	Alert	1	Hard	1
Transborder Arrival Not Assigned to Transborder Gate	Alert	1	Hard	1
Transborder Departure Not Assigned to Transborder Gate	Alert	1	Hard	1
Schengen Arrival Not Assigned to Schengen Gate	Alert	1	Hard	1
Schengen Departure Not Assigned to Schengen Gate	Alert	1	Hard	1
Simultaneous Operations	Alert	1	Hard	50
Invalid Airline for Assigned Gate	Alert	1	On	1
Invalid Gate for Market	Alert	1	Hard	50
Insufficient Market Buffer	Alert	1	Hard	50
Wrong Arrival Zone Violation	Alert	1	Hard	50
Wrong Departure Zone Violation	Alert	1	Hard	50
Enforce Single Originator and Single Terminator on Each Gate	None	1	Hard	1
Match Equipment for Last Terminator and First Originator on Each Gate	None	1	Hard	1

Hard And Soft Constraints Gate Planner Constraints dialog allows gate planners to specify various hard and soft constraints along with the penalty used by the optimizer in gating flights.

Sabre AirCentre Gate Planner



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