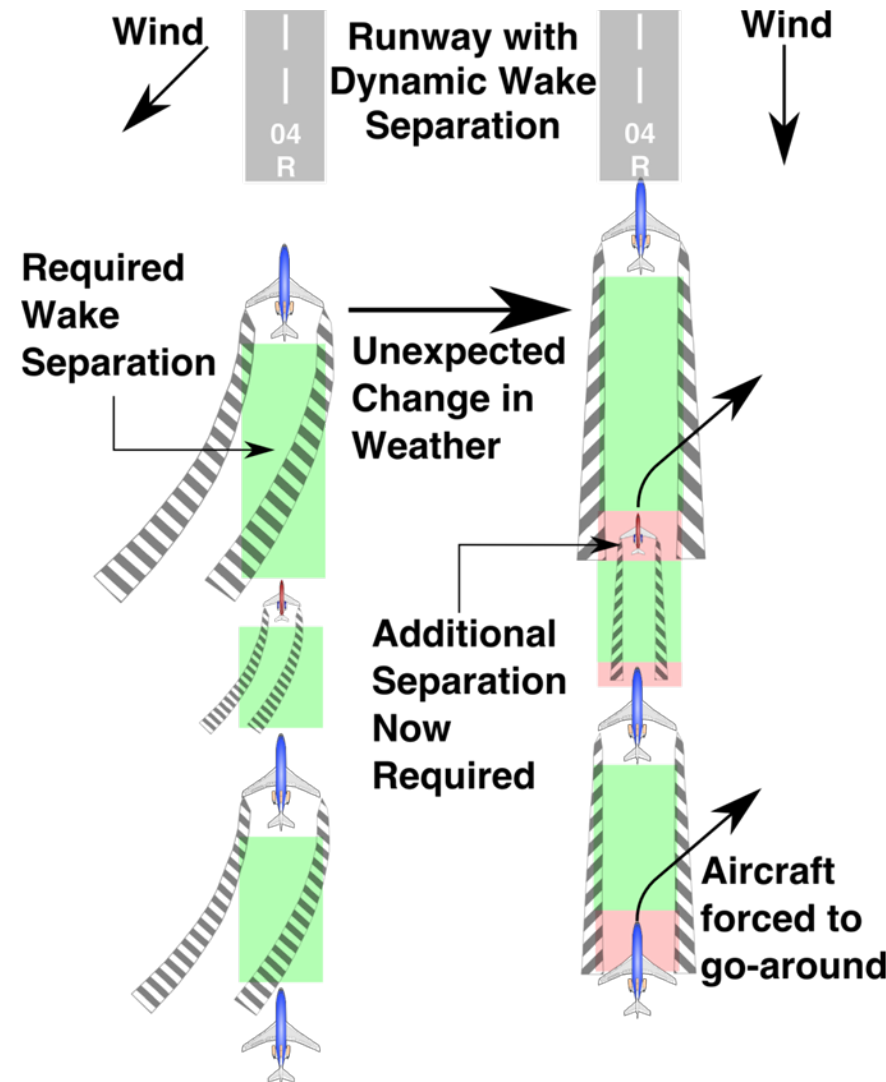


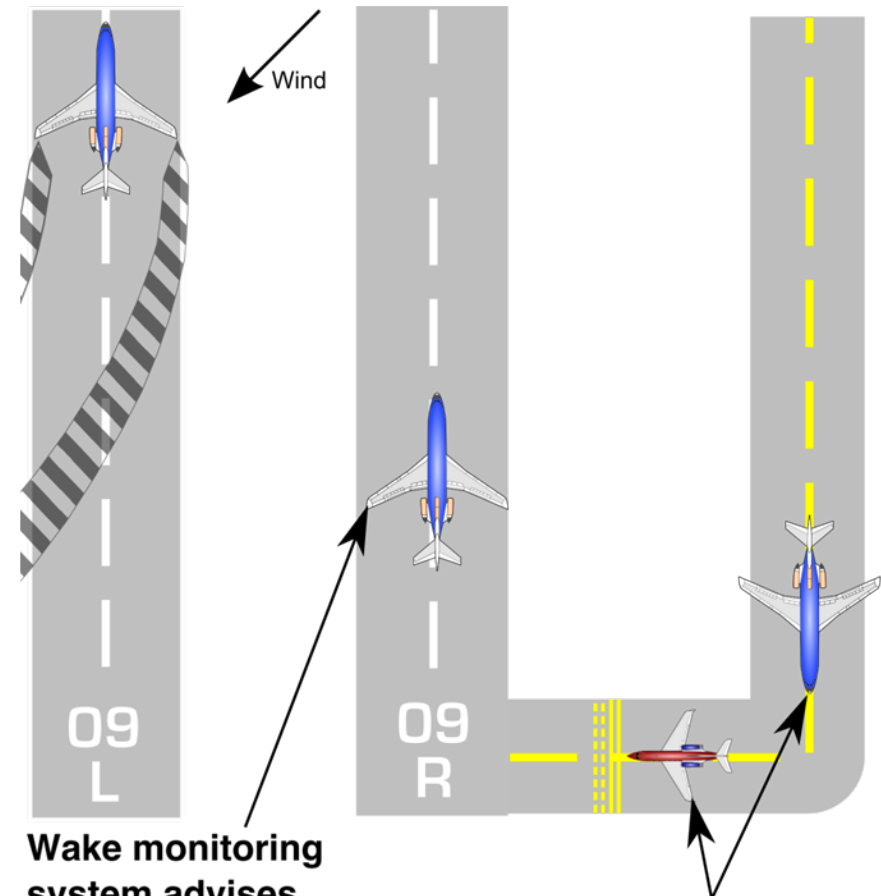
# Dynamic Arrival Sequencing

- “Real-time adaptation of applied separation for vortex mitigation”
- Disruption to the arrival stream is costly to runway throughput
- A dynamic separation system will have to balance the cost of unexpected separation changes with the cost of buffering for that uncertainty
- The separation requirements will have to be reliably forecast on the timescale of the approach (at least 15-20mins)



# Dynamic Departure Sequencing

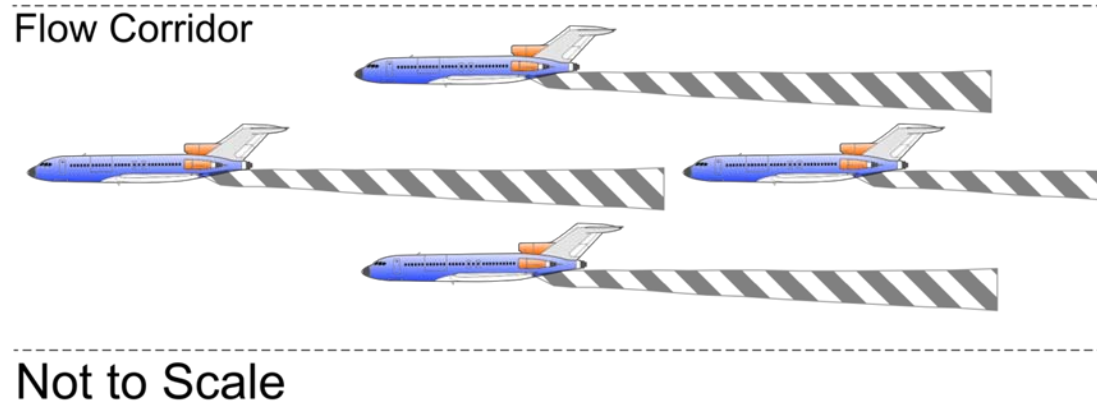
- Dynamic departure separation will be easier to implement than dynamic approach separation
  - Aircraft waiting to take-off can tolerate small uncertainty in departure time
- For departures-only single or parallel runways dynamic separation maximizes runway capacity with little risk
- Mixed-use runways will encounter the same issues as dynamic spacing for arrivals



**Wake monitoring system advises controllers that runway is safe for departure**

**Uncertainty in the wake dependant departure rate is buffered with a short taxi queue**

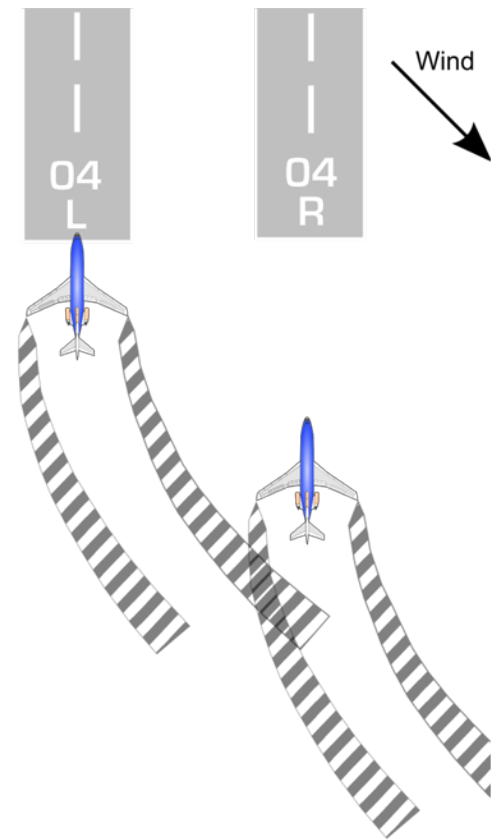
# Flow Corridors



- NextGen is seeking to create flow corridors, comprising “bundles” of parallel high altitude en route trajectories
- Wake vortex separation constraints may be the limiting factor in sizing these corridors
- Understanding the behavior of wakes generated by high-speed, high-altitude aircraft in clean configurations will be important in safely designing these procedures

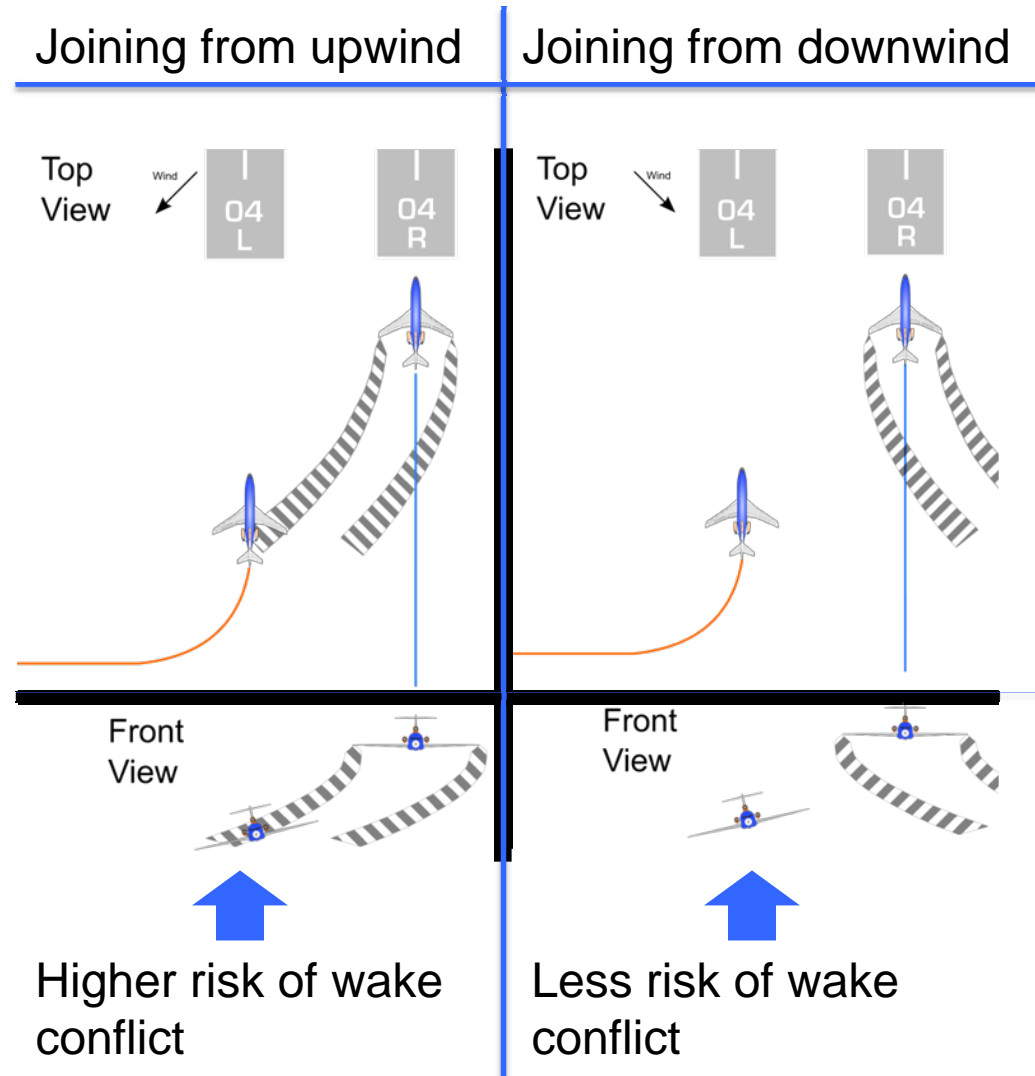
# Closely Spaced Parallel Approaches

- A well known but acute problem
- Closely spaced parallel approach improvements under NextGen:
  - Achieve VMC capacity to CSPA under IMC
  - Increase capacity beyond current VMC capacity
  - Reduce separation requirements between CSPA
- At close runway separations dependent approaches seem inevitable
- CSPA force aircraft into tight proximity procedures
- Procedures must protect from wake encounters during routine approaches, and also ensure risk of an encounter is mitigated during blunders and missed approaches



# Setting-up CSPAs

- Positioning aircraft onto CSPA may present unique wake issues
- Currently an altitude differential is used to protect against overshoots, this differential may be reduced for closely spaced dependant approaches in NextGen
- This reduced vertical separation may increase the wake hazard
- Practical considerations often limit the flexibility that would be needed to use crosswinds to mitigate this risk



# Increased Exposure of Small Aircraft

- NextGen will accommodate a wider range of aircraft sizes than currently operate in controlled airspace, from tiny VLJs to the large A380.**
- Small aircraft (e.g. UASs and VLJs) will be particularly vulnerable to wake vortex encounters given their generally lower weight and, for UASs, potentially reduced situational awareness
  - NextGen also seeks to increase accessibility of terminal and high altitude airspace to smaller aircraft types potentially exposing these types to a higher risk of wake encounters

# Procedures with the Highest Potential for Wake Issues

# Terminal Area Tight Proximity Operations

- The list of wake issues was filtered to identify procedures with the highest potential for wake concerns
- Terminal area tight proximity operations contain most of the wake issues
- Four generic tight proximity operations were identified for further analysis:
  1. Closely spaced parallel approaches (CSPA)
  2. Close proximity arrival procedures
  3. Crossing arrival and departure streams
  4. Close proximity departure procedures
- Investigating these wake issues will inform other less critical wake situations

