Thailand Capacity Assessment: History

Airport Capacity
- IATA Airport Slot Coordination Process
- Collaboration with AOT

Airspace Capacity
- LFV Aviation Consulting Capacity Study
- EU-ASEAN Air Transport Integration Project (AATIP) ATM Modelling and Simulation Workshop
- Thailand Capacity Review Plan
- Thailand Capacity Enhancement Plan
Traffic Growth: Bangkok FIR

Average Daily Flight Movement in Bangkok FIR
January 2010 - December 2013

- 2010 Average: 1,280 flights
- 2011 Average: 1,460 flights
- 2012 Average: 1,630 flights
- 2013 Average: 1,900 flights

Average growth rates:
- 2010: 14%
- 2011: 12%
- 2012: 16%
Collaboration with AOT

- AOT/AEROTHAI Joint Capacity Definition
- ANS Planning & Capacity Balancing Purpose
- Manual on Collaborative ATFM
- Priority/Order of Implementation

1. Phuket
2. Suvarnabhumi

...and other key airports
LFV Aviation Consulting Study

• Commissioned in 2010

• Based on “experience”; supported by Fast-Time Simulation
  – Traffic Demand: “Busy Day”
  – Airspace Configuration in 2010

• Proposed airspace capacity in terms of hourly Entry Counts
Entry Count vs Occupancy Count

- LFV Aviation Consulting suggested Entry Count Capacity

- ATFM support system worked on Occupancy Count
  - Traffic Demand based on Flight Plan and ATS messages
  - Surveillance Track not included yet

- ATCOs perceived Traffic Demand forecast as “inaccurate”

- Preliminary Solution: Revert to Entry Count
EU-ASEAN Collaboration

- European Union – Association of South-East Asia Nations (ASEAN) collaboration

- ASEAN Air Transport Integration Project (AATIP) to support establishment of ASEAN Single Aviation Market (ASAM) in 2015 as a part of ASEAN Economic Community (AEC)

- ATM Modeling and Simulation Workshops

- Cross-Border ATFM Workshop
Defining and Managing capacities

European experience aligned with Doc 9971

in coordination with

Brian Flynn, EUROCONTROL – EU ASEAN AATIP ATM Expert
Some Capacity Guidelines

• Capacity is what you know you can handle today
• Capacity = safe throughput capability of an individual or small team
• All individuals are different!

• Complexity and uncertainty are two important limiting factors

• Models are very valuable to compare different modelled scenarios (more than the model result with reality)
Complexity

- Traffic Mix
- Regularity of traffic pattern
- Regional airports, new schedules

- Standard control procedures, runway in use, SID, STAR
- Separation and coordination procedures
- Contingencies, technical problems
The Human Capacity

• Staff under training, recently qualified, experience, age

• Sustainable capacity (1 hour, 2, 3, …)

• Fatigue (day, night, working conditions)

• The sector / tower team

• Language proficiency

• Your capacity and your neighbour’s capacity

• Staff management relations
Predictability and Uncertainty

• Accurate prior knowledge of traffic

• Missing flight plans

• Adherence to procedures (ATCO, pilot)

• Weather

• Military activity
Determining Enroute Capacity (Doc 9971)
Modelling Capacity

Controller Workload assessment models

Large set of simulation parameters to be defined

Critical event task generation:
- Sector entry
- Conflict Search
- Conflict Resolution
- Sector exit

Comprehensive set of more than 120 standard tasks developed over many years
Modelling Capacity

Average task execution times and responsible defined with operational working groups

New tasks may need to be added (e.g. control in areas not covered by normal surveillance)

Conflict types, supervision and resolution parameters (time, distance....)

Many iterations of model required to obtain stable results.
Critical Event Model

1. Flight Progress Strips
2. Coordination
3. Entry conflict search
4. First call identification
5. Clearance
6. Coordination
7. Transfer
8. Conflict detection
9. Conflict resolution
Example Workload Threshold Analysis

The quantitative threshold values used and their corresponding qualitative interpretations are:

<table>
<thead>
<tr>
<th>Threshold</th>
<th>Interpretation</th>
<th>Recorded Working Time during 1 hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>70 % or above</td>
<td>Overload</td>
<td>42 minutes +</td>
</tr>
<tr>
<td>54 % - 69 %</td>
<td>Heavy Load</td>
<td>32 - 41 minutes</td>
</tr>
<tr>
<td>30 % - 53 %</td>
<td>Medium Load</td>
<td>18 - 31 minutes</td>
</tr>
<tr>
<td>18 % - 29%</td>
<td>Light Load</td>
<td>11 - 17 minutes</td>
</tr>
<tr>
<td>0 % - 17 %</td>
<td>Very Light Load</td>
<td>0 - 10 minutes</td>
</tr>
</tbody>
</table>
Example Model Output

Figure 0-2 - Traffic Demand and Controller Workloads
Entry Count v Occupancy

Capacity for an airspace sector is normally defined as an **entry count** (maximum number of aircraft entering an airspace sector in a given period of time).

A complementary measure is **occupancy count** (maximum number of aircraft within an airspace sector in a given period of time) as well as other possible units.

Occupancy count can be used to **complement** entry counts, and allow higher values for such entry counts, where **accurate and frequent live surveillance data updates** are included in the ATFM system and that these are available well in advance of flight entry into the given airspace sector and are constantly updated.
Determining Airport Capacity (Doc 9971)

- Environment
  - Emission reduction?
  - Noise abatement
  - Curfew
  - Airports slots?
  - Runway allocation scheme?

- Separation
  - Arrival interval
  - Departure interval
  - Headwind
  - IMC?

- Weather
  - Weather conditions

- Airspace complexity
  - High speed exit
  - Multiple taxiways

- Aerodrome design
  - Single active runway?
  - Mixed mode?
  - Multiple active runways
  - Dependent runways?

- Runways
  - Runway condition
  - Runway occupancy time
  - Fleet mix

- Demand
  - Average ground speed on final

Airport capacity
Airport Capacity

**Airport Acceptance Rate (AAR):** Number of **arrival** aircraft that an airport, in conjunction with terminal airspace, ramp space, parking space, and terminal facilities can accept under specific conditions during any consecutive 60 minute period.

Varies greatly with each runway configuration and weather

**Theoretical** single runway capacity = Ground Speed / separation required at threshold

- Intersecting arrival and departure runways
- Lateral distance between arrival runways
- Dual use runways – runways that share arrivals and departures
- Land and Hold Short operations
- Availability of high speed taxiways
- Airspace limitations and constraints
- Procedural limitations (noise abatement, missed approach procedures)
- Taxiway layouts
- Meteorological conditions
Airport Capacity

Separation

Terminal – airport slots

ATC Tower / APP

Runway mode and configuration
Capacity - Conclusions

• Capacity = safe throughput capability of an individual or small team
  • All individuals are different!

• Participation of Controllers is essential in discussing and modelling capacity

• Complexity and uncertainty are very important limiting factors

• Models can provide valuable assistance in establishing, validating current and future capacity baselines.

• Capacity is dynamic – it changes!
Thailand Capacity Review Plan

• Phase 1: Review Current Airspace Capacity (2014)
  – Current ATS automation support system
  – 2014 Airspace Configuration and Route Structure

• Phase 2: Revise Airspace Capacity (2014 – 2015)
  – New ATS automation support system
  – 2014 Airspace Configuration and Route Structure
  – More scenarios to assist transition to new ATS automation support system

• Phase 3: “Dynamic” Airspace Configuration
  – New ATS automation support system
  – More “creative” sector configuration
Thailand Capacity Enhancement Plan

- Tactical Operations
  - Tactical ATM System Modernization (TMCS)
  - AI DC Automated Aircraft Transfer of Control
  - Stripless Operation
  - AMAN / DMAN Integration
Thailand Capacity Enhancement Plan

• Pre-Tactical Operations
  – ATM Network Management Centre (ATM NMC)
    • ATFMU
    • Airspace Management Cell (AMC)
    • Information Management Unit