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VATSIM SCANDINAVIA

PRACTICAL GUIDELINES FOR AREA CONTROL

Introduction

This document describes general guidelines and controlling techniques to be used in area control with radar.

Ensuring Separation

It is essential to ensure that the required separation is always maintained. One must always **know** that aircraft will be sufficiently separated – it is never enough to look and think that "this will probably work." That the distance between aircraft is more than 1000 ft / 5 NM (or whatever separation minimum is applicable) does not automatically mean that separation has been ensured. How to ensure separation in practice will be discussed later in this document.

Vertical and horizontal separation

Either vertical *or* horizontal separation must always be applied – there is no reason to use "double" separation (both vertical and horizontal). For example, if two aircraft are on crossing tracks and also need to cross levels, first ensure horizontal separation. Vertical separation is the not applicable, and the aircraft can climb/descend until vertical separation is re-established, at which point horizontal separation is no longer needed. This may look obvious, but it is easy to apply "too much" separation, which results in unnecessary extra workload.

In general, you could say that vertical is the best form of separation. If for example you have an aircraft that is due to land within the next half hour, it may be a better solution to descend the aircraft a few thousand feet in order to solve a conflict, instead of making things more complicated by vectoring.

Work methodology

1. Information gathering

When an aircraft appears on the radar screen about to enter your sector, you should look at the label and sector inbound list (or equivalent) to collect information about the flight: aircraft type, where the aircraft is going, what level, and that PEL and XFL are correct. Is the flight expected to climb/descend in your sector or just transit in level flight? Is it possible to give any direct routing (shortcut)? Do you need to issue inbound clearance? Is the aircraft at the correct semicircular level or correct level according to its ATS route?

2. Entry conflict search

The next step is to check if the aircraft is in conflict with any other traffic in or inbound to the sector.

An entry conflict means that two aircraft at the same level are expected to cross tracks within a specified distance, usually 20 NM.

Example:

Sector layout:

D

A B C

E

1. Aircraft 1 will fly E-B-D and Aircraft 2 will fly C-B-A, both at FL360. Their tracks will cross with a minimum distance of 2 NM = this is an entry conflict. Track will cross at 15 NM = entry conflict. Tracks will cross at 25 NM = no conflict.

2. As above, but Aircraft 1 is climbing to FL340, but is flight planned at FL360. There is no conflict in this case since the aircraft are separated unless the clearance is changed.

Once a conflict is identified it should be a reminder that something might have to be done to maintain separation.

3. Exit planning

Before you are done with the new aircraft, the conditions when the aircraft is expected to leave your sector must be checked. Here we can use the sector exit list to check if any other traffic will exit the sector via the same point and level. If there is traffic going via the same exit point at the same level, the next step is to look at the estimated time over the exit coordination point: If the difference in ETA over the exit point is 10 minutes or more, no action is required. If the time difference is less than 10 minutes, you should use the radar to estimate the expected spacing.

The required spacing varies between sectors and is regulated via LoA. A normal distance is 20 NM or 10 NM constant or increasing. With verbal coordination it is possible to reduce the distance to the radar separation minimum, normally 5 NM.

The simplest way to solve an exit conflict is of course to change the level of one aircraft, but with a lot of traffic on the same route the available levels are quickly taken. In this case a more detailed analysis of the traffic situation is required:

- Which aircraft types are involved? A B744 will quickly catch up on a B734. Many exit problems can be solved easily by putting “the right aircraft in the right place.” A B744 following a B734 is not a good solution (unless the routes are diverging soon), but a B734 following a B744 will always work. For aircraft types with similar cruise speeds (e.g. B738/A320, B752/B763, A343/B772), speed control may be used to keep a constant spacing. However, speed changes larger than about M .02 for long periods should be avoid if possible. In this case a level change is probably a better option to allow the aircraft to cruise at their optimum speed. (On VATSIM, different pilots having different wind conditions can also make speed control impossible.)

- What are the routings? If the routes are diverging after a short while, or if an aircraft is soon due to start descent towards its destination, it is likely that the next sector will accept a "catch up" situation, but if both aircraft are following the same route for a longer time this is not a situation that anyone wants. If an aircraft is approaching its destination anyway the simplest solution is probably to descend the aircraft. A heavy aircraft departing on a long haul flight is unlikely to be able to accept a high cruising level, but this is usually not a problem for a short haul flight.

In busy traffic conditions, exit planning can become a very complex puzzle, which is why in real life there is normally a Planning or Coordinating Controller (PC or CC) who is responsible for conflict search, exit planning and coordination with adjacent sectors.

Separation in practice

Separation minima and guidelines

The minimum vertical separation in area control is 1000 ft (2000 ft for non-RVSM approved aircraft above FL290). The radar separation minima is normally 5 NM (3 NM below FL200 in certain areas depending on the range from the radar antenna). These are **minima**. In real life, this means that the difference between passing with 5.0 NM and 4.9 NM is that in the latter case there will be an investigation and a whole lot of paper work!

In addition to these minima some guidelines are also provided. These are provided in order to help ensure that separation minima are never infringed. Guidelines and how they are applied may differ between different ATS units.

1:60 rule

A practical rule of thumb is the so called 1:60 rule: 60 kt = 60 NM/h = 1 NM/min. 120 kt = 2 NM/min, 180 kt = 3 NM/min 240 kt = 4 NM/min etc.

Example: A B772 (GS 480 kt) is following a B733 (GS 420). The distance is 20 NM. How long time will it take before the 5 NM separation minima is infringed?

Answer: The B772 is 60 kt faster and thus the distance is reduced by 1 NM per minute. It follows that the distance will be 5 NM in 15 minutes.

Vertical separation

This may seem obvious but it is worth emphasizing: Vertical separation does not exist just because two aircraft *happen* to be more than 1000 ft apart vertically. What matters is the cleared level. An example: Aircraft 1 at FL350 is about to meet Aircraft 2 which is at FL250 on a reciprocal track. The distance is 1 NM. Can Aircraft 1 now be cleared for descent to FL250? The answer is no – this would be considered an ”unsafe clearance.” You need to wait for the aircraft to pass and the distance to increase to 5 NM before clearing the aircraft to the same level.

Mode C information:

- An aircraft is considered to maintain a level when the mode C altitude indicates within +/- 300 ft (in RVSM airspace +/- 200 ft) of the assigned level
- An aircraft is considered to have vacated a level when the mode C altitude has changed by 300 ft. This means that an aircraft leaving FL300 must indicate a mode C level of FL287 before another aircraft can be cleared to FL300.
- An aircraft is considered to be in level flight when mode C indicates the same level for at least three consecutive radar updates. In modern radar systems (and on VATSIM), radar updates can be difficult to distinguish and then the vertical trend vector (↑ / ↓) may be used; when the arrow has disappeared the aircraft is considered to be in level flight. In the example above, the next aircraft can be cleared to FL300 when the first aircraft has displayed FL290 (+/- 200 ft) during three updates, or when the ↓ symbol is no longer displayed.

Guidelines

Vertical separation should be established at the latest

- 2 minutes / 15 NM before crossing point for aircraft on crossing tracks
- 2 minutes / 30 NM before crossing point for aircraft on reciprocal tracks

Example: 2 aircraft on reciprocal tracks, distance 60 NM (around 4 minutes until they cross). Aircraft A at FL300; Aircraft B at FL290 but requesting FL310. Can Aircraft B climb to FL310?

Answer: Vertical separation must be established within 2 minutes (at that time the distance will be about 30 NM and it will be 2 minutes until the aircraft meet). Aircraft B has to climb 2000 ft, so a vertical speed of at least 1000 ft/min will be required. As this is just on the limit, some margin can be included by clearing Aircraft B to “climb FL310 at 1500 ft per minute or greater.” If no climb rate is given the aircraft may climb with a rate of 500 ft/min or even less, and then separation would not be ensured. It is also important to consider the performance of the aircraft: You can forget that an A340 at the start of a long flight will be able to do 1000 ft/min – in this case you have to find another solution; either wait with the climb or give vectors to establish horizontal separation before the climb.

Example: A B763 at FL360 has to descend to FL250. There is crossing traffic at FL290-FL330 about 50 NM away. What rate of descent is required?

Answer: The B763 must reach FL280 2 minutes before the cross in order to be below the crossing traffic. Considering no wind, a B763 will have a GS of around 480 kt = 8 NM/minute. This means the cross will take place after around 6 minutes, so FL280 should be reached within 4 minutes. 8000 ft in 4 minutes = 2000 ft/min. “Descend to

FL250 at 2000 ft per minute or greater until passing FL280" will work, although 2500 ft/min is a good choice for some extra margin.

Separation using climb/descent rates

1. This is a method which is applied in some countries but normally not applied in others as it is considered a "risky" type of separation. For example, Aircraft A is instructed to climb with 1500 ft/min or greater, and Aircraft B which is below will be instructed to climb with 1500 ft/min or less. This gives constant or increasing vertical separation, as long as both aircraft follow the instruction accurately. However, the separation will be decreased if Aircraft A is unable to maintain its climb rate and a loss of separation can occur if ATC is not informed in a timely manner (which may be difficult on a busy frequency).
2. An alternative method is to climb/descend the first aircraft with a relatively high initial rate and then clear the second aircraft to levels that the first aircraft has vacated. For example, Aircraft A at FL340 will descend to FL260 and Aircraft B at FL360 will descend to FL270. Descend Aircraft A to FL260 "at 2500 ft per minute or greater." Wait until Aircraft A has passed FL330 (indicated FL327), and Aircraft B can then be cleared to FL340. Just over a minute later Aircraft A should be through FL300 and then Aircraft B can be cleared to FL310, and so on. This method requires a bit more work from the controller, but saves you having to monitor that the aircraft are maintaining the assigned climb/descent rate.

Horizontal separation

Conflict

Aircraft are considered to be in conflict with each other if they are crossing with a distance of less than 20 NM unless vertical separation exists.

Radar monitoring

If the closest distance in a conflict is 10-20 NM the only required action is to monitor the situation using radar. The circumstances may change with speed changes during climb/descent, depending on wind or at turning points, which means that the projected minimum distance in a conflict situation can change considerably.

Vectoring

If the minimum distance in a conflict is less than 10 NM, it is good practice to use vectoring to ensure that the radar separation minimum (5 NM or 3 NM) will be maintained. If vectoring is employed it is important to note that both aircraft in the conflict should be issued with vectors, even if it is just "continue present heading." The reason for this is that under own navigation an aircraft may turn unexpectedly, for example due to an error in the FMS flight plan, while an aircraft "locked" on a heading can be expected to continue exactly on the heading.

Achieving effective vectoring takes practice, but it is possible to give some basic tips:

- Start by determining the crossing point for the aircraft.
- Then determine which aircraft will reach the crossing point first.

- Turn the aircraft which will be nr 2 at the crossing point *towards* aircraft nr 1.
- Turn aircraft 1 in the same direction, i.e. if aircraft 2 turns right, aircraft 1 also has to turn right, resulting in aircraft 1 turning away from aircraft 2.
- Don't aim for 5 NM (or 3 NM where applicable), as there is then a risk that the result would be 4.5 or 2.5 NM, which would be a loss of separation. Instead aim for 6-7 NM (4-5 NM if the minimum is 3).
- How many degrees to turn depends on the situation and the airspace available, but there are several options, such as turning one aircraft more than the other or just turning one of the aircraft. Normally a track change of 5-20 degrees is needed.
- The sooner you start vectoring, the smaller the track change required.
- Normally vectoring should commence at the latest around 4 minutes from the crossing point; a final check and possible adjustment of the headings should be done 2 minutes before the crossing.
- If vectoring is started very late (within 2 minutes of the crossing), very large course changes will be required (60 degrees or more is possible), and an urgent tone should be used, as any delay in carrying out the instruction could lead to a loss of separation: "turn left **immediately** heading XXX [to avoid traffic… (traffic information)]"
- Vectoring should be terminated ("resume own navigation [direct] (point)") when aircraft 1 has passed the "12 o'clock" position of aircraft 2.
- Remember that track and heading are different. With a southerly wind and an aircraft tracking westbound (track 270), if you say "turn left heading 265" you may be surprised to find the aircraft almost making a 360 turn, because the original heading was 260! The alternative is to use "report heading" and when the heading is known "turn left heading XXX", or simply use "turn left 5 degrees [report new heading]." If the aircraft's heading is not known but you know what heading is required you can use "fly heading XXX."

Speed control

Speed control is mainly used for sequencing arriving traffic, but can also be used for enroute separation.

Mach/IAS

Speed instructions are given in intervals of .01 Mach above FL245 and in intervals of 10 kt below FL245.

.01 Mach equals about 6 kt at high level.

The TAS for a given IAS/Mach increases with altitude. A rule of thumb is that the TAS will increase by approximately 6 kt for every 1000 ft increase in altitude, or by .01 Mach for every 2-3000 ft increase in altitude. Example:

- An aircraft at FL240 is at IAS 280 kt. The same GS would give an IAS of around 262 kt at FL270.
- An aircraft at FL290 is at Mach .80. The same GS would give around Mach .83 at FL370.

Enroute speed control

Large speed changes during cruise should be avoided, in order to allow traffic to operate at close to optimum cruising speed. Speed control should normally not be used as a means of separation if the speed (without speed restriction) differs by more than .03 Mach or about 20 kt. Use vertical separation instead.

Example:

- Preceding aircraft Mach .73, following aircraft Mach .79 – change level for the following aircraft (or the preceding if this facilitates the traffic management).
- Preceding aircraft Mach .77, following aircraft Mach .79 – instruct the preceding to increase to Mach .78 "or greater" and the following Mach .78 "or less."

Speed control for arrival sequencing

When using speed control for arrival sequencing, there is more flexibility regarding assigned speeds compared to the cruise phase. In general, most jet aircraft can be assigned speeds between 250 kt and 300-320 kt IAS. Note that speeds below 250 kt IAS should not be assigned above FL245 without pilot consent.

Traffic information and avoiding action

Traffic information can be given for several reasons: if the pilot asks for it ("we can see some traffic [on TCAS], can you confirm what it is?"); in airspace where visual separation is applied; and also in unforeseen circumstances, such as unknown traffic in the sector or a loss of separation.

Traffic information should always be given in the same format: "(callsign) traffic XX o'clock, XX miles, (direction), (relative altitude), (relative speed), (other information as required)"

The reason for giving relative altitude instead of actual level is to avoid the information being misinterpreted as an instruction to climb or descend.

When the traffic has passed, remember to say "clear of traffic."

Example:

- You see an unknown radar track passing close to your traffic (within about 20 NM, depending on direction, speed etc). Mode C indicates FL375, GS 500 kt, and your traffic is at FL360: "Scandinavian 123, traffic 10 o'clock, 8 miles, passing from left to right, unverified mode C indicating 1500 ft above your level, fast moving, type unknown." Since you are not in contact with the traffic it is important to mention that the mode C altitude is not verified.
- Traffic information may also be given to keep pilots informed of traffic in the vicinity which is being separated but which may cause a TCAS TA or appear close when looking out the window: "Speedbird 456, traffic 3 o'clock 4 miles, same direction, A320 climbing to maintain 1000 ft below your level"

Essential traffic information / Avoiding action

Essential traffic information is given when separation is not maintained to traffic that should normally be separated. The reason could be pilots misinterpreting an instruction (e.g. a level bust), an emergency descent (in this case pilots will descend first and advise ATC when their workload permits), or the worst case scenario – you have failed to maintain separation!

Essential traffic information is given in the same format as ”normal” traffic information, but an urgent tone is needed. It may also be necessary to give instructions for avoiding action. In the case of avoiding action, climb/descent instructions should not be used, as these can contradict TCAS resolution advisories that pilots have to follow. Use turns instead.

Example: You realised too late that SAS123 (B737 on heading 360) and BAW456 (B763 on heading 090) are in conflict and will pass with only 2 NM.

”SAS123 turn right **immediately** heading 060 to avoid traffic 10 o'clock, 7 miles, passing from left to right, B767 same level, **break break**, BAW456 turn right **immediately** heading 150 to avoid traffic 2 o'clock, 6 miles, passing from right to left, B737, same level.”

Coordination

Effective coordination is necessary for air traffic to flow safely and efficiently between various sectors and ATS units. The most important aspect of coordination is to always ensure that separation is maintained and that there is never any ambiguity about who is responsible for separation.

On VATSIM we are somewhat spoiled by always having all information about a flight available (we always have flight plan information, are able to see which aircraft is which even without the correct transponder code etc.). However, today realistic radar simulations are becoming the norm, which makes clear coordination even more important: Never assume that another controller has the same information as you have on his screen. Thus it is important in verbal coordination to use complete callsigns, and be specific when referring to locations, transponder codes, cleared levels etc.

A basic rule is that coordination is required for all situations which are not covered by local operating procedures or LoA, or if for some reason it is not possible to meet the conditions specified in local procedures or LoA. If no coordination takes place, the next sector will of course assume that the traffic will delivered meeting the LoA conditions!

Coordination IRL

As mentioned we are a bit spoiled on VATSIM in that we always have access to all information, since everyone is connected to the same network. Naturally, in reality things are a bit different. Here is a brief explanation of real life coordination procedures, provided as background information:

”Back in the day” everything was done over the phone – you would call the next sector or ATS units to inform them about incoming traffic; they would then write the information on paper flight progress strips, and if any information would change a new phone call would be made and the new information noted on the strip. Within the same ATS unit this could mostly be done manually, by shouting to the next sector controller sitting at the other side of the room and walk over with the strip for handover.

Today, things are naturally a bit different:

- Flight plan data is normally available at all concerned ATS units. The flight plan is filed by the pilot/operator and sent to Eurocontrol which distributes the information.
- Between ATC centres OLDI (On-Line Data Interchange) is normally used. OLDI automatically sends different coordination messages. The exact details of the OLDI procedures are described in LoA, but in general it works as follows:

  30 minutes before a flight reaches the sector boundary, an ABI (Advanced Boundary Information) message with information about the flight is sent to the next ATS unit. ABI contains:

  - Aircraft Identification;
  - SSR Mode and Code
  - Departure Aerodrome;
  - Estimate Data (EST);
  - Destination Aerodrome;
  - Aircraft number and type;
  - Route (optional);
  - Other flight plan data (optional).

  With the information received in the ABI the radar system can couple the flight plan with a radar track and we get correlation of the callsign and flight plan information with the radar track and transponder code.

  10-15 minutes before the sector boundary an Activation message (ACT) is sent. The ACT contains information similar to the ABI, but is updated with the latest EST data, i.e. time estimate and level at the applicable Coordination Point (COP). The ACT is only sent once, which means that when the ACT has been sent, the only way to transmit updated information to the next sector is via phone call. So if for example a level change is done after the ACT is “gone”, a call to the next sector has to be made so they know which level the traffic will actually be at.

- Within the same centre and in some cases between different centres, all data is available online (similar to the situation we have on VATSIM), and so what is seen on the screen at one sector is instantly displayed in other sectors. This would normally include all label information such as CFL, scratchpad/operator entered text, direct routings etc.

Verbal coordination

As with communication between controllers and pilots, the communication between controllers follows a standard format and standard phraseology should be used where applicable. Here are some examples of different messages.

- Estimate (EST): Informs the next sector of ETA for applicable COP, level and SSR code. (EST is normally sent via OLDI, but if OLDI is not available EST must be done verbally.)
- Revision: Used to revise an EST, e.g. change of level or ETA.
- Approval request: Used in order to request an exception from agreed procedures (e.g. LoA). Example: Transfer of traffic with less separation than as prescribed in LoA.
- Expedite clearance: Used instead of EST/revision/approval request when the message is sent with very short notice (e.g. a change of coordinated level within 5 minutes of the sector boundary).
- Release: A permission for the receiving sector to climb, descend or turn (by not more than 45°) an aircraft before it has reached the transfer of control point (i.e. normally the sector boundary). A release can be requested by the receiving sector or given by the transferring sector without being requested by the receiving sector.
- Radar handover: Used to hand over radar control. The message includes SSR code and position so the receiving controller can identify the aircraft on radar. (Radar handovers are rarely used today but were common with old radar systems which lacked automatic code/callsign correlation. Today a radar handover could become necessary for instance if an aircraft has transponder problems or if OLDI unavailable.)

Here are some examples of coordination messages between different ATS units:

EDUU: *Rhein?*
ESMM: *Malmö. Approval request SALLO, Lufthansa 123, FL370, following Scandinavian 456, distance 25 miles reducing.*
EDUU: *Approved.*
ESMM: *Roger.*

ESOS: *Stockholm.*
ENOS *Oslo. Approval request MASEV, Norshuttle 876 FL270.*
ESOS: *FL270 not approved, request Norshuttle 876 FL250.*

ENOS: *Roger, Norshuttle 876 FL250.*
ESOS: *Approved.*

ESMM: *Malmö.*
EKDK: *Copenhagen. Request release for turns and climb, KLM 1114.*
ESMM: *KLM 1114 is released for climb and is released for turns 5 miles before SVD .*
EKDK: *Roger, KLM 1114 released for climb and released for turns 5 miles before SVD.*
ESMM: *Correct.*