S1/S2 Training material

2.1 Choosing your ATC position [S]
When first getting introduced to Virtual Controlling the various positions and call signs used can look very intimidating at first glance. The easiest manner to decipher these is to divide them into three distinct categories:

While the exact terminology varies from country to country, there are generally three different types of ATC.

- **Control Towers**
- **Approach controllers**
- **Centre controllers**

As a new member to VATSIM and depending on the local restrictions in use at your vACC, Student Controllers will usually start controlling at a Ground or Tower position and then move up to Approach and Departure positions and from there to Area Control positions and eventually once the required rating has been achieved will be able to control a FSS position.

2.1.1 Tower Positions [S]
The primary method in real life of controlling the immediate airport area is by means of visual observation from the control tower. The tower is a tall, windowed structure located on the airport. Tower controllers are responsible for the separation and efficient movement of aircraft and vehicles operating on the taxiways and runways of the airport itself, and aircraft in the air near the airport.

Radar displays are also available at some airports (on VATSIM at all airports). Tower uses radar to display airborne traffic on final approach and for departing traffic once they are airborne.

Some airports (on VATSIM all airports) also have radar designated to display aircraft and vehicles on the ground. This is used by Ground controllers as an additional tool to control ground traffic.

The areas of responsibilities for tower controllers fall into three general operational disciplines:

- **Clearance Delivery**
- **Ground Control**
- **Local Control (Actual Tower position)**

The following provides a general concept of the delegation of responsibilities within the tower environment.

Clearance Delivery, the position responsible for verifying a flight plan and issuing IFR clearance.
Ground, responsible for controlling traffic on the airport “movement” areas, this generally include taxiways and holding areas and giving traffic information and suggestions (for example approving push-back) to traffic on aprons.
Tower, responsible for movements on the runways and traffic in the control zone, (CTR) which surrounds the aerodrome and normally extends around 5 to 10 NM from the aerodrome and from the ground up to normally, 1500-2000ft. The tower is the position that clears aircraft for take off or landing and ensures the runways are clear for these aircraft.

As in real life and in dense traffic, at certain large airports more than one of these positions may be opened, for example S or N for South or North.

2.1.2 Radar Positions [S]

Even though as described above Tower and Ground also use radar displays, we will refer to the following as Radar Positions since they rely 100% on radar in order to control and separate traffic.

These positions are not located in the actual tower; these facilities on the other hand can be located in buildings adjacent to an airport or even in buildings totally separated from it. A radar position as the name implies uses Radar scopes to track and follow the movement of traffic in the air. These teams are in turn subdivided into:

Approach Control (APP)

- **Area Centre Position (ACC)**
- **Flight Information Service (FIS)**

- Approach Position, the position responsible for controlling, separating and sequencing arriving and departing aircraft. APP is usually responsible for the terminal control area (TMA). At small airports, the TWR and APP position is often combined. On the contrary, at large airports or in complex TMAs, APP is usually divided into several sectors. APP positions may have different radio callsigns depending on the function, such as Departure, which as the name implies controls departing aircraft, Arrival or Director, which usually handle vectoring of arriving aircraft.
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- Area Control Centre, the position responsible for controlling traffic in the control areas (CTA) and upper control areas (UTA) within the centre's area of responsibility. The area of responsibility is generally a FIR or part of a FIR, so ACCs cover large areas, and therefore may be divided into several sectors, both horizontally and vertically.
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- FIS, Flight Information Service is not used much in VATSIM but should it be on line then it is responsible for providing traffic information, flight following and providing information to VFR flights. It is not a Control Position and can not give instructions to aircraft but only advisories and information. As FIS is not a standard Designator on VATSIM, controllers providing this service usually log in with XXXX_I_CTR call-sign

FIS in essence is the most basic form of air traffic service that is provided to aircraft.

2.2. List of positions in VATSIM [S]

Call sign	Designator	Short Description
Delivery (Clearance)	DEL	Responsible for issuing IFR clearances
Ground	GND	Responsible for movements on the ground on the manoeuvring area.
Tower	TWR	Responsible for traffic on the runways and in the CTR..

Departure	DEP	Responsible for separation and flow of departing traffic at certain airports.
Arrival/Approach	APP	Responsible for separating and sequencing arriving and departing traffic in TMA's
Final/Director	APP	Responsible for final vectoring of arriving traffic at busy airports.
Control/Radar	CTR	Responsible for en-route traffic and traffic in CTA/UTA
UIR Sectors	FSS	Responsible for control of upper airspace from FL245 when no local CTR is on line

A further position is AFIS

AFIS (Aerodrome Flight Information Service	TWR	Gives information about traffic and weather at some uncontrolled airports.

In VATSIM **AFIS** must log on with a TWR call-sign but the controller information (ATIS) will state when it is an **AFIS**

ESSA_DEL : Arlanda Clearance Delivery
LTBA_GND : Ataturk Ground
EDDF_TWR : Frankfurt Tower
EPWA_DEP : Warsaw Departure
LIPZ_APP :Venice Tessera Approach
LEBL_CTR :Barcelona Control

2.3 Visual Ranges [S]

The VATSIM community relies on a network of computers interlinked to provide position updates to controllers and pilots alike. The network is donated by third parties. In an effort to avoid any wasting of bandwidth the following Maximum ranges have been imposed.

Position	**Range**
DEL/GND	10 to 20 nm
TWR	30 to 50 nm
APP/DEP	100 to 150 nm
CTR	300 to 600 nm
FSS	1500 nm

When a user logs on to network, it is important that the visual range slider be set to the appropriate range depending on the position being manned, the main reason is to limit the waste of bandwidth. Bear in mind that a user will receive information packets every few seconds, so a GND controller having a range of 400nm will also be receiving traffic information in a radius of 400nm from the position being manned this is an absolute waste of bandwidth and should be avoided at all cost.

Unfortunately some controllers forget to change their facility type when switching to another ATC position. Setting a correct facility type is important; since it affects the radio range of the controller. Therefore in some cases a wrong facility type could affect the text communication between a controller and a pilot.

RANGE is the visual range set by the controller in ASRC/VRC options using the range slider. There is one exception: visual range for FSS facilities is hard coded to 1500nm (since this is much more then the slider is allowed to be set to). This range defines from which distance the controller gets aircraft position reports, so which traffic is shown at the radar scope and which not. It's obvious it should be adjusted to the service the controller is providing. The best situation is when controller is capable to see the traffic within his sector plus a small margin. Therefore the visual range should be adjusted to the size and shape of the sector

(NOTE that the visual range is calculated from the point where the radar scope is actually centered, unless the .vis command has been used to set a different visibility point).

If you use VRC as radar client, it is a good practice to configure it for the facility you are manning and then save the profile with its callsign to make sure that all settings are appropriate for your position. (i.e.: LEBL_TWR, EGKK_APP, etc.)

There are some situations, when extended range is justified, for example a very large or an irregular shaped sectors or some special operations.

(NOTE: for irregular shaped sectors, you can use multiple visibility points in order to have a "radar antenna" at the significant points of your sector, so that it's not needed to increase range

3.1 Radio Communication the Basics [S]

Communication is essential for air traffic control. Both text and radio can be used (even if voice is preferred) in order to exchange information and are equally important. Sending in a flight plan is a form of communication, as are the instructions transmitted over radio between pilot and controller. Messages between two or more controllers, in order to coordinate traffic, are also communication. In short, there is a lot of communication required in order to control the traffic in the air.

With this amount of messages being sent, there is an obvious risk for misunderstanding. There is also a need to keep transmissions short in order to save valuable time. These are the main reasons why a special format and syntax of radio communication has been created. In order to give proficient and safe ATC, you will need to learn this radio communication language.
Fictive callsigns will be used in the examples below:

XXX123 = Exair 123
Control= Somewhere

3.1.1. Radio Technique [S]

Let's start with the basics – there are some basic rules that you need to adhere to or there will be chaos:

Listen before you talk It's impossible for two radio stations to transmit on the same frequency at the same time. If this is done, the radio signal will be blocked and this will result in a nasty noise on the frequency. Therefore it's important that every station monitors the frequency for about 5 seconds before transmitting, to make sure there's no ongoing radio traffic. If you hear an ongoing conversation, wait until the conversation is over before you begin to transmit. Don't start your communication if there is a read-back expected on the last transmission even if there is a short pause.

Think before you talk The radio traffic flow should be as smooth as possible. To achieve this it's vital to "think first" before transmitting so that a clear, concise and uninterrupted message can be sent.
Use standard phraseology and syntax (As far as possible)

To prevent misunderstandings and to maintain the radio traffic as effective as possible, stick to standardized phraseology and skip slang and of course private messages.

Speak out Long messages shall be cut into shorter phrases with a little pause in between. Normal speaking speed is about 100 words / min but when reading out long messages such as weather reports and complicated route clearances, decrease the speed to about 60 words / min. When transmitting, talk with normal voice tone and keep the microphone at a constant distance from your mouth.

3.1.2. Language [S]

English is the primary language for communication in aviation. In most countries English is prevailing at international airports. Local language may be common at smaller airports where there is lots of general aviation and/or VFR traffic or when handling domestic IFR traffic.

There are several advantages to using English, the most obvious being that everybody on the radio channel understands everybody. It is the pilot who chooses which language is used, and ATC should respond in the same language. However, ATC may suggest changing language is it is believed that it will ease communication.

3.1.3. Callsign [S]

Due to the fact that it is impossible to see the one you are talking to when using a radio, it is vital that all stations at all time knows who is transmitting and to whom the message is sent to. Hence all users of the radio shall have a specific and unique callsign.
(NOTE: the system prevents you to log on using a callsign already in use).

If you for example are flying KFR123, your callsign will be KFR123 *(Kingfisher one-two-three).* If you are talking to for example Lahore Approach then Lahore Approach will use *"OPLA_APP"* as his/her callsign.

When establishing contact with a station you must first state what station you are addressing your call to, and then state your own callsign. When the receiving station calls you back, he/she must first state your callsign and then his/her own callsign. An example of establishing contact:

XXX123: "Somewhere Control, Exair one-two-three, good evening"
Control: "Exair one-two-three, Somewhere Control, good evening"

When contact is established, the controller may leave out his/her own callsign when answering or contacting aircraft with which he/she has already established contact.. The controller may also use abbreviated callsigns if contact is established and there is no risk of misunderstanding a callsign. Once contact is established, aircraft also may leave out the controllers' callsign when transmitting a request.
An example of a descent clearance once contact is established:

Control: **"Exair one-two-three, Descend to flight level one-two- zero."**
XXX123: "Descend to flight level one-two-zero, Exair one-two- three"

Callsigns used by airline flights usually consist of the airline's callsign followed by the flight number (SAS123 being "Scandinavian 123"). General aviation flights, however, normally use the aircraft's registration as callsign. Example: **SE-IBG (Sierra-Echo-India-Bravo-Golf)**

When checking in to a new controller you have to state your full callsign, (all five letters).

As long as the controller calls the pilot using the full callsign, the pilot should use it as well. However, the controller often reduces the callsign to the first letter, followed by the two or three last letters, for example S-BG. If aircraft with similar callsigns, such as SE-IBG and SE-EBG are on the same frequency, ATC must not reduce the callsign so that confusion may occur. In this case the correct abbreviation would be S-IBG and S-EBG. When ATC has contacted the pilot using the abbreviated callsign, the pilot may use it as well.

When a station takes the initiative to call another station, regardless of whether the stations have established contact or not, it is mandatory to begin the transmission saying the station callsign so all others in the frequency know who is transmitting. This does not apply to the controller since all stations recognize the controller and it will be pretty obvious who is directing the traffic. An example where XXX123 takes the initiative and requests descent:

XXX123: "Exair one-two-three, request descent"
CTR: "Exair one-two-three, descend to flight level one-two-zero"
XXX123 "Descend to flight level one-two-zero, Exair one-two-three"

Below is another example, where the controller takes the initiative and issues a clearance for XXX123 to turn left direct TROSA VOR. Note that the controller leaves out his/her callsign:

Control: "Exair one-two-three turn left direct TROSA"
XXX123: "Left direct TROSA, Exair one-two-three"

3.1.4 Readback [S]

When a controller (or aircraft) transmits a message to a station it is very important that the receiving station acknowledge the message and reads back any required parts.. If the receiving station does not acknowledge, the transmitted message is considered as a lost transmission and the sender should resend the message or check if the receiving station got the message.

Items that must always be read back in full are all clearances (including altitudes, headings, speeds, radials etc), runway in use, altimeter setting (QNH or QFE) and transition level, and all frequencies. For a controller, this is extremely important to remember, since if a pilot's readback is incorrect, the controller has to ask for confirmation, i.e a new readback. There are also items that should not be read back to reduce unnecessary radio transmissions. In short, this includes everything not mentioned above, but a few examples are: wind, temperature and other weather information (except altimeter settings) and traffic information in detail. Here are a few examples of how to acknowledge transmissions:

Arrival: "Exair one-two-three, turn left heading three-six-zero, descend to altitude two-thousand-five-hundred feet on QNH niner-niner-eight"
XXX123: "left three-six-zero, descend to two-thousand-five-hundred feet, QNH niner-niner-eight, Exair one-two-three"
Tower: "Exair one-two-three, wind two-six-zero degrees at one-two knots, runway two-six, cleared to

land"
XXX123: "runway two-six, cleared to land, Exair one-two-three"

Note: that when a pilot reads back a message, the pilot should end the transmission by stating his/her callsign.

Remark: "Roger" means "I have received and understood your message", and thus is only used to acknowledge messages, or parts of messages, which do not require a read back. "Roger" does NOT mean either "yes" or "no". When a positive or negative reply is required, the phrases "affirm" and "negative" should be used.

3.1.5. Readability [S]

When calling another radio station, it is some times good to perform a radio-check to test the transmission and reception quality. For this purpose a readability scale has been developed:

Scale Definition

1 Unreadable
2 Readable now and then
3 Readable, but with difficulty
4 Readable
5 Perfectly readable (loud and clear)

XXX123: "Somewhere Tower, Exair 123 - radio check"
Tower: "Exair 123, somewhere Tower, Read you five"
XXX123: "Roger, read you five as well, Exair123"
XXX020: "Somewhere Tower, Exair 020, radio check"
Tower: "Exair 020, Somewhere Tower, read you five by five - go ahead"

Note: 5 by 5 does not mean 5 out of 5. The First value indicates the signal strength; the second

3.2 Phraseology [S]

To a friend, you can tell a story in a number of different ways. To a pilot, you should give instructions in a very strict and specified way. This is to minimize the risk of misunderstandings and keep the message as short as possible. Some words, which you normally think of as synonyms, cannot be exchanged in aviation, since they mean different things. It is hence important to learn the phraseology used in aviation.

It is a bit like learning a new language and this can only be done by practice. Many persons are afraid of talking on the radio. It can be hard to get all words right in the beginning, but you should remember that it is often better to say something, even though it isn't perfectly correct, than saying nothing at all. Practice and studying radio phraseology will give you experience.

You can find various phraseology links under References sub menu

3.3.1. Take Off [S]

Pilots appreciate if they can receive a continuous climb from take off to cruise altitude. The controllers should therefore try to re-clear the aircraft for a higher flight level well before it reaches the current cleared level.
If this means that the aircraft must be handed over to a new controller it is important to make this handover well in advance.

One example is the handover from TWR to DEP. One method of preventing “level offs” because of long hand over times is to issue the following clearance before departure:

TWR: “Exair 131, when airborne contact departure on 126.65. Runway 19 Right, cleared for takeoff, winds 170 at 21 knots.”

Below are some other examples of take off clearance that can be used.

TWR: “Exair 131, when airborne fly runway heading and climb to 5000 feet. Runway 21, winds 190 at 15 knots, cleared for takeoff.”

“Right turn out” must always be specified if a right turn is to be performed after take-off, because left turn is standard procedure. This is not required, however, if the aircraft is on a SID which begins with a right turn, since the right turn is implied in the clearance for the SID.

TWR: “Exair 131, Runway 08, right turn out, cleared for takeoff.”

3.3.3. Approach [S]

There are many different ways to make an approach to an airport. An aircraft can:

1. Receive radar vectors all the way in to final approach course.
2. Initially follow a STAR and then receive radar vectors to final approach course.
3. Follow a STAR all the way in to final approach course.
4. Fly by own navigation to the Initial Approach Fix and perform a full Procedure Instrument Approach.
5. Perform a visual approach if the pilots have a good visual sight of the airport.
6.

Let us now see some examples of the instructions given by ATC for these 5 different approaches:

(1) An aircraft (XXX950) is approaching an airport without ATIS and STARs. The pilot has received inbound clearance from ACC "via LAPSI runway 19"

XXX950: “Approach, Exair 950 FL 150”
APP: “Exair 950, Approach, radar contact. Descend to 2500 ft on QNH 998, transition level 55”
XXX950: “Descend to 2500 ft on QNH 998, transition 55, Exair 950”
APP: “Exair 950, intention radar vectoring for ILS approach to runway 19. MET Report, Wind 210 degrees 9 knots, visibility 5 kilometers in light rain, clouds scattered 2000 ft overcast 4000 ft, Temperature 15 dew point 14”
The Controller omits QNH and Transition Level in the met report as is has just been given to the pilot
XXX950: “Roger runway 19, Exair 950”
APP: “Exair 950, turn right heading 030 degrees”
XXX950: “Right heading 030, Exair 950”
APP: “Exair 950, turn right heading 160, cleared ILS approach runway 19, report established”
XXX950: “Right heading 160, Cleared for ILS approach runway 19, WILCO, Exair 950”
XXX950: “Exair 950 established ILS rwy 19”

Note: WILCO = WILL COMPLY. (This is one of the few cases where you can use this word)

(2) An aircraft (XXX112) is approaching Somewhere, an airport with ATIS and STARs. The last waypoint in the STAR (Clearance Limit) that XXX112 is cleared to is Tebby VOR (TEB).

APP: “ExAir 112, after Tebby turn right heading 050 and descend to 2500ft Vectors for ILS approach runway 26”
XXX112: “After Tebby descend to 2500 ft and turn right heading 050, vectors for rwy 26, ExAir 112 ”
APP: “ExAir112, Turn left heading 290, cleared ILS approach runway 26, report established”
XXX112: “Turn left heading 290, cleared ILS approach rwy 26, wilco, ExAir112 ”

(3) An aircraft (XXX131) is approaching airport Somewhere on XYZ 3 ECHO arrival. The airport has ATIS and the STARs will guide the aircraft all the way in to final approach course. So if the traffic situation is light and no ATC vectors are needed for separation it can expect to follow the arrival route all the way in to the localizer.

Exair131: "somewhere control, ExAir131 flight level 100"

APP: "ExAir131, radar contact. Descent to 2500 ft on QNH998, cleared ILS approach runway 17"

ExAir131 "Descent to 2500 ft on QNH998, cleared ILS approach runway 17, Exair 131"

(4) An aircraft (PA28 D-IAM) is approaching somewhere airport. It is a student pilot and he requests to perform the full procedure ILS approach for runway 21.

D-IAME: “Somewhere Tower, Delta-India-Alpha-Mike-Echo, maintaining 5000 ft, request the full procedure ILS”
TWR: “Delta-Mike-Echo, radar contact. Descend to 3300 ft on QNH 1013, cleared for the ILS app runway 21 via ABC VOR, report localizer established”
D-IAM: “3300 ft on QNH 1013 and cleared ILS approach runway 21 via ABC VOR, wilco Delta-Mike-Echo.”
TWR: “Delta-Mike-Echo, Met Report “somewhere” CAVOK, Wind 230 degrees at 4 knots, QNH 1000, Temperature 15 degrees, dew point 8 degrees, No Significant Change.

(5) A visual approach is basically a pilot's request approach. This means that the pilot will take the shortest and most convenient way to the runway. A visual approach is permitted (ATC approval is required) whenever there is visual contact to the destination airport.

X4321 Is inbound ABC VOR with runway 07 in use at “somewhere” Airport
X4321 “Exair4321:”Somewhere Approach, ExAir4321 request visual approach runway 07”

APP: “Exair4321 roger, report runway in sight"

X4321: “Wilco, Exair4321”

X4321: “Exair 4321 runway in sight”

APP: “Exair 4321, cleared visual approach runway 07, final”

X4321: “Cleared visual approach runway 07 wilco, Exair 4321”

3.3.5. Missed Approach [S]

A missed approach can be initiated both from the pilot or the controller to prevent a dangerous situation from occurring.
If the runway is occupied or if the arriving aircraft is too high or to fast on the approach, the controller can instruct the pilot to carry out a missed approach.
Every runway has a missed approach procedure that the pilot is expected to follow unless otherwise instructed by ATC. Often ATC revises the missed approach procedure due to traffic or to shorten the aircraft’s route. Missed approach initiated by the pilot

X4321: “ExAir 4321, going around”
TWR: “ExAir 4321, roger, climb to 4000 feet and turn right heading 300. Radar vectors for a new approach”
X4321: “Climb to 4000 feet and right heading 300, ExAir 4321”
TWR: “ExAir 4321 contact somewhere Approach on 126.650”

Missed approach initiated by ATC:
TWR: “ExAir 4321 go around (I say again, go around).”
X4321: “Going around, ExAir 4321”
TWR: “ExAir 4321, climb to 4000 ft and turn right heading 300, vectoring for new approach.”

3.4. Correcting Mistakes [S]

Examples on how to act when things don't run as smooth as you wish:

APP: "Exair 987, turn right heading 35. Correction, right heading 250"
X987: "Right heading 250, Exair 987"
or
APP: "ExAir987, descend to ……….t…Q..05…….
X987: "Approach, say again for Exair 987"

APP: "ExAir 987, descend to 5000 feet on QNH 1015"
X987: "Descend to 4000 feet on QNH 1015, exAir 987"

APP: "ExAir 987, negative, I say again, Descend to 5000 ft on QNH 1015"
X987: "Descend to 5000 feet on QNH 1015, ExAir 987"
Useful words here to use: *Correction, Say again* and *Negative*.

The example below shows a situation where the pilot in XXX123 does not copy the name of the VOR (SCHIPHOL, SPL) that he is cleared to and ATC therefore spells out the identification code of the (VOR

CTR: "ExAir 123, re-cleared direct Schiphol "
XXX123: "Say again for ExAir 123"
CTR: "ExAir 123, I repeat, re-cleared direct Schiphol "
XXX123: "Read you two, say again the name of the points please Exair123"
CTR: "ExAir 123, re-cleared direct Sierra-Papa-Lima VOR"
XXX123: "Direct Sierra-Papa-Lima, ExAir 123"

VATSEA - 4. Clearances
Clearances

4.1. On The Ground
4.1.1. Clearance
4.1.2. Pushback and Startup
4.1.3. Taxi
4.2. Airborne
4.2.1. Take-off and Cruise
4.2.2. Landing and Vacating the Runway
4.2.3. Ending a Flight
4.3. Clearance Limit
4.4. Conditional Clearance

4.1 On the Ground [S]

Before a pilot departs on a flight, he/she has to make a number of Pre Flight preparations based on, amongst others, information about current weather, departure routes, arrival routes, waypoints en-route, cruising levels, weight and balance and aircraft conditions etc. When the pilot has received all information needed, he/she will create a flight plan (mandatory for IFR flights, but only required in some cases for VFR flights) either from scratch or from a pre stored flight plan. When the flight plan is complete it will be sent to the ATC and be processed into a flight strip and distributed to suitable ATC facilities. The flight strip will contain data such as departure and arrival aerodromes, requested cruise level, route, type of aircraft, cruising speed, if the flight is to be flown under VFR or IFR regulations, alternate arrival aerodrome and special remarks. This flight strip makes the substratum for the controller's actions. This means that it is vital that the flight plan and flight strip is updated by ATC if any changes should occur during the flight.

4.1.1 Clearance [S]

The pilot will perform pre startup checks and call clearance delivery for ATC-clearance, provided clearance delivery is on-line. If Delivery is not on line, but Tower is on line then the pilot will call Tower for clearance. If Tower is not on line but Approach is on line then the clearance will be requested from Approach. I.e. the pilot will always call the next position "above" the one ideally required. **(NOTE: FSS stations do not provide clearance service, as they man traffic ONLY above FL245).** The pilot in command will also go through loading sheets, fuel data, and boarding data together with ground personal and flight crew. The ATC-clearance is very important, because this clearance clears the aircraft from the aerodrome of departure to a specified clearance limit. This is normally the destination aerodrome, but may in certain cases be a navaid or fix (such as a FIR border). It also contains the route to follow after departure (a SID, direct to a significant point, or a heading/track or radial to follow), including altitude restrictions (although altitude restrictions may be included in the SID, and thus not included in the spoken clearance).These give the pilot a chance of pre-tuning radios and prepare himself and the aircraft so the workload on climb out may be limited. Due to the fact that the pilot is quite busy with the pre startup procedures the controller shall make sure the pilot is ready to copy the ATC clearance before reading it out. It is vital that the clearance is understood correctly so everything in the clearance must be read back before proceeding.

Items marked with (*) below can be excluded in some instances

.

The call for clearance from the pilot should include:

1. Who (s)he is *(Exair 131)*
2. Where (s)he is (*Somewhere stand 36/Apron South)*
3. What (s)he is* *(Boeing 737)4*.
4. Current ATIS designation, at some airports including QNH *(Information Mike, QNH 993)*
5. What do s(he) want *(Request startup and clearance to Someplace airport)*

The clearance from ATC should include:

1. Clearance limit *(Someplace airport)*
2. Departure route (*Can be a SID/Significant Point/Heading /Track/ Radial) (VORING 2 Golf departure)*
3. Route* *(Upper November 850)*
4. Initial altitude/level *(5000 feet, not needed if this is specified in the SID)*
5. Transponder code (*Squawk) (Squawk 7351)*

NOTE1: A SID normally includes the published initial altitude and climb constrains as such this information is not usually necessary. However it is often included in the clearances.

NOTE2: mainly in the USA the clearance also includes the departure frequency, as such a 6th element in the clearance would be:

6. Departure frequency *(After departure contact 125.35)*

This is also referred to as **CRAFT**: **C** (learance): cleared to destination, **R**(oute): via SID dep **A**(ltitude): climb initially 5000' **F**(req): after dep contact xxx.xx **T**(ransponder): squawk 7134

Additional information from the controller:

1. Departure runway* (Runway 19 – not given if it is included in ATIS)
2. Wind* (250 degrees 5 knots – not given where ATIS is available)
3. QNH* (QNH 993 – not given if the pilot has already reported the correct QNH)
4. Temperature* (15 – given to turbine engine aircraft where no ATIS is available)
5. Runway Visual Range* (RVR) for the departure runway (given when reported, where no ATIS is available)
6. Runway conditions (braking action and contamination)* (Braking action good, runway wet – given when reported, where no ATIS is available)

At many smaller airports, where the ATC clearance is transmitted to the pilot by TWR or AFIS, the controller or AFIS officer must obtain the clearance by calling the ACC or APP unit, when the pilot requests start-up. Therefore, at these airports, TWR/AFIS will not be able to transmit the clearance to the pilot on the initial call. Depending on how long time it takes to retrieve the clearance, it will be issued before or during taxi. Naturally, it must be given before take-off.

If you have the time, it might be good to write down the clearance on a piece of paper before you feel that you can give a clearance fluently.

An alias sentence is very valuable in order to issue ATC clearances

If the pilot calls you before you have been able to make all necessary preparations to give the clearance, you can ask the pilot to wait. It is however important to stress that any call from a pilot should be acknowledged as soon as possible, even though you can't give the clearance straight away. In those instances you can often give some information, such as the QNH and active runway.

XXX131 "Somewhere Clearance delivery, Exair 131, Boeing 737, Stand 36 with information Echo. Request start-up and clearance to Someplace."
DEL "Exair 131, Start-up approved, QNH 993. Stand by for clearance.
XXX131 "Start-up approved, QNH 993, Exair 131.

A rule of thumb is that you shouldn't read the clearance to the pilot if he hasn't asked for it. If he only asks for push-back, that's what you should give him initially. The actual clearance would then follow in a separate transmission. If you have asked the pilot to wait until you have reviewed his flight plan and made necessary preparations to give him the clearance, you should ask him if he is ready to copy the clearance before you read it to him. In other words, avoid issuing the clearance unless you are certain that the pilot is ready to copy.

DEL "Exair 131, (are you) ready to copy clearance?"
XXX131 "Ready to copy / Go ahead, Exair 131"
DEL "Exair 131, clearance to Someplace via VORING 2 Golf departure, 5000 ft, Squawk 7351"
XXX131 "Clearance to Someplace via VORING 2 Golf departure, 5000 ft, Squawking 7351, Exair 131"
DEL "Exair 131, read back correct, Contact Ground on 121.95 for pushback"
XXX131 "Ground on 121.95, Exair 131, Bye"

The pilot should read back all elements in the clearance to confirm that he has copied them right. As controller it is hence very important to listen to the read back actively. If the read back is correct, this should be acknowledged and if not, the mistakes should be corrected. If for example the squawk is read back wrongly, you don't have to read the whole clearance one more time. It is enough to correct only the parts that were misunderstood.

4.1.2. Push-back and Start Up [S]

When boarding is completed and all pre-startup procedures are done, the pilot will call for either pushback or startup or both. (whether pushback is required naturally depends on the parking position). At certain airports, apron control (callsign "Apron") is available to handle pushback, start-up and aircraft movements on the aprons. At other airports, Ground approves pushback and start-up, but the actual manoeuvres are supervised by ground mechanics. Before you give push-back approval, make sure that the immediate area around the aircraft is free of any conflicting vehicles or other aircraft. You can also tell the pilot to push-back at own discretion, in which case he has to look out for traffic on his own. It is however better to give clear and precise instructions in order to minimize the risk of crashes.

XXX131 "Somewhere Ground, Exair131. Stand 36, request pushback"
GND "Exair 131, pushback approved"
XXX131 "Pushback approved, Exair 131"
XXX124 "Somewhere Ground, Exair 124, Stand 34, request pushback"
GND "Exair 124, hold position, company MD11 pushing from Stand 36"
GND "Exair 124, when free of company MD11 pushing from Stand 36, push back approved"

Sometimes ATC may have to delay the start up approval due to congestion on the ground or due to saturation in the area.
GND "ExAir123, Expect Start Up at 15.15Z"
Or
GND "ExAir123 Expect Departure time at 15.15Z Start Up At your discretion"

4.1.3. Taxi [S]

To allow the ground controller to rely on and use traffic flows on the taxi ways, the pilot should be ready to taxi before requesting taxi clearance. As soon as the taxi clearance is received, the pilot is expected to carry out the taxi instructions as soon as possible to obtain best traffic flow.

The taxi-ways are many and varied and their structure is complex, especially at bigger airports. Taxi-ways are often one-way only in order to avoid situations with two aircraft converging nose to nose – aircraft have no reverse gear. The ultimate embarrassment for a Ground controller occurs when two aircraft taxi on the same taxiway but head on. In these hopefully rare cases the rule of thumb is that each aircraft on the ground should turn to the right to allow sufficient space between the aircraft, prior to continue with taxiing Taxi-ways can be one-way in one direction (say south) when one runway-configuration is in use, and one-way the other way (say north) when another runway-configuration is in use. It is good to have a chart over the published standard taxi-way routes at hand when you are controlling a bigger airport. All Taxiways that you want an aircraft to follow to the Runway or to a gate should be specified by the controller.

If traffic is dense and many planes are taxiing to and from the gates and runway, you have to think one step ahead. You might have given instructions to pilots to hold at certain intersections to let other aircraft pass, or instruct pilots to follow preceding traffic to maintain a safe and smooth flow.

XXX131 "Exair 131 request Taxi"
GND "Exair 131, behind company DC 9 passing from left to right on Yankee, taxi to holding point runway 19 Right"
XXX131 "Behind company DC 9, taxi to holding point runway 19 Right, Exair 131"

NOTE: In 2005 ICAO as part of a comprehensive effort to improve runway safety, changed the phraseology "TAXI TO HOLDING POSITION" into "TAXI TO HOLDING POINT" in the PANS-ATM, in order to avoid confusion with the non-ICAO phraseology "TAXI INTO POSITION AND HOLD" which continues to be used by some worldwide. As the "holding point" referred to in the revised phraseology is synonymous with "runway holding position" Therefore; when used in radiotelephony phraseology, "runway holding point" refers to "runway holding position".

Whilst Ground is primarily responsible for all traffic movements on the ground and would normally hand over to Tower when the aircraft is holding short of a Runway, an exception occurs at many airports having taxi routes that cross a Runway (even if not active) as in these cases Ground hands over responsibility to Tower at the holding point of the runway to be crossed and Tower from that moment on continues issuing Taxi instructions, except when Ground and Tower coordinate the ground and taxi movement between them in which cases usually Ground will have received prior approval from Tower authorizing Ground to issue Runway crossing instructions to any aircraft on the ground. There are different manners in which Ground or Tower as the case may be can issue Taxi Instructions:

GND "ExAir23 Taxi Via Y and B to holding point B3 runway 22R"
Or
GND "ExAir123 Taxi to Holding Point F1 runway 18"
Or
GND "ExAir123 line up runway 12 via backtrack, report ready for departure"
Or
GND "ExAir123 Turn (First/Second) taxiway (Left/Right)"

4.2 Airborne [S]
4.2.1. Take-off and Cruise [S]

When the aircraft has reached the holding point and the pilot is ready for departure, it is time to line up. An aircraft is lined up when it is standing on the runway centre-line with the nose pointing in the direction of the active runway. It is allowed to instruct a pilot to line up even though the runway isn't clear – i.e. preceding traffic hasn't vacated the runway.

The only time the word "take-off" is used is when the aircraft is cleared for "take-off". in all other transmissions, the word "departure" should be used. This is very important since a misunderstanding at this stage can be very dangerous.

XXX131: "Tower, Exair 131"
TWR: "Exair131, You are no 2 for departure, in sequence behind the SAAB 340, line up and wait Rwy 19 right"
XXX131: "In sequence behind the SAAB 340, line up and wait Rwy 19 Right, Exair 131"

The instruction "line up in sequence" means that when the aircraft in front of XXX131 has begun his take-off roll down the runway, XXX131 can line up and wait behind him with no further ATC instructions

TWR: "Exair 131, you are no 2 for departure"
XXX1465: "Tower, Exair 1465 is ready for departure"

Next follows the take-off clearance. The runway designation always has to be included in the take off clearance. Also include the present wind if it is significantly different from the wind reported in the ATIS or previously given to the pilot.

TWR: “Exair 131, rwy 19 Right cleared for take off; wind 210 degrees 8 knots.”
XXX131: “Rwy 19 Right, cleared for take off, Exair 131”

Reminder: Wind direction and speed is weather information from the ATC and is not required to read back. (QNH is the exception) As QNH is required information for procedures (TA/TL) it’s a directive and not an information. That said, QNH, being a directive, needs the read back. All other information which does not imply directives (as weather information or ANY other information) do not need read back

4.2.2. Landing and Vacating the Runway [S]

Before you can clear an aircraft to land, you have to make sure the runway is free from all other traffic and that no other aircraft is ahead on final. If this is the case, you’ll have to instruct the pilot to "continue approach" until you are able to give him clearance to land.

Remember that speed is the best way of separating aircraft on final, but that speed restrictions usually are waived when the aircraft passes over the outer marker, as specified in the AIP for the airport.
If the phrase “Callsign only” is included in handover, it means that the pilot should check in to the new controller with his callsign only. No need to make any position report to ATC.

APP: “Exair 4321, contact Tower 118.5, callsign only”
XXX4321: “Tower 118.5, with callsign only, Exair 4321”
XXX4321: “Somewhere Tower, Exair 4321”
TWR: “Exair 4321, continue approach, you are no 2, wind 280 degrees 4 knots”
XXX4321: “Continue approach, number 2, Exair 4321”
TWR: “Exair 4321, Runway 26, cleared to land
XXX4321: “Runway 26, cleared to land, Exair 4321”

Note: If there is no big changes in wind speed or direction this information only have to be told by the controller one time and therefore be left out the in the last “cleared to land” phrase in this example.
The word “vacated” is used when we mean that an aircraft has left the runway or “vacated runway”.
The word "clear" or "cleared" should never be used in this context in order to avoid confusion.

XXX4321: “Exair 4321 vacated runway 26”
TWR: “Exair 4321, roger taxi to stand 36”
XXX4321: “Taxi to stand 36, Exair 4321”

4.2.3. Ending the Flight [S]

When the aircraft has vacated the runway it is time to taxi to the gate or apron. These instructions are covered in the section above (3.1.3). Since aircraft are very different in shape and size, parking stands and gates are designed for different aircraft types and sizes. There may also be different terminals for different airlines and different aprons for different types of traffic (general aviation, cargo, military etc) Study the information for your airport to know where different aircraft should be parked

Many pilots ask permission to end the flight at gate, or to shut the engine.

XXX4321: “At the gate, request closing Flight Plan and leave frequency”
TWR: “Roger, thanks for Flying to "Somewhere" Have a nice evening. Goodbye”

4.3. Clearance Limits [S]

We have mentioned the words Clearance Limit in various contexts above but for good orders sake, in order that both ATC and Pilots know what these words mean
The Clearance Limit mainly concern pilots and what actions they are expected to take in the event of communication failure. This is of course especially important in busy periods like a fly-in

Clearance Limit is the point to which an aircraft has been cleared by a particular ATC. The aircraft is at any time allowed to proceed to that particular point, but not past it.

The Clearance Limit differs, depending on the ATC Position issuing the clearance.

Clearance Limit issued by Delivery:
ExAir123, cleared as filed to LFPG via flight plan route, sq 1122, intl FL70, Rwy 36C
In the above example, the Clearance Limit is LFPG and forms part of the general clearance.
Clearance Limit issued by Ground
ExAir123, taxi via Y and A to 22R, hold short of crossing 12/30
In the above example, the Clearance Limit is the Holding Point short of crossing 12/30 where the aircraft HAS to stop and await further instructions.
Clearance Limit issued by Tower
ExAir123, taxi via Y to Rwy 22R hold short at A3
In the above example the Clearance Limit is the holding point A3, short of runway 22R, the aircraft HAS to stop at A3 and await further instructions.
Or
ExAir123, cleared for take off on SORGA1C sid, winds 220 at 20
In the above example the Clearance Limit is the prescribed Max Altitude relevant to the SID being flown and the Limit (in event of a communication failure) is SORGA, the aircraft will climb to and mantain this altitude until cleared to climb further and will need to enter a hold over SORGA is no further instructions are given.
Clearance Limit issued by ACC
ExAir123, Proceed EEL reach EEL at FL110
In the above example the Clearance Limit is EEL, the aircraft has been cleared to EEL vor at FL110, if the aircraft does not receive further instructions before reaching EEL, the aircraft HAS to enter a standard hold until receiving further instructions. Most pilots like to receive a short cut from ATC if possible, and this usually is done during the cruise by the ACC. The thing to bear in mind here is that you should never clear a pilot to a ”direct” navaid or point which falls outside of your AOC.

If however ACC instructs the pilot to proceed ”direct EEL” as a short cut the the pilot is expected to continue according to the flight plan route when reaching EEL

ExAir123, Cleared Direct EEL
Or
ExAir123, Cleared inbound Arlanda via TROSA3M arrival Runway 26

In this example the Clearance is the end of the STAR in this case it would be at TEB (which is the IAF). The pilot can follow the arrival route as pescribed and over TEB unless the approach controller has recleared the aircraft further would enter the hold.

In Conclusion, unless a follow up clearance is given or a handoff to a new ATC is done, an aircraft will HOLD at the clearance limit. Aircraft's on the ground will stop and hold for instructions, whilst aircraft's in the air will enter standard Hold patterns.

Airborne

5. In the Air
5.1.1. General
5.1.2. Vertical Separation
5.1.3 Horizontal Separation
5.2. Departure and Sid
5.3. Routes
5.3.1. Route Components
5.3.2. Complete Routes
5.3.3. Airways - Flight Levels and Direction of Flight
5.4. STAR and Arrival
5.5. Approaches
5.5.1. Type of Approaches
5.5.2. General Principles
5.5.3. Instrument Approaches
5.5.4 Precision Approaches
5.5.5 Non Precision Approaches
5.5.6 Straight In Approach
5.5.7. Circling Approach
5.5.8. ARC Approach
5.5.9. Visual Approach
5.5.10. Full Procedure Approach
5.5.11 Further Reference
5.6 Airfield Traffic Pattern
5.6.1. Traffic Pattern
5.6.2. Wind Direction
5.6.3. Layout
5.6.4. Overhead Join
5.6.5. Contra Rotating Pattern
5.6.6. Altitude
5.6.7. Helicopters
5.7 ILS

5. In the Air [S]

This is the place where aircraft belong – flying. The preparations done by air traffic control and pilots prior to departure aim to enable a safe and smooth journey through the airspace. In general you might say - the better the preparations done prior to departure, the less work for the air traffic controller and pilot en route

5.1. General [S]

Rules regarding separation follow ICAO document 4444, however in VATEUD these rules vary a bit from country to country especially in relation to reduced separation applied at certain busy airports. It is not in the scope of this guide to give all details regarding separation in all countries in VATEUD, but we will focus on the general rules.

Maintaining separation between aircraft is the main task for air traffic control, a task that can be quite difficult and very demanding. Here you'll find the rules and some tips on how to maintain good separation in the air. Let's start with the basics – some guidelines and tips that make separation easier.

- Have a clear strategy what you want the pilot to do. Order and contra orders leads to confusion and frustration.
- Consider what implications your instructions have. It's not a good idea to give a pilot clearance to land if you at the moment before gave another pilot instruction to line up on the same runway.
- Talk clearly and not too fast. It may sound "cool" talking fast but it often leads to misunderstanding which makes it slower.
- Use standard phraseology. This reduces the risk of misunderstanding and confusion.
- Listen to the read back carefully as it was the first time the instruction was given. Mistakes happen easily.
- Act immediately if you have a situation with a potential conflict. Don't wait until the conflict is imminent – then it's usually too late.
- Don't take on more than you can manage. Take a position which you feel you manage and ask for help if you need it.

Since VATSIM is a radar environment, radar separation may be used in general. A rule of thumb for separartion minima is; **1000ft and 5nm.** There are of course several exceptions to this rule of thumb, but you'll manage most situations just fine with it alone.

5.5.1. Approaches [S]

The Approach Controller main task is to separate arriving traffic in order to maintain an optimum flow of traffic into any given field by means of giving course, altitude and if needed speed restriction instructions to pilots.

In VATSIM, pilots most often request and ATCs most often give ILS approaches regardless of time, weather conditions, or type of aircraft. There are however more types of approach types than only ILS.

So, the aircrafts are now well on their way in to the field, they have followed the STAR and the Approach or Director Controller now has to vector the aircraft in towards the field for a safe and orderly handoff to the Tower Controller for a safe landing.

5.5.2. General Principles [S]

The most challenging and work intensive part of any flight is the landing phase, as the saying goes a good landing is a controlled crash at the best of times. But before an aircraft actually lands it has to Approach a field.

Approaches are classified as either **precision** or **non-precision**, depending on the accuracy and capabilities of the navigational aids (navaids) used. Precision approaches utilize both lateral (course) and vertical (glide-slope) information. Non-precision approaches provide course or glide-slope information only.

An instrument approach or instrument approach procedure (IAP) is a type of air navigation that allows pilots to land an aircraft in reduced visibility (known as instrument meteorological conditions or IMC), or to reach visual conditions permitting a normal landing.

Charts depicting instrument approach procedures are called Terminal Procedures, but are commonly referred to by pilots as "approach plates." These documents graphically depict the specific procedure to be followed by a pilot for a particular type of approach to a given runway. They depict prescribed altitudes and headings to be flown, as well as obstacles, terrain, and potentially conflicting airspace. In addition, they also list missed approach procedures and commonly-used radio frequencies.

The whole of the approach is defined and published in this way so that aircraft can land if they suffer from radio failure; it also allows instrument approaches to be made procedurally at airports where air traffic control does not use radar or in the case of radar failure.

Change of Plans

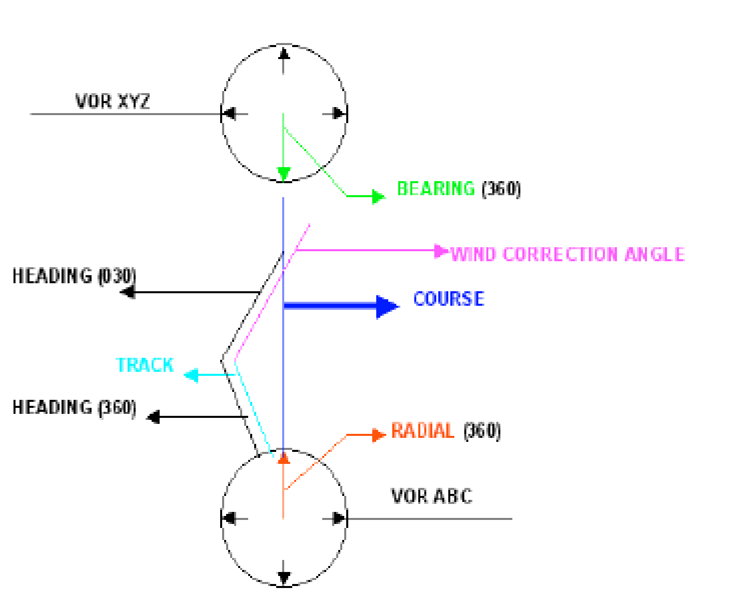
6.1 Vectors
6.1.1. Lateral Vectoring
6.1.2. Vertical Vectoring
6.1.3. Conditional ATC instructions
6.1.4 Calculating the TOD
6.2. Re-routing
6.3.Holdings
6.3.1. Concept
6.3.2. .Usage
6.3.3. Flying a Hold
6.3.4. Holding Clearance
6.3.5. Standard Holding Pattern
6.3.6. Non Standard Holding Pattern
6.3.7. Holding Entry Procedures
6.3.8. DME Holdings
6.3.9. published en-route and Terminal Chart Hold Patterns
6.3.10. Estimated Approach Time
6.3.11. Examples and Recap
6.4. Speed
6.4.1. General Concepts
6.5.2. So what does this all mean?
6.4.3. Minimum Speed
6.4.4.Speed Restrictions
6.4.5. Conversions
6.4.6. Summary

6.1. Vectors [S]
As ATC we tell aircraft what to do, what route, heading or track to follow, as well as what Flight Level to fly at. In essence ATC has the right to instruct any aircraft to turn in any direction depending on local circumstances.
When dealing with lateral separation we speak about vectoring and when dealing with vertical separation we speak about climb or descend instructions. (in fact all of these are a kind of vectors)
In order to issue either of the above correctly, efficiently and above all purposefully you need to have the Area Charts and know the airspace around you.
There really is not that much that can be explained about radar vectoring as it is something you will pick up and learn as you progress.
The Main thing to bear in mind is “Do not Over Vector”. What we mean by this is keep your instructions to the point, do not tell the pilot what to do every 2 minutes, don’t ask the pilot to report in every 5 minutes. There is absolutely no need for this and above all think ahead at all times.

6.1.1. Lateral Vectoring [S]

Let us start with an explanation here of what navigation is. This is more relevant to pilots, but from time to time you get a pilot who has just un-packed his Flight Simulator, joined VATSIM, fired it all up, come on line being totally new and does not know the difference between a VOR and an ILS.

The essential component of navigation is the concept of direction and this applies both to Pilots and to ATC.



Let us consider the above diagram: bearing in mind that a VOR has 360 different Radials or if you want 360 compass degrees, where 360 degrees (note that 000 does not exist) indicates North, 90 degrees East, 180 degrees South and 270 degrees West.

- **Heading: The direction the nose of the aircraft is pointed at**
- **Course: The direction over the ground that the PIC want to fly**
- **Track: The actual path over the ground which the aircraft is following**
- **Wind Correction Angle: The angle used to compensate for wind drift.**
- **Radial: The direction from a navigation aid (outbound)**
- **Bearing: The direction to a navigation aid (inbound)**

Now that we have established the most basic components dealing with direction or lateral navigation we will look at a few things you as ATC need to bear in mind when controlling.

When issuing a HDG advice to an aircraft, always use a direction ending on 0 or on 5.

ExAir123, Turn Right Heading 090, or Left Heading 155

If we once again refer to the above diagram, keep in mind that the radials of a VOR (all 360 of them) extend from the VOR. Therefore if you instruct an aircraft to leave VOR ABC on Radial 360, Direct to VOR XYZ, the aircraft will point its nose to heading 360 and will be flying the inbound leg towards VOR XYZ on Radial 180, but on a Bearing of 360.

When issuing Left or Right turn instructions to an aircraft, keep the turn radius in mind, as the heading the aircraft ends up on after leveling out, may very well be the heading you instructed but on a different track altogether. Therefore add the expected variance to the head instruction.

The higher the speed at which an aircraft is flying, the larger turn radius is needed to come to the heading instructed by ATC.

For instance an Aircraft is flying a heading of 190 but you want it to be at a specific point, showing a heading or track of 130 at a particular moment in time. Instead of instructing the aircraft to turn Left hdg 130, add another 5 to 10 degrees that you want the aircraft to turn, in this instance to intercept your desired points, instruct the aircraft to Turn Left Hdg 120.

The above example depends on a number or factors, such as speed of aircraft or speed and direction of wind. As you become more experienced you will automatically get into the habit issuing these corrective-heading instructions.

Most of your active vectors will be when you as ATC have traffic inbound to a field that either requires ATC vectors for the approach due to not being able to follow a STAR or who need to be vectored away from conflicting traffic or vectored for the sake of maintaining or increasing separation on approach or final.

A good Controller will always explain to the pilot the reason for the vector instructions being issued. For instance a pilot is following a published STAR and ATC decides to deviate from this STAR
ExAir123 Turn Right heading 120 expect vectors for approach runway 05L

6.1.2. Vertical Vectoring [S]

Let us start by recapping on the two main concepts to use when giving climb or descend instructions:
Flight Levels
Used for aircraft flying Above the Transition Altitude, Transition Level or for Aircraft climbing through and above the Transition Layer
The Altimeter in the aircraft is set to Standard Barometric Pressure 1013 (QNE)
Altitude
Used for aircraft flying below the Transition Altitude or for Aircraft descending through and below the Transition Layer
The Altimeter in the aircraft is set to Local QNH pressure.

When instructing an aircraft to climb or descend to a Flight Level below FL100, omit the initial “0” from the FL.

ExAir123 Climb and Maintain FL80
or
ExAir123 Descend and Maintain FL60

Remember to ensure that the aircraft are at a correct Altitude when nearing the Final Approach Fix (a good rule of thumb is 3000FT at 10 miles from the Runway.
Remember that aircraft fly slower and use more fuel at low altitudes than at higher altitudes; it is therefore pointless getting an aircraft down to 5000ft or 3000ft with 50 or 60 miles to go until on final.
Try to avoid the Descend/maintain/descend again/maintain etc situation and instead aim for a continuous and fluid movement where the aircraft at all times is gently descending, if needed advice the Pilot the Rate of Descend he should follow.

Another advice that ATC can give to a pilot which helps the pilot to choose a good rate of descent is to advice the pilot of the remaining track-miles to thouchdown
ExAir123 expect 45nm to touchdown, when ready decent to 4500ft, QNH 1020

VATSEA - 7. Coordination

Coordination

7. Coordination
7.1 Cooperation with other Controllers
7.2 Handoff
7.2.1 Handoff Recap
7.3 Shift Change
7.4 Coordination between the different ATC units

7 Coordination [S]

Coordination before hand-off is usually needed when an aircraft has diverted from its planned route or isn't able to follow standard procedure. Coordination is not really needed if the aircraft follows standard procedure. Should any uncertainty arise, coordination should be initiated and cleared before transfer of control

7.1 Cooperation with other controllers [S]

All coordination should be initiated well before the aircraft enters the airspace of the next controller. An aircraft is considered to follow standard procedure and does not need to be coordinated in the following instances:

- Traffic climbing or descending without restrictions to the temporary or final level as entered in the tag
- Traffic en-route, following the flight plan
- All regular departing traffic on a SID
- All Arriving traffic following a STAR
- Departing traffic from TWR climbing to initial altitude as published
- Traffic established on final approach according to the published procedures.

If a controller cannot accept any more aircraft into his sector, he should communicate this to other controllers by any means possible, usually could be due to over saturation. Other controllers should instruct traffic under their control to hold as published and not let any aircraft enter that sector until advised to the contrary.

7.2 Hand-off [S]

A handoff is an action taken to transfer the radar identification and control of an aircraft, from one controller to another. It consists of four steps:

- Coordination before hand-off
- Initiate and accept handoff, (using the relevant ATC software functions, "F4", etc) prior to traffic leaving the area of responsibility.
- Handoff of communication (advice the traffic on voice or text who they shall contact next), prior to traffic leaving the area of responsibility.
- Handoff of control either when traffic leaves the area of responsibility or immediately after handoff of communication. (depending on Letters of Agreement "LOA's" in place),

Provided that an aircraft is being transferred from one controller to another in accordance with Standard Operating Procedure then the handoff is simply accomplished by using the automated handoff facility built into ASRC and VRC (F4 function) or by using the Right Click Mouse hand-off to button if using VRC. In order to be able to use this facility it is essential that all aircraft which are in the air and under Control from ATC are "tracked" by the controller initiating the handoff.

The controller accepting a handoff is responsible for the aircraft from the moment the aircraft enters into its area of responsibility. The acceptance of the handover is an indication to the previous controller that the aircraft may enter into the area of responsibility of the receiving ATC.
When the receiving controller has accepted the aircraft, no further adjustments to the flight by the delivering controller are allowed. The aircraft should be issued instructions to change radio frequency before entering the next controller's Area of Responsibility.

Where a Standard Operating Procedure does not exist, or an aircraft has to be transferred other than in accordance with the SOP then individual Controller to Controller co-ordination must take place. This can be via ATC channel, via Private Chat or by direct voice communication using intercom or by other means (Teamspeak, Skype).

When handing off an aircraft outside of SOP it is important to let the receiving controller know about instructions you have given to an aircraft. At the same time it may be necessary to tell the pilot to report such instructions to the next controller. Although an area of control goes all the way to the Boundary, it's polite to hand-over a good 10 to 20 miles from the actual Boundary, regardless of sector, be it TMA, FIR or VACC. Under all circumstances you need to ensure that a full hand-over has been completed at least 5 miles from the respective Hand Over Fix.

Members making use of the Flight Strip function should transfer the appropriate flight strip to the accepting position a few minutes prior to the aircraft being handed over.

Radar and non radar handover: A number of VACC's may operate under the procedure that Ground and Tower positions are non-radar hence these positions do not "track" any aircraft. In practice this would mean that Approach does not hand-over the aircraft to Tower but rather simply Drop Track whilst instructing the Aircraft to contact Tower.

Tower in turn would not Start Track but keep the aircraft untracked.
Similarly Ground and Tower would not track any aircraft and as such departing aircraft are not handed over to Approach or Departure, but simply appear once airborne.

7.2.1 Handoff Recap [S]

To recap on the Main ATC positions here follows a general and brief reminder of where and when and to whom you will hand-off traffic

GROUND
Handles all Traffic on the Ground and hands over to Tower either at the Holding point or Prior to any aircraft crossing a runway. Ground will receive landing aircraft from Tower after vacating the active runway.
Runway crossings can also be done by coordination between TWR and GND without actually handing off the aircraft to TWR.

TOWER:
Handles all traffic on runways or the extensions thereof. Departing traffic should in general contact Departure or Approach depending who is on line as soon as airborne or before passing 2000ft and under

all circumstances within 10 miles from the runway. Arriving Aircraft should be passed to Tower by Approach once the landing aircraft is established on Final or when intercepting the localizer depending on the agreement made between Tower and Approach as the case may be.
Tower can also instruct traffic to contact GND prior to having vacated the runway after landing .

APPROACH:
Usually handles all inbound traffic within 30 to 50 miles from the airfield up-to FL120, once an aircraft is established on final it is passed to Tower, as a rule of thumb this is usually around 10 miles from the runway. There are airports where the FAF is closer to the runway and hence the handover to TWR will only take place at 6 to 8 miles from the runway.

DEPARTURE:
Handles all departing and crossing traffic within the area of control in general up-to FL120, some exceptions exist whereby Departure remains in control up to FL190 but this is an exception to the rule. Departure receives departing aircraft from tower once airborne, at or close to 2000ft and within 10 miles from the Runway. Departure in turn hands-off to Centre (also known in certain VACC's as "Control" or "Radar" at the appropriate point.

CENTER:
Handles all airborne traffic except that under the control of Tower, Departure or Apprpach in the FIR. co-ordinates with adjacent ATC facilities and passes aircraft over to Approach when entering the appropriate area.

Centre usually also handles all departing and arriving aircraft to any other airfiled in the FIR which is not controlled at any given time, this can include the issuing of Clearances, Push and Start-Up as well as Taxi and Take of Clearances or Landing Clearances.
Centre finally co-ordinates with Euro Control if no other appropriate ATC is on line.

VATSEA - 1. ATC Basics
1. ATC Basics

1. How to read the manual
2. The responsibility and role of a ATCO
3. Controller functions
    - Clearence Delevery (DEL)
    - Ground (GND)
    - Tower (TWR)
    - Departure (DEP)
    - Approach (APP)
    - Area Control Center (ACC)
    - Flight Information Service (FIS)
4. The VATSIM community
5. About VATSIM

1.1 How to read the manual
This manual is intended both for those novice to air traffic control, who want to learn the basics, and to those who want to learn more.
If you are new to air traffic control, we'd like to point out that this manual is quite comprehensive, and it is absolutely not necessary to know everything in this manual by heart. You will get an idea of what it is all about, and can later use the manual as a reference to get necessary information.

Some sections are more advanced than others. The sections are marked according to what level they correspond to in the following way:

- (unmarked) – Required knowledge for all controllers.
- [S] – Required knowledge for Students and above.
- [S+] – Required knowledge for Senior Students and above.
- [C] – Required knowledge for Controllers and above.
- [C+] – Required knowledge for Senior Controllers and above.
- [Ref] – Reference only for all controllers.

In conjunction to this manual you should also read the GUIDE. The GUIDE contains material that focus more on practical ATC. Aditionally stand alone manuals covering each ATCO position can be found on this site.

Finally, we would like to point out that our motto is “as real as it gets”, but also always remember to have fun while aiming at that goal. Good luck!

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1.2 The responsibility and role of an ATCO [S]

We start with the most important:

As a controller, your main task is to separate aircraft. Your responsibility is therefore to make sure no collisions occur. You must at all time avoid any risk of collision.

Now that we have said it in three different ways, we hope that you remember what your main task is. But there are other tasks as well..

- Prevent collisions between aircraft.
- Prevent collisions between aircraft and ground / obstacles on ground.
- Expedite and maintain an orderly flow of air traffic.
- Provide advice and information for safe and efficient conduct of flight.
- Make it as real as it gets and at the same time understand that all involved shall have as fun as possible.

As a controller, you have a good overview over the traffic, but you never know how the situation is inside the cockpit where the pilots sit.
Your responsibility is therefore to the traffic situation.
You are not responsible to how the aircraft is flown. Every pilot has a responsibility for his aircraft.

Sometimes, there is a disagreement between you as as is the most important difference between real life and the virtual world. Try not to get angry, never argue with anybody, but rather point out the problem in a calm and constructive manner.

The above can be summarized in “common sense” and “humility” - two good characteristics.

If a situation gets unpleasant or hatred, or if a pilot deliberately tries to sabotage our environment, you should try to contact a Supervisor (SUP) or Administrator (ADM).
These people have a responsibility to act in this kind of situations, and they are also the only ones who can expel pilots and controllers.

Let's move on from this boring but necessary topic and look closer on your task as a controller.
Apart from separation, you should also give service to the aircraft. Simply said, you should guide the pilots from point A to point B.
The pilots are in a never ending need of current information. They need weather acontroller and the pilot as to what is the right action in the current situation. Remember that it is the pilot who has final word in these situations.
This doesn't mean that he can fly his aircraft the way he pleases, but rather that you cannot give the pilot an instruction which he or his aircraft is physically unable to perform.
To avoid this kind of conflicts, it is always important to give the reason why unusual instructions are given.
It is very rare that disputes occur in our virtual world. We always try to help each other. If you end up in a dispute anyway, try to remember that we are real people in a virtual world.
If you or anybody else makes a mistake, no lives are at stake. Thind traffic information etc. It is your responsibility to deliver this information as correctly and quickly as possible.
There is one final task which isn't less important than the others. That is to have fun. We want you to enjoy yourself online VATSIM!

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1.3 Controller functions [S]

One of the most common mistakes made in the VATSIM environment is the misconception of a particular facility's function.

A controller can work in many different roles, where maybe Tower is the most well known. Every role has its own responsibilities and working tasks as described below.
Note that in the on line environment, we have reduced the number of tasks, in real life, there are many more.

A basic summary of what each position does follows below. The usual practice is that a position takes over all of the “lower” when they are unmanned.

Example:

TWR handles all the duties of the position DEL, GND and TWR if none of the “lower” is on-line.
If DEL gets online, then DEL will of course handle DEL and TWR will handle GND and TWR.
Finally (to make things really clear) if GND gets online, then GND handles DEL and GND and TWR only TWR.

Note that some positions require a minimum rating. There may also be stricter local rules that apply for certain controller functions. Please refer to your local vACC for more information.

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1.3.1 Clearance Delivery (DEL) [S]

Clearance Delivery gives ATC clearances to the pilot after checking the Flight Plan.
If the Flight Plan contains error it is DEL’s responsibility to correct them before releasing the aircraft.
This function is not often in use online during normal operation, but you might see it on very busy airports and during fly-inns.

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1.3.2 Ground (GND) [S]

Ground Control is responsible for exercising general surveillance on the airport movement area - apron.
Ground gives taxi clearances and restrictions. Note however that Ground isn't responsible for the

runways, they are tower's responsibility. When the aircraft is approaching the active runway, Ground hands over to Tower, who "owns" the runways.

If an aircraft needs to cross a runway, (active or inactive) on its way to it's destination a specific clearance to do so must be obtained. Ground then needs to coordinate with tower to get approval or hand over the aircraft to TWR for that clearance (the first being the preferable).
There are a few airports that have runways that are used as taxi-ways. They are controlled by GND, if this is clearly stated and coordinated between TWR and GND.

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1.3.3 Tower (TWR) [S]

Tower is responsible for all take-offs and landings and gives instructions to effect proper sequencing and separation of aircraft for departure.
Tower decides which runways are being used for take-offs and landings depending on wind direction etc. You are also responsible for aircraft on the ground when they are on the runway or are about to cross a runway.

Landing aircraft are handed over to Ground as soon as they leave the runway (or sooner at tower's discretion)
Departing aircraft are handed over to the next controller when they leave your airspace, which normally means 3000-4500 ft. The hand-off can also be done earlier if coordinated between TWR and next controller

1.4 The VATSIM community [S]

VATSIM is a huge and quite complex organization.
There is only one sort of membership, but you can say that there are three different kind of activity that you can engage in. Many members participate in more then one of these activities.

- ATC
- Pilot
- Administration

As a pilot or ATCO there is little need to know everything about the organization as such, but from time to time you might want to contact someone from administration to get help or guidance.
Since it isn't always easy to know who to turn to, a brief insight in the organization-tree is presented here for reference. There is also a short description of the history of VATSIM at the end of this section.
It is not in the scope of this manual to describe the VATSIM organization in detail and the best way of finding the right person is to start looking at your own vACCs homepage. There will be a staff-list with contact information on that page. The staff will guide you in the first instance if your request can't be handled within your vACC.
You can also turn to the VATSIM forum and ask for help and further assistance.

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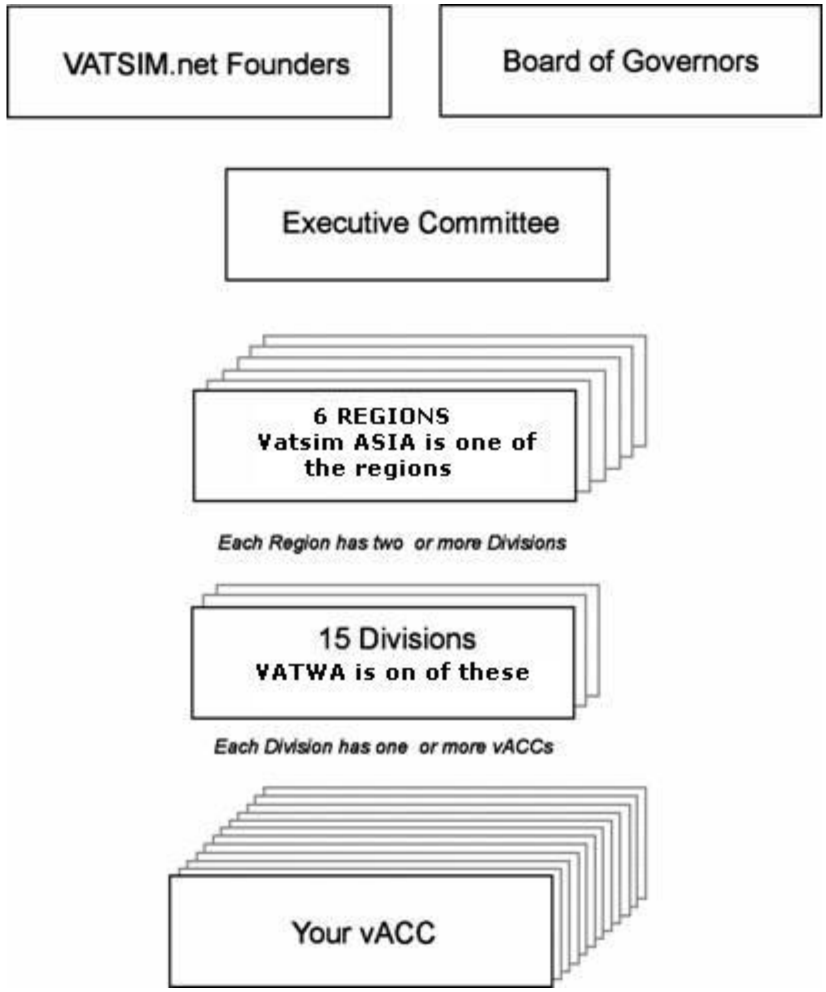

1.5 About VATSIM [S]

An Introduction into the Great Hobby of Online Flight Simulation and Simulated Air Traffic Control

It wasn't long ago when the whole world was ours alone. Beginning with Microsoft's Flight Simulator Version 5.0, we could simulate flying to many parts of the world.
Flying, however, was a very lonely proposition. There were no other airplanes in the skies while we flew en-route and our arrivals at major airports were like landing in ghost towns.
There was dynamic scenery and beginning with Microsoft's Flight Simulator 98, multi-player capability to keep you company. But other than that, Flight Simulator, as wonderful a program as it has been throughout its history, fell flat when it came to simulating air traffic control.

In 1997, all of that changed with the introduction of SquawkBox©, an add-on program for Flight Simulator 95/98, and ProController©, a stand alone program.
Over time, SquawkBox© has been revised several times and now works with all major Flight Simulation programs including Microsoft Flight Simulators 2002, 2004, FSX, Precision Simulator and the Fly! series of programs.

Through the use of ProController, and later on more advanced versions such as ASRC, VRC and more recently Euroscopeand the internet, people operating as air traffic controllers could track and control

aircraft in real time as they flew in Flight Simulator by utilizing a simulated radar screen.
Pilots, using SquawkBox and more recently FSINN, could now talk to and receive air traffic control from people using one of the ATC software platforms in use. Soon thereafter, various organizations were established to bring order and structure to this new nîche in the hobby.

The Virtual Air Traffic Simulation Network, known as VATSIM.net or "VATSIM" was created in 2001 by a group of individuals who came together with a goal of creating an organization which truly served the needs of the flight simulation and online air traffic control community.
With an eye towards more than just providing a network of computers for users to log into, VATSIM is an online community where people can learn and, at the same time, enjoy the pastimes of flight simulation and air traffic control simulation, all while making new friends from all over the world.

VATSIM is not just for individuals who have experience in online flight simulation and ATC. It is perfect for both the new user, and the long time "simmer".

- For someone who has just learned about online flight simulation and air traffic control and is interested in real world procedures, VATSIM and its members, many of whom bring real world experience and expertise to our community, offer an ideal environment to learn real world skills.
- For pilots, you'll be able to fly with radar service by air traffic controllers who issue instruction and assistance in all phases of flight from getting your clearance to arriving at your destination airport.
- For air traffic control enthusiasts, the entire world is simulated meaning you can work ATC virtually anywhere…from a general aviation airport to the busiest airports in the world. Nearly all of the real world positions are available for you to choose and learn to work.

The best part of all of this is that VATSIM brings real people together who share your passion for flight and air traffic control. When you contact that controller or pilot, you aren't contacting a computer generated voice or image - you will be communicating with a real person who shares the same interests as you!
All it takes is a few moments to register and join VATSIM. Once you do, prepare to learn and be rewarded with friendships that will span the globe. In addition, you'll receive the appreciation and thanks of the online flight simulation and air traffic control communities

Meteorology

1. **Introduction**
2. **METAR – Aviation Routine Weather Report**
   - **Wind**
   - **Visibility**
   - **Runway Visual Range**
   - **Weather Phenomena**
   - **Clouds**
   - **CAVOK**
   - **Temperature**
   - **Dew point**
   - **Air pressure QNH**
   - **Trend**

- **Runway Conditions**

3. **VMC Visual Meteorological Conditions**
4. **Figure - METAR**

2.1 Introduction

Weather knowledge is essential in aviation: Visibility, air pressure, thunderstorms, temperature, clouds, rain and dew point etc.
All affect flying in one way or another. You are most affected by weather when flying VFR, but also when flying IFR, there are restrictions how bad weather can be before plans must be changed. In this section, we'll look into how weather is reported, but not how weather affects flight.
There are many acronyms and concepts in weather reporting, which we will learn throughout the rest of this document. Below we'll cover rather completely the weather report. There are many acronyms and concepts. You need not know them all from the beginning, but you must be able to get the name of the airport, wind and air pressure. Since you as a controller read the weather report to the pilots, you'll soon learn the rest of the acronyms.

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2.2 METAR – Aviation Routine Weather Report [S/S+*]

**** As a Student you should have knowledge about what a METAR is and recognize the most essential parts (Where, when, winds and QNH) by heart and know where to find information about the other elements. As a Senior Student you should be able to read out a whole METAR.***

At major airports, weather observations are made every half hour, day and night.
The weather in the METAR is the weather observed 10 minutes before the report.

The following is part of a METAR:

- Airport (for example EKCH for Kastrup)
- Observation time (day and time followed by Z)
- Wind at ground level: direction, speed and unit (knots)
- Meteorological visibility
- Runway Visual Range (RVR) if visibility is below 1500 m.
- Present weather
- Clouds, amount, type and base
- Air temperature and dew point
- QNH (air pressure), preceded by Q.
- Other information, for example wind change.
- Landing forecast, trend.

The following is a brief breakdown of some of the basic METAR elements:

METAR EHAM 121755Z 21016G24KT 180V240 1500 R06/0600U -RA BR BKN015 0VC025 06/04 Q1005 BECMG 9999=		
METAR	TYPE OF REPORT	Either routine (METAR) or non-routine (SPECI). En Route Facilities use either a M or S which follows the time of the report.
EHAM	ICAO IDENTIFIER	Four letter ICAO Code.
121755Z	DATE and TIME	First two digits are the date, followed by the hour and minutes in UTC time (Z).
21016G24KT **180V240** **VRB04KT**	WINDS	Normally a 5-digit grouping (6-digits if speed is over 99 knots). The first 3-digits is the direction, the next two or three is the speed. **G** indicates gusts with the highest gust report after it. **V** indicates variable wind direction. **VRB** indicates variable

		wind speed 6 knots or less ***Note: International stations may use meters per second (MPS) or kilometers per hour (KMH) and code the wind speed accordingly.***
1500	VISIBILITY	Prevailing visibility reported in Meters. 2800 represents 2,800 meters and 9999 represents a visibility greater than 10 km.
R06/0600U	RVR VALUES	"R" indicates the group followed by the runway heading (06) and the visual range in meters. The report might include a "U" for increasing or "D" for decreasing values.
-RA BR	WX PHENOMENA	This example shows light rain with mist. Some main weather codes: SN=Snow, GR=Hail, SH=Showers, FG=Fog, +=Heavy, -=Light
BKN015 0VC025	SKY CONDITIONS	Shows the amount of sky cover and cloud base height. FEW = less then 1/8 SCT = 1/8 till 3/8 BKN = 4/8 till 7/8 OVC = 8/8
06/04	TEMP/DEW POINT	Reported in two, two-digit groups separated by a slant ("/"), in degrees Celsius. Temperature and dewpoint below zero are prefixed with a "M".
Q1005	ALTIMETER	QNH reported in a four-digit format in HectoPascals (Hpa) preceded with a "Q". In i.e. USA altimeter reports are in inches of mercury.
BECMG 9999=	TREND	How the weather is going to develop in the time the METAR is current (2 hours). You can here find Sky conditions, Visibility, Wind, Weather TEMPO = Temporary change in weather BECMG = Permanent change in weather

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2.2.1 Wind [S]
Wind is measured 10 m above ground.
The direction is from where the wind is coming. The precision is 10 degrees.
In the METAR, the wind velocity is a 10 minute average and given in knots (kt). If there are gusts 10 KT over the average value, this is reported as well. The gusts are reported as G17 and should be read "gusting" or "maximum".

When flying, the wind direction in itself isn't the most important factor, but it's the side-wind component. If the wind direction varies more than 60 degrees and if there's more than 3 kt wind, it is reported as V (variable). If there is less than 3 kt wind and it varies, this is reported as VRB. Calm is reported as 00000KT.

Example:

- VRB02KT – *variable two knots*
- 25020KT – *two five zero degrees two zero knots*
- 15015G25KT – *one five zero degrees one five knots maximum (or gusting) two five knots*
- 24018G35KT 160V290 – *two four zero degrees one eight knots maximum (or gusting) three five knots variable between one six zero and two niner zero degrees*

2.2.9 Air Pressure QNH [S]

As described in other sections in this manual, the air pressure is vital to know, since it affects the altitude measuring system. Air pressure can be measured in different ways, and relative different levels. QNH is air pressure at sea level (or reduced to sea level in standard atmosphere if it's measured at another point).
QFE is air pressure at the airport.

A high value means high air pressure and vice versa.
Standard pressure is 1013.25 hPa or 29.92 inch Hg.

In the METAR, the value is preceded by a Q if the unit is hPa and A if it's inch Hg. Q is used in Europe.

Example:

- Q0987 – *Q-N-H niner eight seven*

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2.2.10 Trend [S]
The trend prognosis should indicate expected changes within next two hours.

There are three MAIN concepts used in Trend:

- Becoming (BECMG)
- Temporary (TEMPO)
- No Significant Change (stable) (NOSIG)

The first two can be given with a time reference.

Examples:

- BECMG FM1250 TL1340 – *Becoming from 1250 till 1340 (the change will take place between 12:50 to 13:40)*
- BECMG AT 1400 – *Becoming at 1400 (will change at 14:00)*
- TEMPO FM 1400 – *Tempo from 1400 (One or more changes shorter than one hour, from 14:00 to two hours after the METAR was reported.)*

Additional Trend prognosis can be From, To and At.

VATSEA - 3. Air Pressure and Altitude
Air Pressure and Altitude

1. **Introduction**
2. **Pressure**
3. **Temperature**
4. **Mean Sea Level (MSL)**
5. **Altitude**
6. **Height**
7. **Flight Level**
8. **Transition Level, Altitude and Layer**
9. **Minimum usable flight levels**
10. **Minimal altitudes MOCA, MRVA and MSA**
11. **Minimum En route altitudes (MEA)**
12. **Further reading**

3.1 Introduction
There are a large number of terms concerning the measurement of altitude within aviation. This chapter will deal with the most usual terms and explain in what situations you use them.

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3.2 Pressure [S]

The static pressure is defined as the pressure that the atmosphere is producing. You've probably heard of high and low pressure, but in aviation you have to be more accurate than that and measure the pressure with digits.
In aviation air pressure is measured in hectopascal, hPa. ICAO has defined a standard atmosphere* in which the pressure at sea level is 1013.25hPa. This is also called 'standard setting' or QNE.
Since the air gets thinner with increased altitude, the pressure is reduced. More precisely with 30hPa / 1000feet*. An aircraft altimeter uses this fact by measuring the pressure around the aircraft and translating it to an altitude.

The pressure at sea level is however not static and an altimeter has to compensate for this in order to show the correct altitude. This compensation is done manually by the pilot by setting a reference that is calculated from the present air pressure. There are two commonly used methods for calculating this reference and they are abbreviated; QNH and QFE.

QNH is the actual air pressure reduced to sea level in standard atmosphere*. When setting the correct QNH, the altimeter will show the airfield's elevation over MSL (see below), providing that the aircraft is standing on the airfield. QNH is the most common setting in civil and private aircrafts.

QFE is the actual air pressure, not reduced to sea level i.e. the air pressure at the airport. When setting the correct QFE, the altimeter will show zero, if the aircraft is standing on the airfield. QFE is rarely used in commercial civil aviation. VFR-traffic sometimes uses QFE and it is common that military aircraft uses QFE instead of QNH.

To be correct, not only the pressure, but also the temperature has to be taken in consideration in order to measure the true altitude. OAT combined with QNH is used to calculate true altitude.

* In standard atmosphere – as defined by ICAO
- Pressure at sea level: 1013.25 hPa
- Temperature at sea level: +15 degrees Celsius (C)
- Decline in temperature: 2 degrees C / 1000 ft
- Tropopaus altitude: 11km
- Temperature in tropopaus: -56.5 degrees C
- Temperature is constant between 11-20km

3.5 Altitude [S]

Altitude is defined as the vertical distance between mean sea level (MSL) and an aircraft. When the pilot has set the correct local QNH he will fly on an altitude.

Aerodromes

1. **Introduction**
2. **Runway designators (numbers)**
3. **Traffic Circuit**
4. **Chart over typical airport**
5. **Instrument Landing System (ILS)**
    1. **Localizer**
    2. **Glide Path**
    3. **Marker Beacons**

    4. **ILS Classification**
6. **Available runway length**
7. **Lights**
    1. **PAPI – Precision Approach Path Indicator**
    2. **Runway lights**
    3. **Taxiway lights**
8. **Areas of interest**
    1. **Movement Area**
    2. **Manoeuvring Area**
    3. **Runway**

4.1 Introduction [S]

A plane should be in the air and not on the ground, but eventually they all come down – preferably at an airport.
Hence it's important for an air traffic controller to have good knowledge about how the airport is built.
All airports are built on the same principal, regardless of size. Take a closer look at the chart below and study the design.

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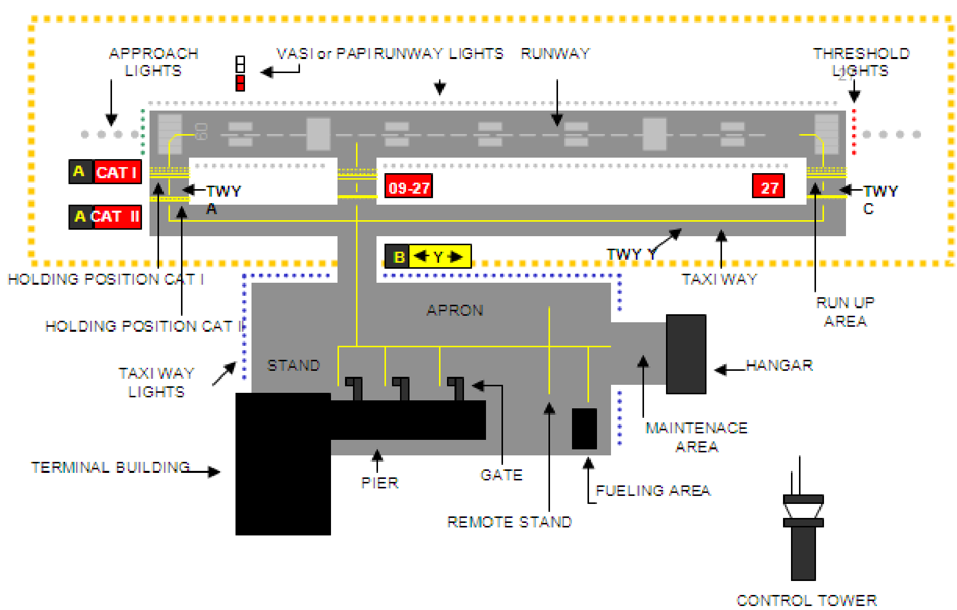
4.2 Runway designators (numbers) [S]

A runway is a strip used for take-off and landing.

The runways are numbered according to the compass-direction they are headed, rounded off to the closest tenth degrees. A runway that has the "course" 180 degrees is hence named 18 and one with "course" 154 is named 15. Since you can use a runway from both directions, it's named with the contra-course from the other side (18/36).
Some airports have parallel runways, i.e. more then one runway that has the same number. They are named with the suffixes R (right), and L (left) after the number to tell them apart if they are two and R, C (centre) and L if there are three.
There are two pairs of numbers that aren't used in some countries; 02/20 and 13/31, even though the runway might have those headings. The reason for this is the risk for mix-up if the figures are reversed.

4.4 Chart over typical airport [S]



Orange dotted area = Manoeuvring area

Aircraft

1. **Introduction**
2. **Wake Turbulence**
    1. **Separation due to vortex**
    2. **Waiving wake turbulence Separation**
3. **Aircraft Approach Category**
4. **Aircraft classification**
5. **Equipment suffix**
6. **Figure 1 - Aircraft performance table**
7. **Figure 2 - Equipment suffix table**
8. **Automatic Altitude Reporting (Mode C)**

1.Introduction [S]

All aircraft do not have the same performance. Weight, weather and winds can make the same airplane have different performance on different flights.

As a controller, you should have knowledge about the performance of aircraft under normal circumstances in order to be able to plan traffic flow and give the pilots relevant instructions.

At the end of this section, you will find a table which lists the performance of the most usual aircrafts.

Use this table as reference.

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2. Wake Turbulence [S]

All aircraft generate turbulence called vortex wake. Large aircraft flying at slow speeds create the most severe wake turbulence. This turbulence can cause problems for following aircraft, which in severe cases can cause the pilot of the following aircraft to loose control. In addition to separation minimum above, the following spacing minima therefore needs to be taken into account. The wake turbulence categories are based on the certified maximum take-off weight (MTOW) of the aircraft.

Aircraft Category	**MTOW**
Light Aircraft (L)	7 000 kg
Medium Aircraft (M)	7 000 – 136 000 kg
Heavy Aircraft (H) Super Heavy (SH)	136 000 kg Above 136.000 kg

VATSEA - 6. Navigation

Navigation

1. **Introduction**
2. **Position Reference System**
3. **Loxodrom and Great Circles**
4. **Directions**
5. **Variation**
6. **Speed**
    - **Speed for the pilot**
    - **Indicated Air Speed (IAS)**
    - **True Air Speed (TAS)**

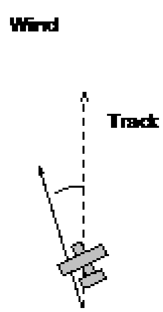
  - **Ground Speed (GS)**
  - **Mach (M)**
7. **Wind**
8. **Time**
9. **Navigational aids**
  - **Non Directional Beacon (NDB)**
  - **Very high freq. Omni-directional Radio range (VOR)**
  - **Distance Measuring Equipment (DME)**
  - **Intersection / Fix**
  - **Global Positioning System (GPS)**
  - **Inerital Navigation System (INS)**
  - **ATS Routes**
  - **Flight Management System (FMS)**
10. **Navigational Aids Limitations**
11. **Further reading**

6.1 Introduction

To be able to fly from point A to point B it is important for the flight crew to know where they are and where they're headed.
Before radar, air traffic control was dependent on pilot position reports via radio. Today, most of the time, we have radar, which makes it possible to closely track the position of aircraft.
Good knowledge about navigation and navigation aids is important for air traffic controllers and therefore we will start with a basic review of this area.

6.4 Directions [S]

All directions in aviation are expressed with the 360-degree system.
The horizon is divided into 360 equal parts and one revolution equals 360 degrees.
A direction of due north means a direction of 360, due east direction 090 and so on.



In aviation there are two (2) basic definitions of directions. Heading and track.
Heading is defined as the direction where the aircraft nose points (the longitudinal axis of the aircraft).
When adding the effect of wind the direction of the path of the aircraft over the ground will be slightly different then the aircraft heading and that is called track

6.6 Speed [S]

In aviation speed is normally measured in knots, which are defined as nm/hour. 100 knots equals 185 km/h.
There are different ways to measure speed

6.6.4 Ground Speed (GS) [S]

While true airspeed is the speed at which an aircraft moves through the air irrespective of the wind, ground speed is the speed the aircraft is moving over the ground.

If an aircraft is flying at a TAS of 250 knots with a 30 knot tailwind the GS will be 280 knots.
That said, just remember that the speed you see on your radar is ground speed, and the speed the pilot normally sees is indicated airspeed. Your speed will usually show a higher value than the pilot's, depending on his altitude, unless he has a strong headwind.

6.6.5 Mach (M) [S]

In the upper airspace Mach is normally used to express speeds.
Mach is a quotient of the local speed of sound and Mach 1.0 is equal to the speed of sound.

6.7 Wind [S]

The wind direction is given in degrees just like it is given for aircraft direction.
The direction of wind is always given as the direction from where the wind comes.

In a weather report for an airport (METAR) the wind direction and strength is given as for example 18003KT, where 180 is the direction (south) and 03 is the strength in knots

Navigation aids are used by flight crew to navigate between different positions on the earth and may consist of transmitters on the ground, receivers in aircraft and most recently also satellites.
The crew navigates between different navigation aids and points called VOR, NDB and intersections. With a joint name these are called waypoints.

Controling

1. **Introduction**
2. **Radar Clients**
3. **Clearance**
4. **Callsign**
5. **Transponder**
    1. **More about transponders**
6. **Understanding Charts**
    1. **Standard Instrument Departure (SID)**
    2. **Standard Instrument Arrival (STAR)**
    3. **Transition**
    4. **Routes**
    5. **Approach**
    6. **Precision approaches**
    7. **Non-precision approaches**
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    10. **Runway Visual Range (RVR)**
    11. **Missed approach Point (MAP)**
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7. **Flight plan and Route**
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8. **Separation**
    1. **Vertical separation**
    2. **Horizontal separation**
    3. **Separation between departing traffic**

4. **Wake turbulence spacing minima**
5. **Speed and height**
6. **Minimum Speed**

9. **ATIS**

7.1 Introduction
We will end this theoretical manual with a description about what you need to know about call-signs, transponder, charts and things that are related to your radarscope. The more practical aspects will be found in the guide and this section is closely related to some of that material.

7.2 Radar Clients [S]
The radar client is the software that you will work with as a controller.
At the time this manual is written there are three clients available; ASRC, VRC and Euroscope. It is not in the scope of this manual to describe them in detail, since they have excellent manuals.
The “radar-part” of the clients is maybe the most important and it gives you information about the traffics movement through the sky and on the ground. But there are numerous other functions built in to the software that will help you control and give information to the traffic. It is well spent time to read the manual of the client that you will be using closely.

7.3 Clearance [S]
All instructions regarding the movement of aircraft in air or on ground are called clearances. You can issue clearances both en-route and before the aircraft is airborne.
A pilot who wants to fly in controlled air space (except for Class E) is required to get permission from a controller. To be able to give permission, you as a controller need to know what intention the pilot has. The pilot can send this information to the ATC in a so called flight plan. Aircraft flying VFR can ask for clearance without having sent a flight plan. The pilot must in that case send all relevant information via radio. This is very unusual in our on line environment. Clearances can vary in content and can contain restrictions of different sort. Before issuing a clearance, you need to ascertain that it doesn't lead to a conflict between two aircraft. A good strategy is to give as few restrictions as possible in the clearance. More about clearance will be found in the GUIDE.

7.4 Callsign [S]
All aircraft need to have a call sign in order to establish radio contact.
There are difference forms of callsigns. SAS345, KLM574, DLH1771 are examples of large companies' call signs. DLH1171 isn't the name of a specific aircraft but rather the ICAO code of a company (Lufthansa) followed by a number that is specific for flight path.
British Airways uses the acronym BAW, but this is read as “Speed bird”. There are tables over these acronyms; you don't have to know them by heart. SE-GTD and OH-SLT are examples of specific aircraft. SE stands for Sweden and OH stands for Finland. The two country letters are followed by three letters to designate the aircraft. Even though all aircrafts have specific call signs like the one above, they are almost only used when flying private and not for a company. Smaller aircraft that flies VFR are one example where the aircraft specific call sign is used.
When writing call sign into the flight plan, the pilot can either use the full aircraft specific name (SEGTD, OHSLT) or the acronym for the flight-operator followed by the flight-specific numbers/letters (BAW554D, KLM574).
When using the call sign on radio, you are allowed to make some abbreviations after the first contact has been established and the quality of the radio transmission is good; When reading OHSLT you can omit the second letter or both the second and third letter, if the above criteria are met and there’s no risk for confusion with other aircrafts in your airspace.

- ·Oscar Hotel, Sierra, Lima, Tango

- ·Oscar, Sierra, Lima, Tango3 Oscar, Lima, Tango

7.5 Transponder [S]
On ordinary radar, you can see the position of the aircraft, but not their height. You also can't differentiate one blip from the other. This has been solved by installing one (or often more than one) transponder in the aircraft. This box transmits a signal which contains information on the height together with a four digit code.

As controller, you give the pilot this unique four digit transponder code. This is done at clearance, but the transponder code can also be changed en route. Two aircraft cannot have the same transponder code if they are in the same area. This is not a problem on line, but you should try to give every aircraft a unique transponder code. You will get an error message (CODE) is this isn't done, but you will still be able to see the correct call sign on your scope.Transponders can be set in different modes:
1.**Stb (Standby)** – Means that the transponder doesn't give information about the code entered or the height. (Default mode on VATSIM when on ground)
2.**Mode A** – Only the code, and not the height is transmitted.
3.**Mode C** – Code and height is transmitted (Should be used on VATSIM when flying)
4.**Mode S** – Used together with TCAS*. Gives same information as mode C
The exception to unique code is VFR aircraft which sometimes are given the same transponder code (7000 in most countries, 1200 in some).

A transponder works with binary digits and can't use the digits "8" and "9". Hence a transponder code can't contain these two digits.

** Traffic alert and Collision Avoidance System (or TCAS) is an implementation of the Airborne Collision Avoidance System mandated by ICAO to be fitted to all aircraft over 5700 kg or authorized to carry more than 19 passengers, designed to reduce mid-air collisions.*

7.5.1 More about transponders [S]
Primary radar works best with large all-metal aircraft, but not so well on small, composite aircraft. Its range is also limited by terrain and rain or snow and also detects unwanted objects such as automobiles, hills and trees. Furthermore it cannot estimate the altitude of an aircraft. Secondary radar overcomes these limitations but it depends on a transponder in the aircraft to respond to interrogations from the ground station to make the plane more visible.
An airborne Transponder transmits a reply signal on a frequency of 1,090 MHz in response to the SSR interrogation which is transmitted on a frequency of 1,030 MHz.

Due to the technique that the transponder is built with, only the digits 0 to 7 can be used (8 and 9 can't be entered). This means that there are 8x8x8x8 = 4096 unique codes. Some codes are reserved for special use.

7.6.1 Standard Instrument Departure SID [S]
SID stands for Standard Instrument Departure.
It is a pre defined route which has been named using a special system. SIE 1A is an example of a SID where SIE (SIEDLCE) is the navigation beacon where the SID ends. 1 is a version number. Next time the

SID is updated it gets version number 2. Changes are quite rare and when done they are mostly minor adjustments.
If you want a pilot to fly, sayARS 3C but the pilot only has charts for ARS 2C, then this is normally not a problem, but you have to make sure that no big changes has been made between the two versions. The ending letter of the SID is usually, but not always connected to a specific runway. For example, all SIDs ending with ”G” at Arlanda depart from runway 19R. but in EKCH for example all "A" designators would be valid both for 04R and 04L.
There are obvious advantages with the SID system. Most SID are quite complex, and to give the instructions to fly them step by step would indeed be time consuming. Since the autopilot usually is used to fly the SID, all aircraft flying the same SID will do it in the (close to) exact same way, making it predictable. Moreover, the SIDs and STARSs (see below) are designed in a way to minimizes potential conflict situations.

7.7 Flight plan and Route [S]
The main reason for filing a flight plan and route is the pilot is informing the ATC units along the way his/her requests to complete the journey; this will include the speed, cruise level waypoint and airways to be flown.
And one other major reason in non-Radar equipped regions (these are becoming much less in the real world and nonexistent in the simulated environment) if you haven't arrived at your destination in the allowed time limit, the emergency services will have a good idea where to look for you. Flying isn't as easy as jumping into your car and going from point A to B.

The Basic format for a f/p route is; *Waypoint Route Designator Waypoint DCT Waypoint RouteDesignator.... etc.*
In some circumstances were a Waypoint doesn't cross from a designated route the letters "DCT" meaning direct are used (there are no waypoints in the world with this name or code). Some countries do not allow deviation from designated routes, or if allowed for short distances only.

7.7.5 A Real Flight Plan [ref]
A real world ICAO coded flight plan contains much more information than what we are usually accustomed to in the simulated environment, here's an example.

CODED ICAO FLIGHT PLAN

(FPL-N100A-IG
-GLF4/M-SXWHIGRY/S
-KEWR2315
-N0465F370 DCT MERIT DCT HFD J42 BOS DCT VITOL/M080F410 N27A
NANSO/N0459F410 N27A RAFIN/M080F410 DCT 45N050W 47N040W 49N030W
49N020W DCT BEDRA/M080F410 UN491 TAKAS/N0459F410 UN491 VMP UL851
MELKO UM606 BLM DCT
-LSZH0652 LSGG
-EET/KZBW0003 KZNY0040 CZQM0041 CZQX0141 EGGX0342 EISN0457
EGTT0531 LFRR0534 LFFF0606 LFEE0631 EDFF0645 LSAZ0646
RAFIN0156 45N050W0204 47N040W0253 49N030W0342 49N020W0432
REG/N100A SEL/GQEK DOF/020214 RMK/TCAS EQUIPPED AGCS EQUIPPED)
KZNYZQZX KZBWZQZX CZQMZQZX CZQXZQZX EGGXZOZX EBBDZMFP LFPYZMFP

This can be decoded as (FPL-N100A(Aircraft Call Sign or Flight Number)-I(FR)G(eneral flight)

- ·GLF4(Gulfstream 4)/M(edium Wake Category)-Equipment/S (transponder equipment do not confuse with equipment suffix)

- ·Departure Airport and Time in Zulu
- ·Route N0465F370 (KTAS465 initial speed and FL370).... at VITOL/M080F410 a climb to FL410.. etc
- ·Arrival Airport (Zurich) and duration of Flight 6hours and 52minutes Alternate Airport (Geneva)
- ·Estimated enroute time for crossing FIR regions... EGTT0531 London FIR in 5hours and 31minutes and other info the pilot wants you to know.

7.8 Separation [S]

As mentioned before, this is your most important task. How much should you separate? What should be done in order to avoid accidents, or as it is called in aviation, conflicts? Since this is such an important task it will be covered here and in the GUIDE.

1.Have a clear strategy what you want the pilot to do. Order and contrary orders leads to confusion and frustration.

2.Consider what implications your instructions have. It's not a good idea to give a pilot clearance to land if you at the moment before gave another pilot instruction to line up on the same runway.

3.Talk clearly and not too fast. It may sound “cool” talking fast but it often leads to misunderstanding which makes it slower.

4.Use standard phraseology. This reduces the risk of misunderstanding and confusion.

5.Listen to the read back carefully as it was the first time the instruction was given. Mistakes happen easily.

6.Act immediately if a conflict can occur. Don't wait until the conflict is developing. An aircraft doesn't turn immediately when given the instruction, the pilot needs to hear the instruction, act on it and then the aircraft starts turning.

7.Don't take on more than you can manage. Take a position which you feel you manage and ask for help if you need it and there is someone available. That was the ”software” which always is the most important.

7.8.1 Vertical separation [S]

Vertical separation should at least be:

- ·RVSM: 1000 ft
- ·Non-RVSM: 2000ft

You are allowed to climb or descend an aircraft to a level previously occupied by another aircraft provided that vertical separation is maintained. This is done by observing the transponder echo in mode C.

To make sure vertical separation is maintained, it has been decided that aircraft eastbound use odd flight levels and aircraft westbound use even flight levels.
This, so called semi-circle-rule applies when no other rules override it.
Some airways/routes have specific flight levels assigned to them that contradict the semi-circle-rule.

There are areas where the rule isn’t applicable due to local restrictions etc. Please refer to your local vACC and charts for this local information.

7.8.2 Horizontal separation [S]

There are several ways of maintaining horizontal separation, but as long as aircrafts are in radar covered area and use a transponder that transmits pressure altitude (mode C (Charlie)) the following rules apply.

There are other conditions not covered here that applies for example when crossing oceans.

The basic rule is that there should be at least 5 nm horizontal separation in all directions. You can therefore imagine a circle around all aircraft with 2.5 nm radius to reach the 5 nm requirement.

There are situations when the 5 nm separation can be overruled. One situation is when two aircraft are on the final for landing. In this case 3 nm separation is sufficient. (not regarding wake turbulence separation) Other rules may apply on national level.
It is however not recommended to use this small separation even in this situation.

Depending on the airspace class you are in most instances required to separate IFR traffic from all other traffic in controlled airspace, so it's often your responsibility to separate IFR from VFR and vice versa

7.9 ATIS [S]

ATIS (Automatic Terminal Information System) is in real life a recorded message that is transmitted on a specific radio frequency. All major airports have ATIS and all pilots approaching the airport are required to monitor the ATIS.

What information that is put into the ATIS depends on which position you man, but please note that an ATIS must never be more than 4 rows with a suggested maximum at 3 rows. This is a VATSIM requirement.
Information that should be included regardless of what position you man:

- ·The name of your position
- ·The ATIS version. You start with ALPHA, and every time you change anything you use next letter in the alphabet. When you reach ZULU you start over with ALPHA. When pilot calls you for the first time he should inform you which ATIS version he has received. This way you know he has the latest information.
- ·Date and time
- ·Active runways used. Always specify landing (arrival) first. (the exception being a DEP controller who does not need to include this information

All the information above may be on the Exam. This information is from the VATSIM Southeast Asian training page. This cover what will be tested for the S1 and S2 exam.
All information compiled by: John Holt