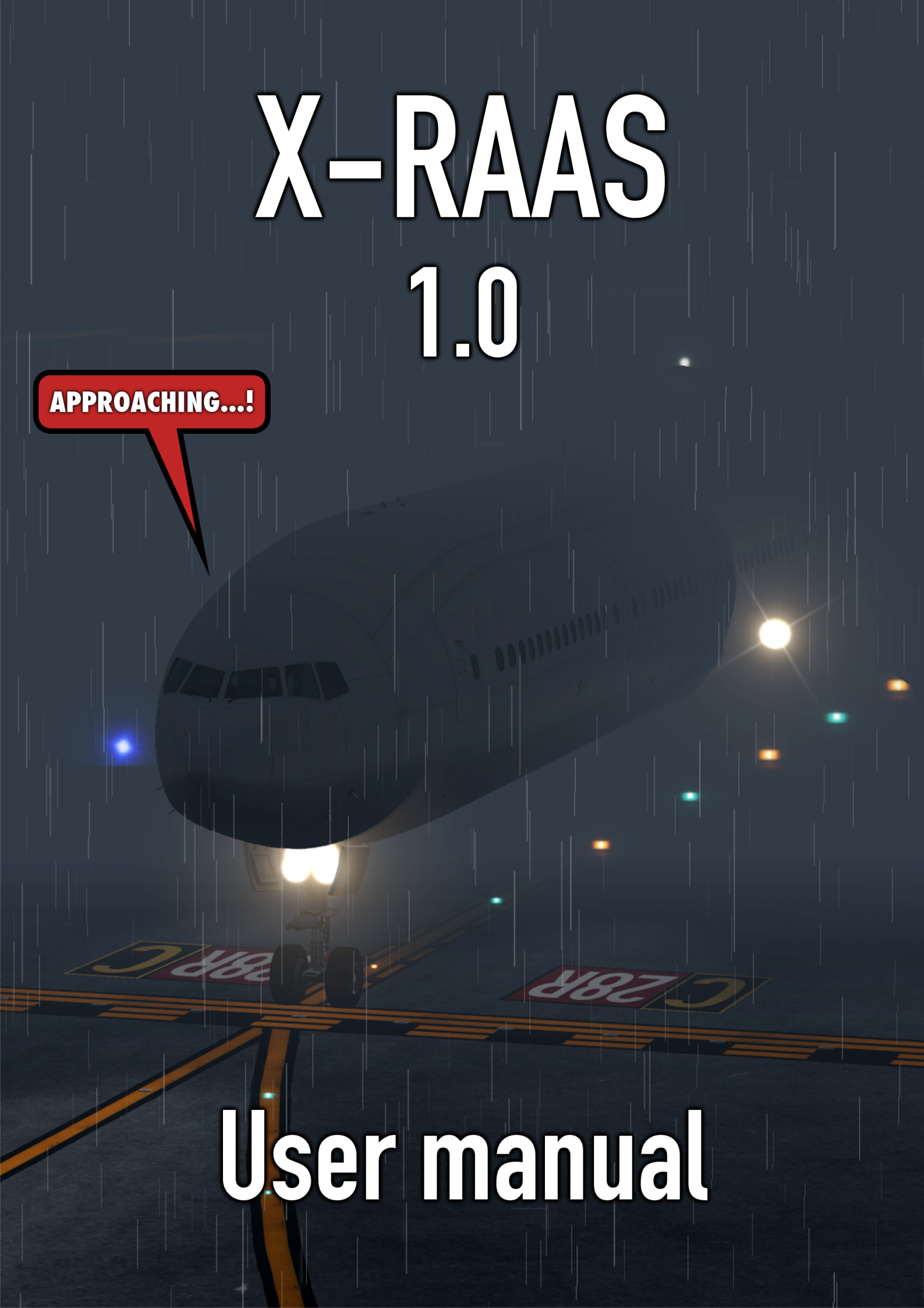
X-RAAS

1.0



User manual

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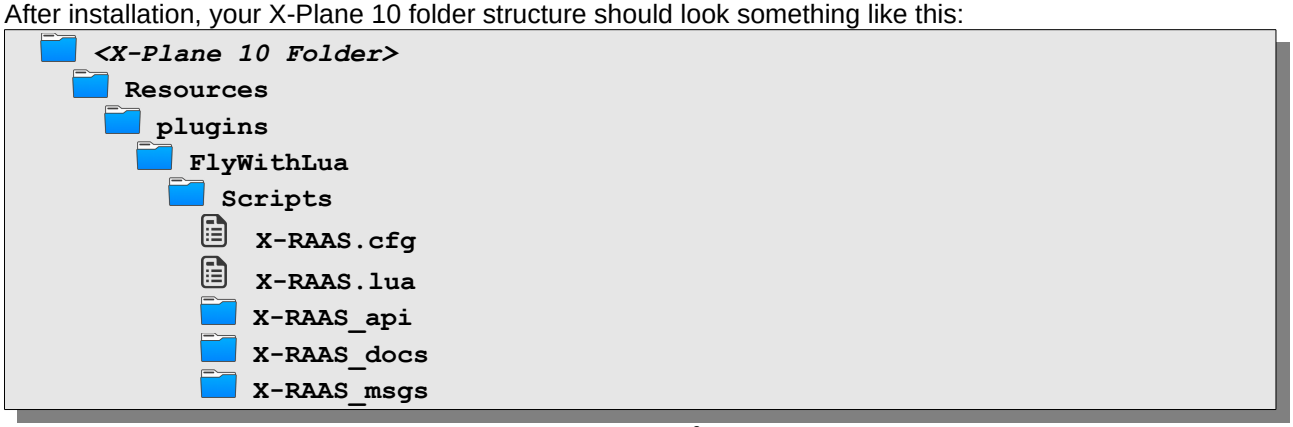
1 Introduction

X-RAAS implements a simulation of the Honeywell Runway Awareness and Advisory System (RAAS)[1], which is itself a set of software extensions to the Enhanced Ground Proximity Warning System (EGPWS) computer. RAAS monitors the aircraft's GPS position and other sensor inputs to construct a picture of the aircraft's position relative to runways and several other threat conditions. When a potentially hazardous condition is detected, RAAS issues caution and warning aural annunciations and visual advisories. X-RAAS models most of these annunciations.

2 Installation

X-RAAS is written in Lua and as such requires the **FlyWithLua** plugin (minimum version 2.4.3) for X-Plane 10. Once that is installed, to install X-RAAS, simply copy **all the files** provided in the compressed ZIP file to the **`Scripts`** folder in **`FlyWithLua`**. X-RAAS is for the most part fully automated, but you are encouraged to read through this manual to fully understand what it monitors and how to extract the most use from its advisories.
After installation, your X-Plane 10 folder structure should look something like this:



The first time you start up X-Plane 10 and load any airliner[2], X-RAAS will scan all of your airport sceneries and extract runway information to build its airport data cache. This can take up to 10 seconds or more (depending on how much scenery you have), during which time the simulator will appear to be frozen. Do not be alarmed. Once the cache is built, X-RAAS will use the cache and startup will be much faster. The reason for this cache is to make sure that X-RAAS's runway information matches your scenery as closely as possible, so you don't get spurious runway alerts. Once started up, X-RAAS should not impose any significant additional load on your simulator.
X-RAAS checks for updates to airport scenery or the AIRAC database in the simulator during startup. If scenery is added or removed, or the AIRAC cycle is changed, X-RAAS will automatically recreate its airport data cache.

NOTE
Updates to existing scenery might not be detected, as X-RAAS doesn't have a reliable way of detecting file modifications. If you have significantly updated existing scenery and would like to force X-RAAS to refresh its airport data cache, you can simply delete the cache. On subsequent startup, X-RAAS will recreate it based on the latest scenery data. The cache is located in the **`X-RAAS_apt_dat_cache`** folder in the **`FlyWithLua/Scripts`** folder. To remove the cache, delete the **`X-RAAS_apt_dat_cache`** folder.
DO NOT DELETE ANYTHING ELSE.

3 Activating X-RAAS in the aircraft

X-RAAS automatically begins functioning as soon as electrical power is applied to the aircraft's primary avionics systems. Normally, RAAS is only used by airliners with a sophisticated EGPWS. RAAS advisories and performance monitoring can be a poor fit for small general aviation aircraft or aircraft with performance significantly different from airliners. To avoid this, by default X-RAAS checks if the current aircraft isn't a helicopter and also two additional parameters about the currently loaded aircraft prior to starting up:

- The aircraft must have at least two or more engines.

1 More specifically, the SmartRunway and SmartLanding products.
2 By default X-RAAS is inhibited in small general aviation aircraft. See section 3 for more details.

- The aircraft's Maximum Take Off Weight (MTOW) must be at least 5,700 kg or more.

If the aircraft is a helicopter or the value of the above mentioned parameters is less than the limits, X-RAAS startup is inhibited. All of this is configurable in the X-RAAS configuration file, so it is possible to re-enable X-RAAS for any aircraft in X-Plane, provided sufficient electrical power is available. See section 5 for details on how to fine tune X-RAAS's behavior.
Please note that certain aircraft models are either wholly incompatible with X-RAAS, or have certain features restricted. Refer to section 7 for a list of aircraft with known compatibility issues.

3.1 Annunciation mechanism and aircraft integration

3.1.1 Aural annunciations

Aural annunciations are made normally through the aircraft's loudspeaker system. The following details of aural annunciations can be adjusted (refer to section 5 for details on configuring X-RAAS):

- Audio volume.
- Voice gender.
- Style of runway number pronunciation (should single-digit runways have a '0' prepended or not).
- Units of measure (feet or meters).
- Whether to append units of measure to the initial callout.

If the current simulator view is external, annunciations are suppressed.

3.1.2 Visual annunciations

If visual annunciations are supported, they are performed in one of two ways:

- Overlaid in large type on the aircraft's navigation or multifunction displays in the 3D cockpit (see illustrations 1 and 2).
- Using a semi-translucent on-screen overlay near the top center of the screen.

Display of visual annunciations in the 3D cockpit model requires 3rd party aircraft integration. If an aircraft does not provide this integration, X-RAAS will by default fall back to display visual annunciations using the on-screen overlay. If the current simulator view is external, annunciations are suppressed.
Please note that not all real aircraft feature visual annunciations in their avionics. In these cases, X-RAAS will disable all visual annunciations. Refer to section 7.3 for a list of aircraft which support visual annunciations and by what mechanism. Aircraft developers are encouraged to refer to section 8 for details and sample code for integrating visual annunciation into their simulated avionics.

Illustration 1: Example routine visual annunciation

Illustration 2: Example non-routine and caution annunciations

4 Advisories

This section lists all the various normal and caution advisories X-RAAS can issue for various potential hazards. It is organized by phase of flight, starting with initially approaching a runway on the ground for takeoff and progressing towards a landing and runway exit.

4.1 Approaching a runway on the ground

X-RAAS constructs a virtual bounding box around each runway which extends laterally approximately 1.5x the runway width from the runway centerline and 2,000 feet longitudinally from each runway threshold[3]. X-RAAS will issue an advisory when the aircraft's nose is approximately 1 second from penetrating this bounding box (calculated based on ground speed). The advisory names the runway end closest to the aircraft.

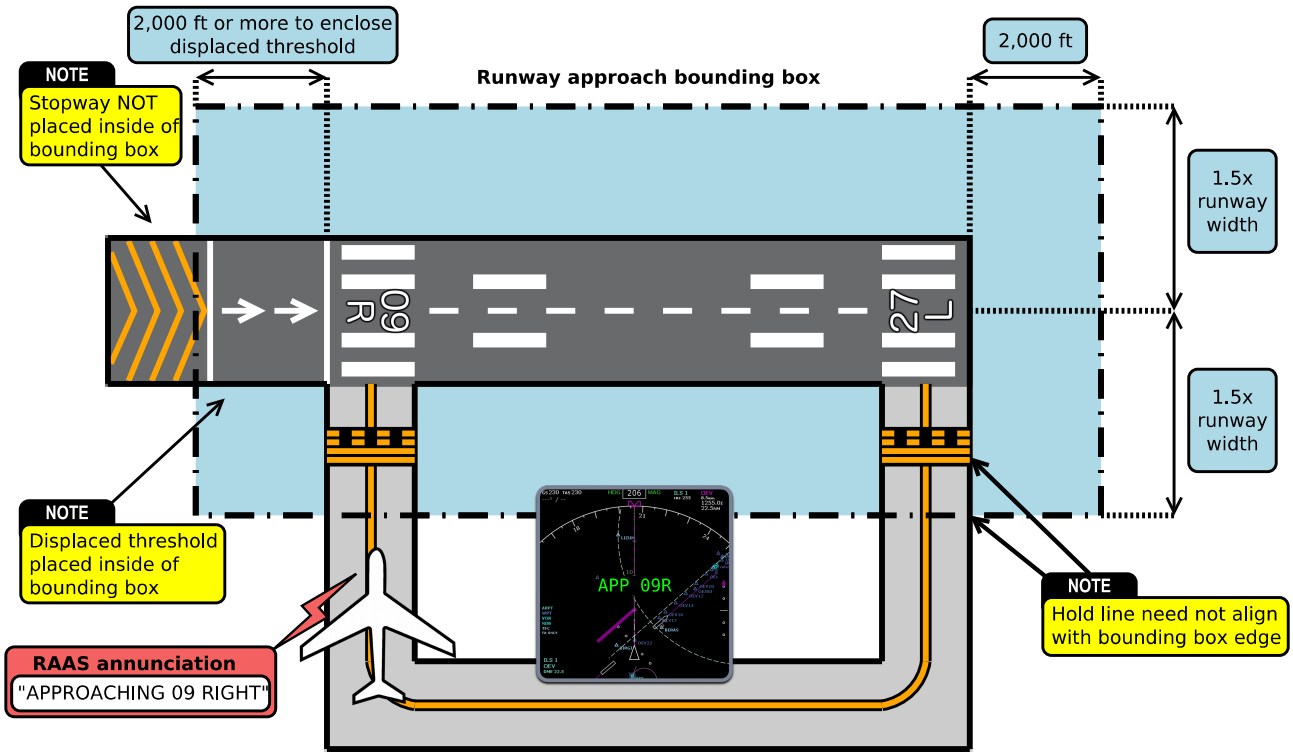


Illustration 3: Approaching a runway on the ground

The aural advisory is accompanied by a routine green visual advisory on the ND:

APP XX

Where 'XX' is the runway identifier. The advisory is inhibited when ground speed exceeds 40 knots (to prevent activation on takeoff through intersecting runways). Please also note that the annunciation does not guarantee the ability to stop before entering the runway.

3 If the runway has a displaced threshold, the bounding box is extended to encompass it completely, but the 2,000 ft buffer is not extended from the displaced end. Stopways are not placed in the bounding box.

4.2 Lined up on runway for takeoff

This annunciation is made initially on lining up on a runway (aircraft heading is within approximately 25 degrees of runway heading). The aural advisory is accompanied by a routine green visual advisory:

ON XX

Where 'XX' is the runway identifier. This annunciation may be supplemented by an annunciation of “FLAPS, FLAPS” if the appropriate takeoff flap configuration has not yet been selected at the time of line up. The takeoff flaps advisory is inhibited if the GPWS flaps override mode is active. If the 'FLAPS, FLAPS' annunciation is to be issued, an amber 'FLAPS' visual caution advisory will be issued instead of the green 'ON XX' advisory:

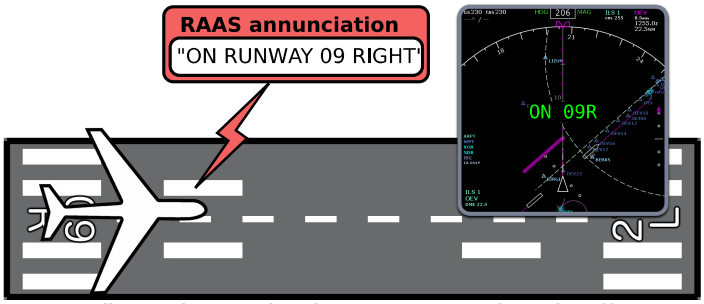


Illustration 4: Lined up on runway for takeoff

FLAPS

4.2.1 Extended holding on a runway

If the aircraft holds in position on a runway for an extended period of time, the on-runway annunciation repeats as a non-routine advisory at configurable intervals. Holding in position is defined as the aircraft being aligned with a runway while its ground speed doesn't exceed 4 knots. The aural annunciation is repeated twice per interval (e.g. “ON RUNWAY 09 RIGHT, ON RUNWAY 09 RIGHT”) and displays an amber “ON XX” visual advisory. The default intervals are defined as follows:

- Delay until the initial annunciation: 60 seconds
- Delay until repeat annunciation: 120 seconds
- Maximum number of repetitions: 3

After the advisory has been repeated for the maximum number of repetitions, further advisories are inhibited until the aircraft lines up with another runway. Refer to section 5 for the interval configuration parameters **RAAS_on_rwy_warn_initial**, **RAAS_on_rwy_warn_repeat** and **RAAS_on_rwy_warn_max_n**.

4.3 Lined up on runway too short for takeoff

If the runway length remaining for takeoff is below an operator-defined minimum for a safe takeoff, the “on runway” annunciation is supplemented by a runway distance available readout (rounded down to the nearest 100 feet or meters). The aural advisory is accompanied by a non-routine amber visual advisory on the ND:

ON XX YY

Where 'XX' is the runway identifier and 'YY' is the runway length available in hundreds of feet or meters.

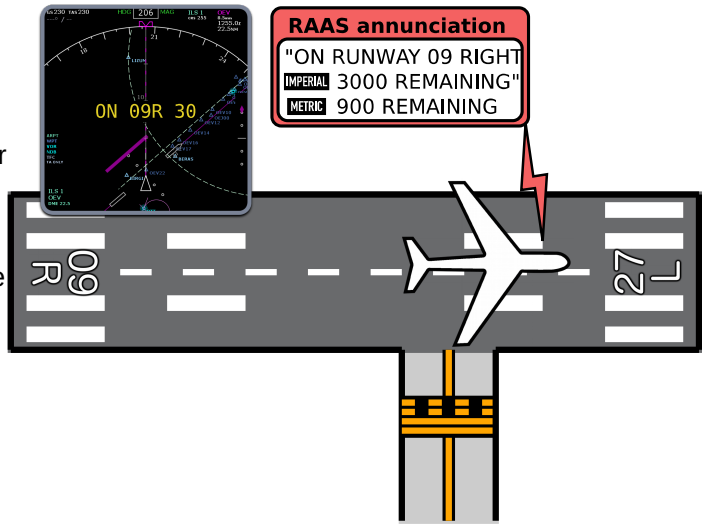


Illustration 5: Lined up on runway too short for takeoff

4.4 Short runway takeoff

If takeoff is attempted on a runway with runway length remaining below an operator defined minimum, once ground speed exceeds 40 knots, a warning annunciation is generated: “CAUTION! SHORT RUNWAY! SHORT RUNWAY!” The aural advisory is accompanied by a caution amber visual advisory on the ND:

SHORT RUNWAY

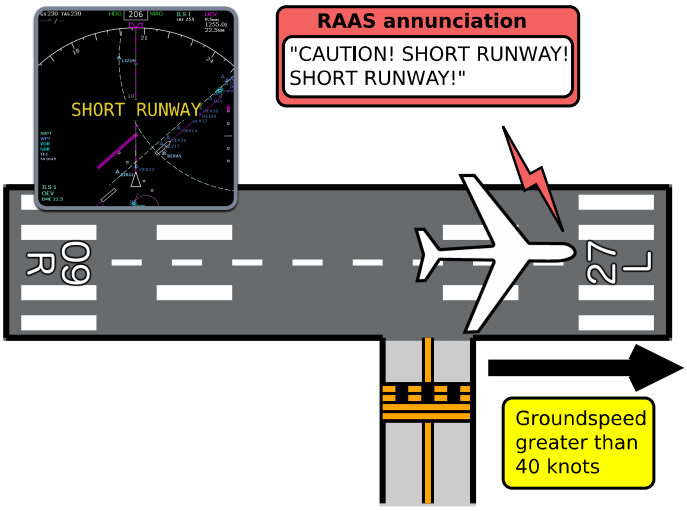


Illustration 6: Short runway takeoff

4.5 Taxiway takeoff

This annunciation warns of attempting takeoff on a taxiway, typically after missing a turn onto the intended departure runway.
The conditions for triggering this annunciation are:

- Aircraft is NOT on a runway
- Ground speed exceeds 40 knots

The aural advisory is accompanied by a caution amber visual advisory on the ND:

ON TAXIWAY

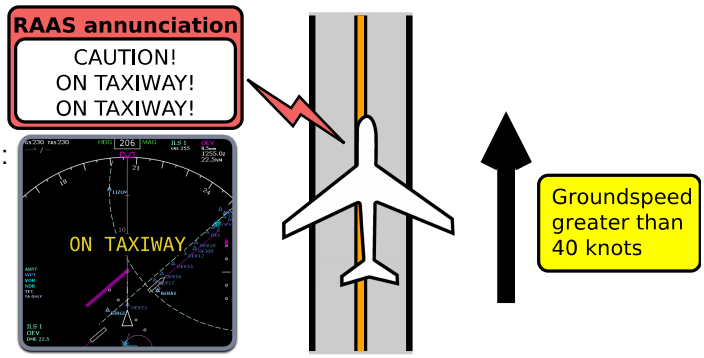


Illustration 7: Taxiway takeoff

4.6 Late rotation on takeoff

If the aircraft is on a runway and accelerates past 40 knots ground speed, X-RAAS switches into takeoff mode. Normally most annunciations are inhibited during this mode, however, if the runway length remaining drops below an operator-defined value and rotation has not yet been initiated, X-RAAS will start to issue runway length remaining annunciations to notify the crew of the rapidly approaching runway end and the need to initiate rotation as soon as possible. No visual advisories are generated.

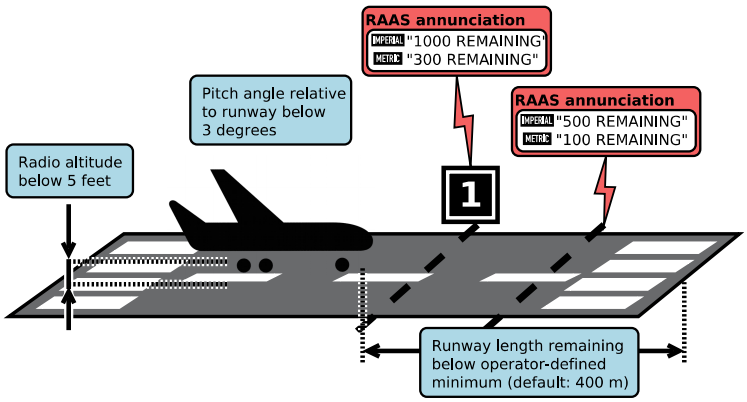


Illustration 8: Late rotation on takeoff

4.7 Rejected takeoff

In takeoff mode (on runway and ground speed greater than 40 knots), X-RAAS closely monitors the aircraft's ground speed. If the aircraft decelerates 5 knots below the maximum ground speed attained during the takeoff roll, X-RAAS assumes that the takeoff is being rejected. During a rejected takeoff, if runway length remaining decreases below 9000 feet or 2700 meters, X-RAAS will start to issue runway length remaining annunciations. No visual advisories are generated.

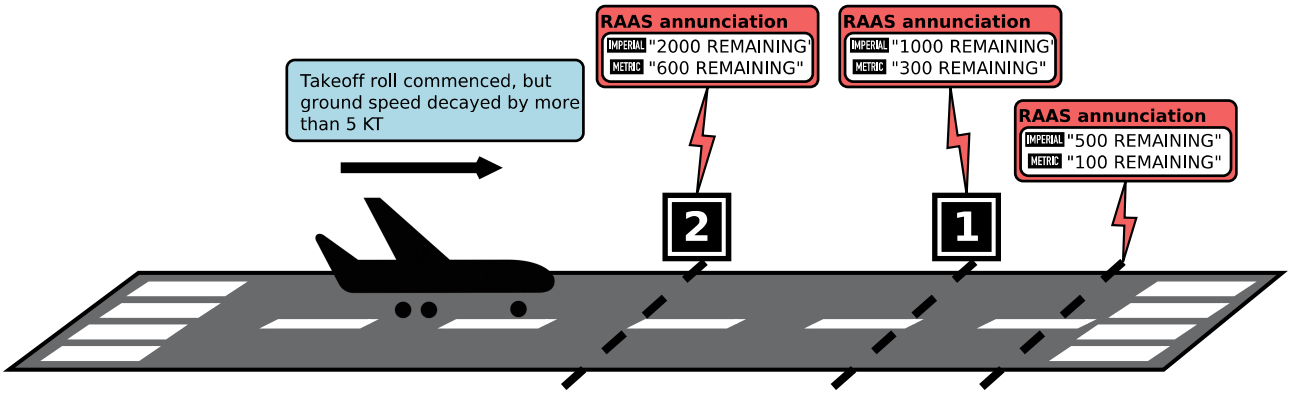


Illustration 9: Rejected takeoff

4.8 Altimeter setting climbing through transition altitude

X-RAAS determines the transition altitude based on database information for the closest airport to the aircraft. If the aircraft climbs through the transition altitude, X-RAAS monitors the barometric altimeter subscale setting. If by 30 seconds after transitioning the subscale is not set to QNE (1013.25 hPa or 29.92 in.Hg), the following advisory is issued: “ALTIMETER SETTING”. This is to prevent incorrect altitude readings in cruise, which increases the possibility of traffic collisions. The aural advisory is accompanied by a caution amber visual advisory on the ND:

ALTM SETTING

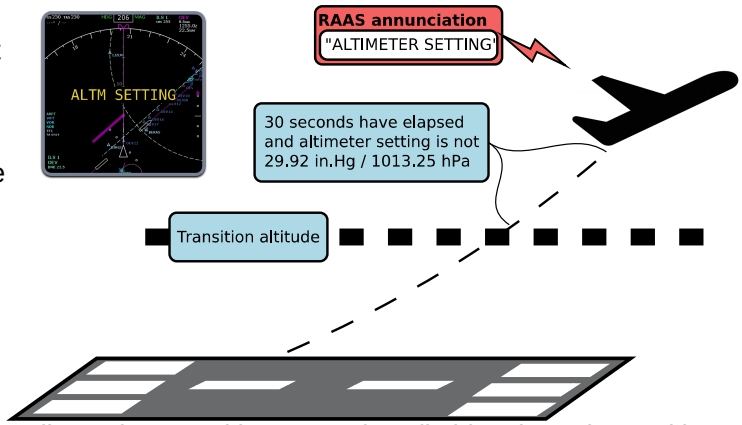


Illustration 10: Altimeter setting climbing through transition altitude

Please note that this advisory might not be available if transition altitude is not published in the navigation database. Flight crews must remain fully alert to crossing the transition altitude and reliance on the altimeter setting RAAS annunciation as part of standard operations is prohibited.

4.9 Altimeter setting descending through transition level

This is the reverse advisory to the altimeter setting advisory during climb and is intended to assist in preventing CFIT (Controlled Flight Into Terrain). X-RAAS determines the transition level based on the navigational database entries of the airport closest to the aircraft. If a fixed transition level is not published, X-RAAS calculates the lowest possible transition level based on barometric pressure readings, GPS calculated elevation AMSL and a published transition altitude, such that the calculated transition level is equal in true elevation AMSL to the transition altitude. Please note that this fallback mechanism might not be as accurate as using the ATC-assigned transition level, so reliance on this annunciation to determine the correct transition level is prohibited.
Once the aircraft descends through the transition level, X-RAAS monitors the barometric altimeter reading and GPS-calculated altitude:

- If QNH altimetry is enabled[4], the GPS-determined elevation AMSL is compared to the barometric altimeter reading. If the values differ by more than a pre-determined threshold after more than 30 seconds has elapsed since crossing the transition level, an “ALTIMETER SETTING” annunciation is generated.
- If QFE altimetry is enabled[5], X-RAAS compares GPS-determined elevation above the nearest aerodrome with the barometric altimeter reading to make sure that they are within a pre-determined threshold.

The default altimetry mode is QNH. The 30 second timeout for the barometric altimeter setting check can be preempted and initiated early if the aircraft descends below 1,500 feet above field elevation of the nearest airport.
The aural advisory is accompanied by a caution amber visual advisory on the ND:

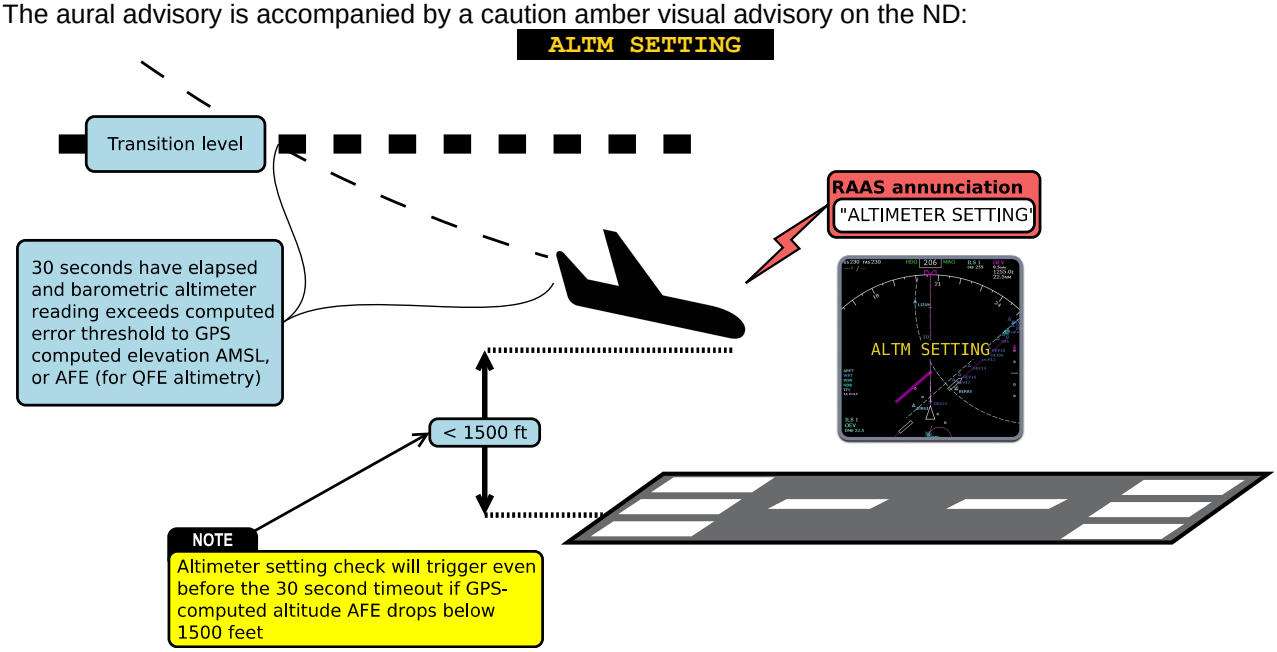


Illustration 11: Altimeter setting descending through transition level

4 See parameter **`RAAS_qnh_alt_enabled`** in section 5.
5 See parameter **`RAAS_qfe_alt_enabled`** in section 5.

4.10 Approaching a runway to land

To facilitate proper runway alignment, X-RAAS issues a runway approach annunciation also when approaching a runway from the air with the intention to land. The following conditions need to be met for this annunciation:

- Within approximately 3 nm of a runway.
- Track is aligned with the runway and heading is within 25 degrees of runway heading.
- In landing configuration.
- Descending through between 700 feet and 320 feet above runway threshold elevation[6].

The aural advisory is accompanied by a routine green visual advisory on the ND:

APP XX

Where 'XX' is the runway identifier. If the runway length is below an operator-defined minimum[7], the annunciation is supplemented by an additional callout of the length available for landing, rounded down to the nearest 100 feet or 100 meters. In this case, the following non-routine amber visual advisory displays on the ND instead:

APP XX YY

Where 'XX' is the runway identifier and 'YY' is the runway length available in hundreds of feet or meters. If the aircraft remains on approach, and descends below 400 feet, but is above 320 feet, an additional annunciation is made: “CAUTION. SHORT RUNWAY! SHORT RUNWAY!” This annunciation is accompanied by a caution amber visual advisory:

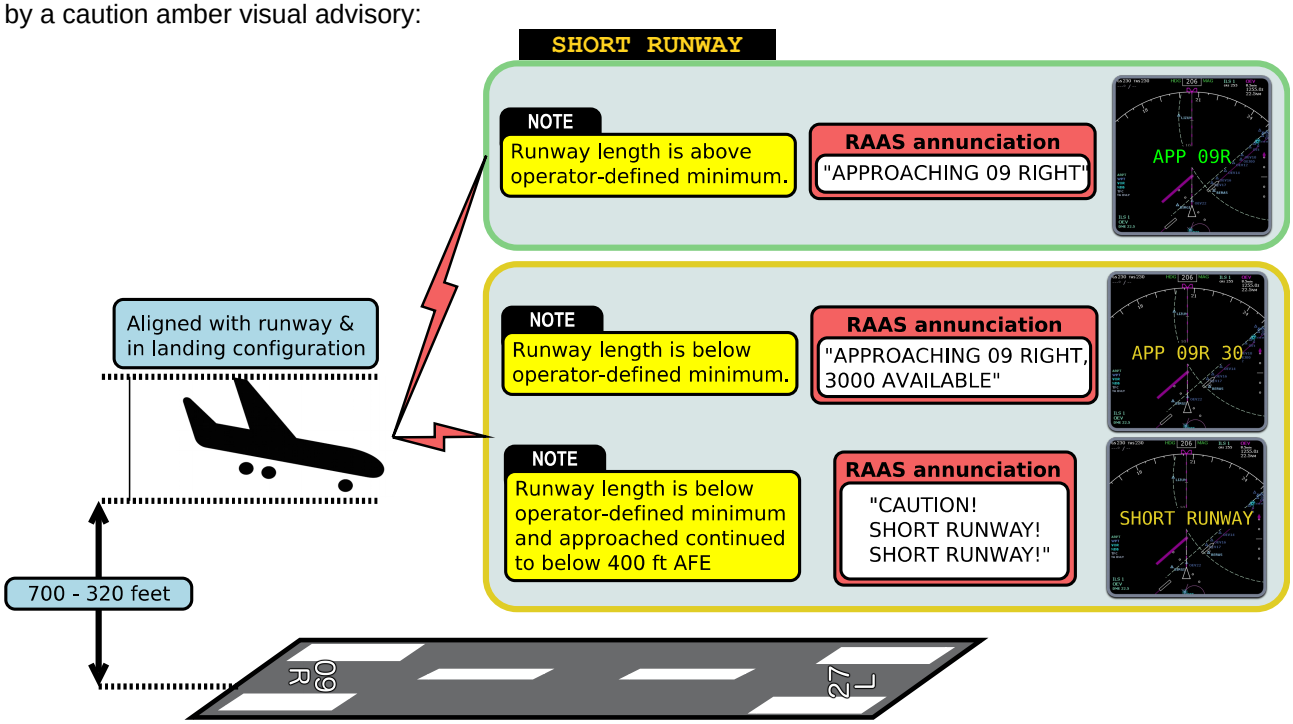


Illustration 12: Approaching a runway to land

6 The annunciation is temporarily inhibited between 520-480 feet and 420-380 feet above threshold elevation to allow for GPWS or manual altitude callouts.

7 See parameter **`RAAS_min_landing_dist`** in section 5.

4.11 Late flap selection during approach to land

X-RAAS also monitors the flaps configuration[8] during an approach to land and issues “FLAPS! FLAPS!” advisories in case flaps are not in the proper setting for landing at certain periods during the approach, based on height above runway threshold:

- 950 feet to 600 feet, annunciation: “FLAPS *(pause)* FLAPS” and a caution **FLAPS** annunciation on the ND.
- 600 feet to 450 feet, annunciation: “FLAPS! FLAPS!” and a caution **FLAPS** annunciation on the ND.
- 450 feet to 300 feet, annunciation: “UNSTABLE! UNSTABLE!” and a caution **UNSTABLE** annunciation on the ND.
- This annunciation is inhibited if:
  - the aircraft descends below 300 feet above threshold elevation, or
  - the GPWS flaps override mode (or terrain override mode if the aircraft isn't equipped with a separate flaps override mode) is active, or
  - gear is not down or the rate of climb exceeds 300 feet per minute.

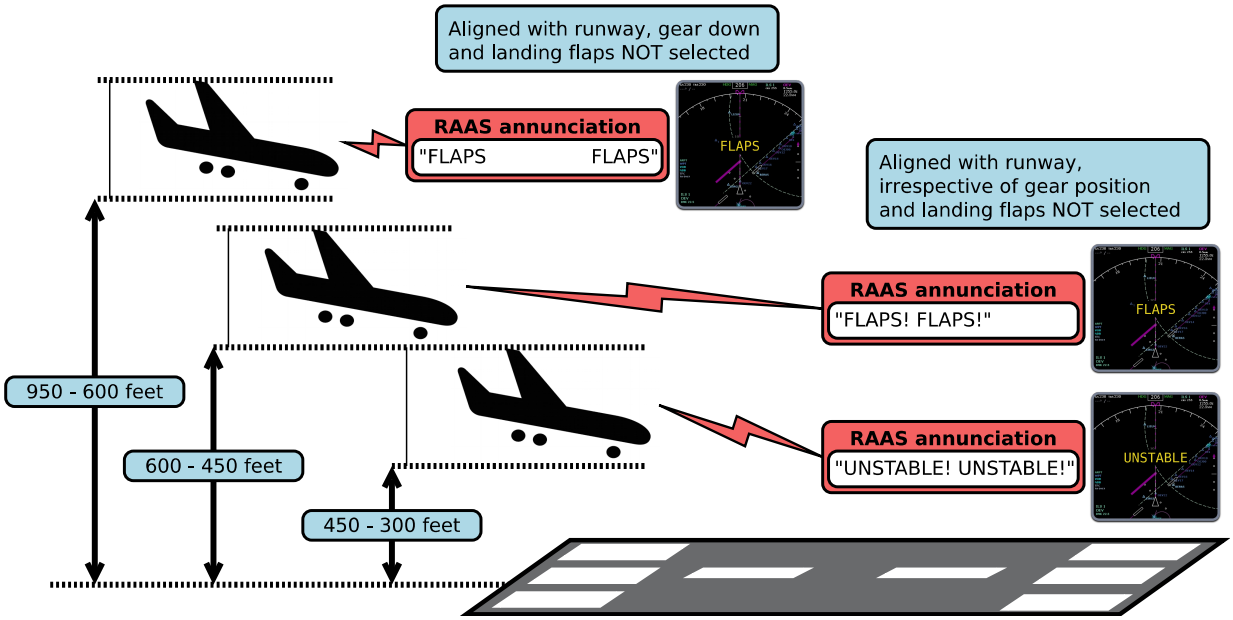


Illustration 13: Late flap selection during approach to land

8 See parameter **`RAAS_min_landing_flap`** in section 5.

4.12 Steep descent late in the approach to land

To protect against steep descents late in the landing approach and “dive bombing it” at the last moment, X-RAAS calculates the aircraft glide path angle and compares it with the optimal glide path angle stored in the database for the runway. If the actual glide path angle exceeds a limiting angle, X-RAAS issues caution advisories, depending on height above runway threshold:

- 950 feet to 600 feet: aural: “TOO HIGH (pause) TOO HIGH” visual: **TOO HIGH**
- 600 feet to 450 feet: aural: “TOO HIGH! TOO HIGH!” visual: **TOO HIGH**
- 450 feet to 300 feet: aural: “UNSTABLE! UNSTABLE!” visual: **UNSTABLE**

Annunciation is inhibited if:

- the aircraft descends below 300 feet above threshold elevation, or
- the GPWS terrain override mode is active, or
- the rate of climb exceeds 300 feet per minute.

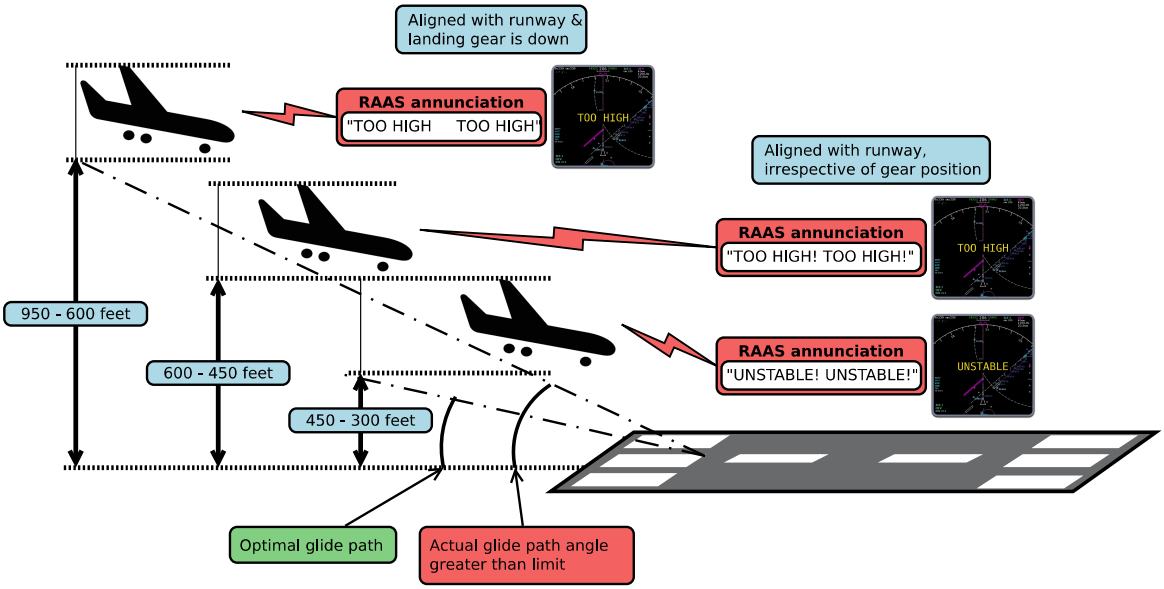
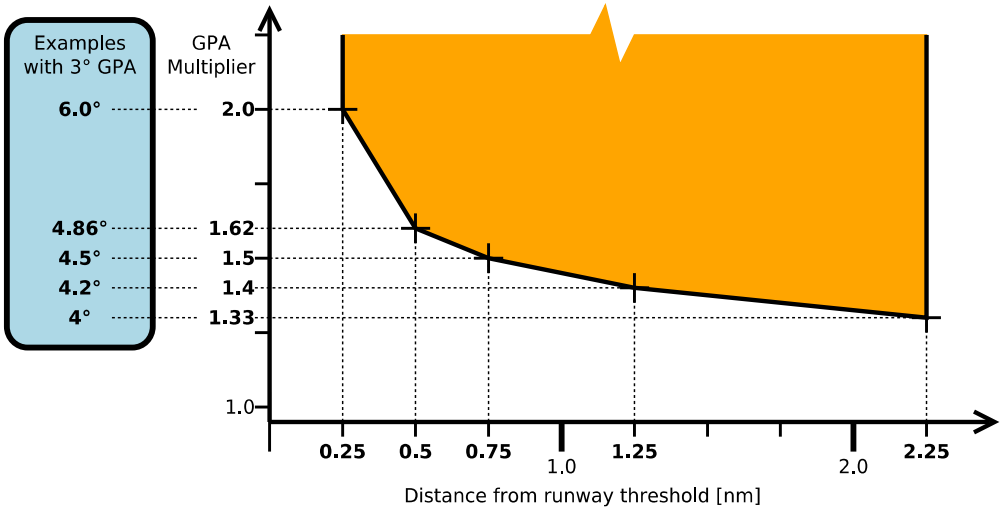


Illustration 14: Steep descent late in the approach to land

The algorithm for calculating the limiting glide path angle is based on the aircraft's distance from the runway threshold. The distance determines a multiplier applied to the optimal angle. For example, if the multiplier is 2 and the optimal glide path angle is 3°, then the limiting angle is 6° for that particular point on the approach. Refer to the table below for details on the actual multiplier values used.



4.13 Excessive airspeed on approach

This check monitors airspeed during an approach and compares it with the landing speed set in the FMS. If the indicated airspeed becomes excessive while passing through pre-determined height gates above threshold elevation, X-RAAS will issue the following annunciations:

- 950 feet to 600 feet: aural: “TOO FAST (pause) TOO FAST” visual: **TOO FAST**
- 600 feet to 450 feet: aural: “TOO FAST! TOO FAST!” visual: **TOO FAST**
- 450 feet to 300 feet: aural: “UNSTABLE! UNSTABLE!” visual: **UNSTABLE**

Annunciation is inhibited if:

- the aircraft descends below 300 feet above threshold elevation, or
- the GPWS terrain or flaps override mode is active, or
- the rate of climb exceeds 300 feet per minute.

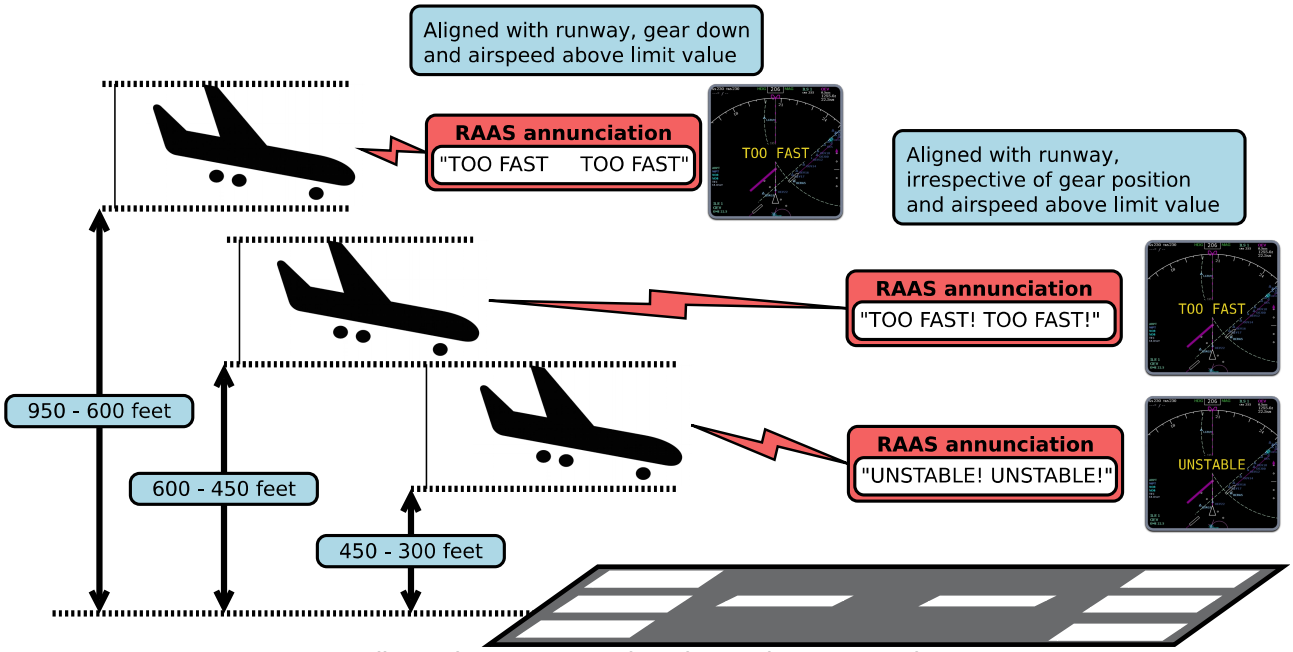
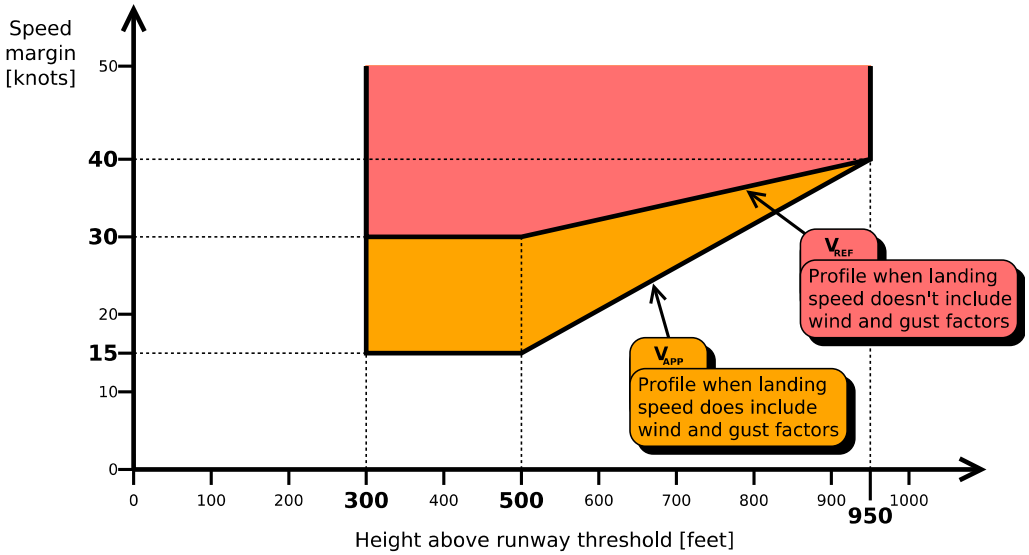


Illustration 15: Excessive airspeed on approach

The amount of speed margin above allowed above the landing speed depends on the height above the threshold and whether the landing speed includes wind and gust factors (V_{APP} – common on Airbus) or not (V_{REF} – common on Boeing):



Please note that excessive approach speed monitoring requires aircraft-specific integration. Refer to section for a list of aircraft which support this feature.

4.14 Attempting to land on a parallel taxiway

Many airports feature runways with close parallel taxiways. Under certain weather conditions, these can look very similar to each other during final approach and lead to confusion as to which is the runway and which is a taxiway. This increases the risk of an aircraft attempting to land on a taxiway, with obvious potential for a collision as a result.

To help in preventing this hazard, X-RAAS closely monitors an aircraft's position during the final stages of approach. If X-RAAS detects the following conditions, it will issue a warning advisory:

- Radio altitude is less than 250 feet, but above 100 feet.
- Aircraft is in landing configuration (gear is down and flaps in the landing position).
- Aircraft is not in the runway approach area or is not aligned with the runway (aircraft heading within 20 degrees of runway heading).

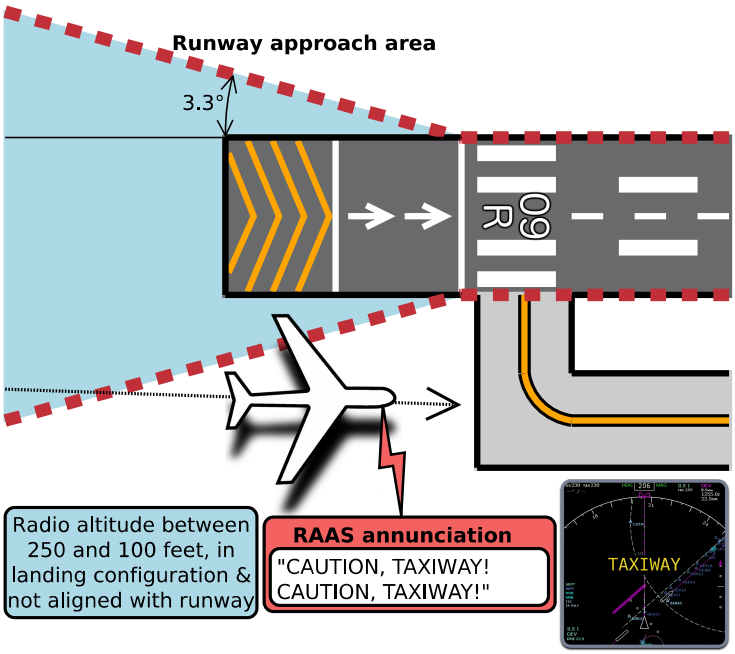


Illustration 16: Attempting to land on a parallel taxiway

The advisory is inhibited below 100 feet radio altitude[9] or if the GPWS terrain override mode is active. The aural advisory is accompanied by a caution amber visual advisory on the ND:

TAXIWAY

9 Due to the minimum radio altitude constraint and the runway approach area shape, there is a minimum lateral deviation of the aircraft's longitudinal center axis off the runway edge, below which this advisory is inhibited. For runways with a 3° glidepath, a threshold clearing height of 50 feet and roughly flat terrain in the runway approach area, the minimum lateral deviation is approximately 56 feet or 17 meters. The shallower the glidepath or the higher the terrain in the approach area, the wider the minimum lateral deviation below which this advisory will be inhibited. Therefore, if the parallel taxiway is very close to the runway, X-RAAS may not be able to detect a taxiway landing attempt.

4.15 Long landing

This annunciation protects against excessive floating on landing or an incorrectly executed too high or too fast approach, resulting in touch down very far down the runway and potentially insufficient runway length available for rollout. Conditions for this annunciation are:

- The aircraft is above the runway.
- Radio altitude indicates less than 100 feet, but more than 5 feet.
- Aircraft is past ¼ of the runway length or past 2,000 feet past the approach runway end or remaining runway length is less than an operator-specified minimum.

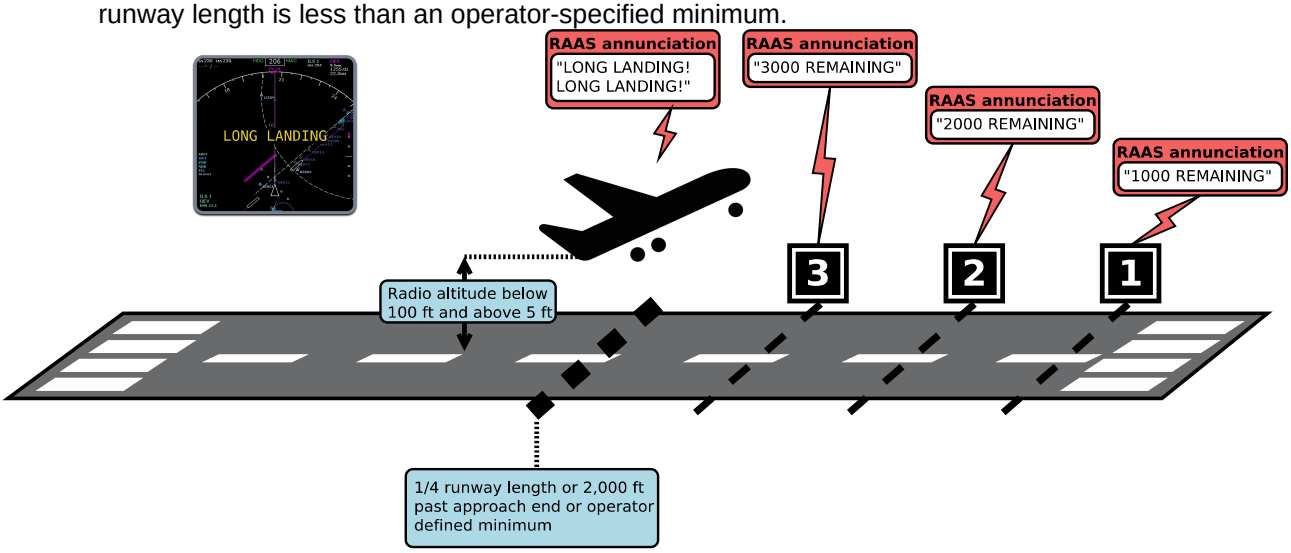


Illustration 17: Long landing

X-RAAS will initially annunciate “LONG LANDING!” twice and the remaining runway length if it is less than 9,000 feet (2,700 meters) or an operator-defined maximum[10]. Afterwards, X-RAAS will continue to annunciate runway length remaining every 1,000 feet (300 meters), unless the aircraft lands and decelerates below 40 knots ground speed, or performs a go-around (refer to section 4.17 for conditions monitored during a go-around). The aural advisory is accompanied by a caution amber visual advisory on the ND:

LONG LANDING

10 See parameter **`RAAS_stop_dist_cutoff`** in section 5.

4.16 Landing rollout runway length remaining

During landing rollout, X-RAAS closely monitors aircraft position, ground speed and deceleration. If the aircraft approaches to within approximately 4,000 feet or 1,200 meters (configurable as an operator-defined value[10]), its ground speed is above 40 knots and the current rate of deceleration is insufficient to come to a complete stop prior to the end of the runway, X-RAAS will start issuing runway distance remaining annunciations in 1,000 foot or 300 meters increments. Thus the annunciation of runway length remaining during a normal landing indicates that additional braking might be required to bring the aircraft to a safe stop. The runway distance remaining annunciations are based on the position the aircraft's nosewheel will attain in approximately 1 second with an added approximate 200 foot or 60 meter buffer. Therefore a “3000 (feet) remaining” annunciation can be sounded between 3,000 to 3,200 feet remaining. The last 1,000 feet or 300 meters of runway length remaining feature two additional annunciations:

- The last 500 feet or 100 meters. Inhibited if ground speed is below 40 knots.
- The last 100 feet or 30 meters. This annunciation is sounded irrespective of ground speed as long as the aircraft remains aligned with the runway to warn the pilot of the need to perform an immediate stop or turn to avoid running off the end of the runway.

The runway length remaining is calculated based on the position of the threshold of the opposite runway. If the opposite runway features a displaced threshold, this displacement length is counted towards the runway length remaining, i.e. the displaced threshold portion of a runway is considered to be suitable for landing rollout. If the opposite runway features a stopway (a “blastpad”), this is NOT counted towards the runway length remaining[11]. No visual advisories are generated.

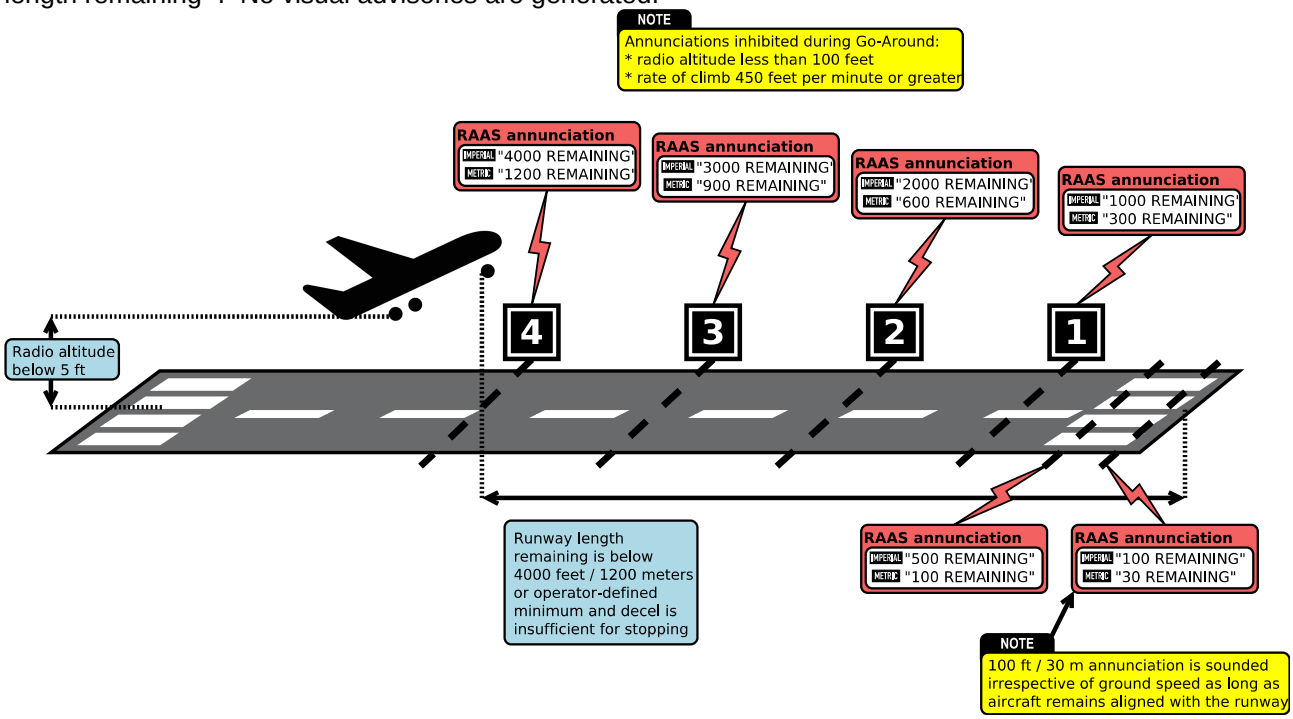


Illustration 18: Landing rollout runway length remaining

Due to how X-RAAS is implemented, landing rollout annunciations are only guaranteed to sound if the aircraft is flying through each distance “gate” below a maximum ground speed:

Distance [feet]	Distance [meters]	Maximum ground speed [knots]
9,000 – 1,000	2,700 – 300	250
500	100	125
100	30	60

11 Stopways are normally designed for emergency use only.

4.17 Go-around

During Go-around, runway length remaining annunciations are inhibited as soon as the aircraft climbs through 5 feet radio altitude and the following two conditions are met:

- radio altitude is below 100 feet
- rate of climb is 300 feet per minute or greater

If the rate of climb decays to below 300 feet per minute, runway length remaining annunciations are continued. If the aircraft climbs through 100 feet radio altitude, runway length remaining annunciations are not resumed, even if the aircraft resumes level flight.

4.18 Runway exit via high-speed exit taxiways

To support efficient high-traffic-density operations, landing traffic needs to be able to exit the runway environment after landing in an expeditious manner. To this end, many airports feature “high-speed exit” taxiways. These taxiways, rather than connecting to the runway at right angles, connect at relatively shallow angles, allowing landing traffic to maintain higher speed when turning off the runway. To support high-speed rollouts onto these kinds of taxiways, X-RAAS monitors groundspeed and aircraft position relative to the runway after landing. If the aircraft exceeds a limiting ground speed, this annunciation will be generated: “CAUTION! ON TAXIWAY! ON TAXIWAY!” and **ON TAXIWAY** on the ND.

- As long as the aircraft remains on a runway, no limiting ground speed is imposed.
- If the aircraft leaves the runway, but remains within the runway approach bounding box (as described in section 4.1), the limiting ground speed is 60 knots.
- If the aircraft leaves both the runway and the runway approach bounding box, the limiting ground speed is 40 knots.

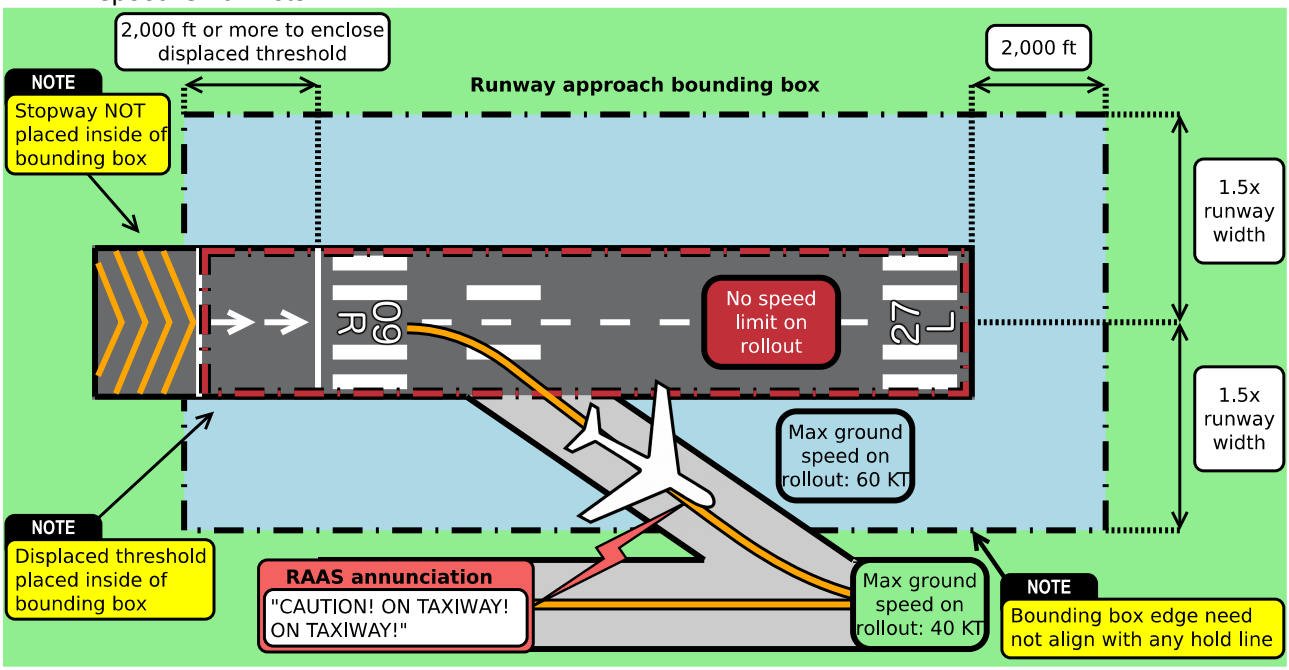


Illustration 19: Runway exit via high-speed exit taxiways

5 Configuration

Just like the real system, X-RAAS can be extensively customized to suit the particular operational requirements of an aircraft or airline. For this purpose, X-RAAS contains a text configuration file called `X-RAAS.cfg`. You can open it up in any text editor such as Notepad or TextEdit. The configuration file is simply a set of lines in the following format:

```
<Parameter> = <Value>
```

You can set the value of a parameter any number of times in a configuration file. The last setting encountered will be the one used. Please note that if you are satisfied with the default value of a parameter, you do not need to set it in the configuration file. Absence of a parameter setting implies that X-RAAS should use the default value. This should help to keep your configuration file short.
Anything following a double-dash (--) is considered a comment and ignored by X-RAAS:

```
-- This is a comment. X-RAAS ignores what's on this line.
<Parameter> = <Value>
```

X-RAAS looks for the configuration file in two locations, first in the **Scripts** folder in **FlyWithLua** where X-RAAS is installed and then in the aircraft folder of the currently loaded aircraft. If both are present, X-RAAS loads both files in this order, so any parameter set in the global configuration file in the **Scripts** folder can be overridden by the configuration file in the aircraft folder, giving the ability to override global settings on a per-aircraft basis.

```
<X-Plane 10 Folder>
  Aircraft
    <Your Aircraft's Folder>
      X-RAAS.cfg            ← overrides any global settings only for this aircraft
  Resources
    plugins
      FlyWithLua
        Scripts
          X-RAAS.cfg        ← global settings for X-RAAS shared by all aircraft
```

The default configuration file shipped with X-RAAS contains a list of all settable parameters with comments on what they do (though all lines are commented out, so all parameters are set to their defaults). For completeness' sake, the list of settable parameters is repeated here.

Parameter Name	Default Value	Description
RAAS_enabled	**true**	This is the master X-RAAS on/off switch. Setting this parameter to **false** will disable X-RAAS completely.
RAAS_allow_helos	**false**	This controls whether X-RAAS will auto-inhibit if it detects the currently loaded aircraft is a helicopter. Setting this to **true** will permit X-RAAS to start up regardless of the aircraft type loaded. Please note that the parameters below must also be satisfied.
RAAS_min_engines **RAAS_min_MTOW**	**2** **5700**	RAAS is primarily designed for airliners and is a poor fit for light general aviation aircraft or special performance aircraft such as aerobatic aircraft. Provided the master **RAAS_enabled** parameter is set to **true** and the currently loaded aircraft isn't a helicopter (see **RAAS_allow_helos** above), X-RAAS also checks the aircraft's number of engines and Maximum Take Off Weight (in kilograms) to see if the aircraft fulfills certain minimum criteria to be considered an “airliner”. To enable X-RAAS on all aircraft just set both of these values to **0**.
RAAS_auto_disable_notify	**true**	To help users quickly determine that startup of X-RAAS is auto-disabled due to aircraft size limitations or compatibility issues, by default X-RAAS prints a short notice at the bottom of the screen for 25 seconds. You can disable this notification by setting this parameter to **false**.
RAAS_use_imperial	**true**	By default X-RAAS reads out runway length remaining in thousands of feet. By setting this parameter to **false**, X-RAAS will read out runway length remaining in increments of 300 meters. See section 4.16 for more details.
RAAS_voice_female	**true**	Set to **false** to make X-RAAS grow a pair.
RAAS_voice_volume	**1.0**	Sets the relative volume of the RAAS announcements from **0.0** (silence) to **1.0** (full volume).
RAAS_US_runway_numbers	**false**	In the United States, runways are allowed to have single-digit numbers, so runway “01” is simply referred to as runway “1”. By default, X-RAAS uses the ICAO standard and always pronounces runway numbers as two digits, prepending a “0” if necessary. If you only fly within the US, you can set this parameter to **true** to make X-RAAS pronounce single-digit runways without prepending a “0”.
RAAS_min_takeoff_dist	**1000**	This is the minimum runway length remaining (in meters) that X-RAAS will consider to be safe for conducting a takeoff. This affects the advisories in sections 4.3 and 4.4.
RAAS_min_landing_dist	**800**	This is the minimum runway length remaining (in meters) that X-RAAS will consider to be safe for conducting a landing. This affects the advisory in section 4.10.
RAAS_min_rotation_dist **RAAS_min_rotation_angle**	**400** **4**	Minimum runway length remaining (in meters) and pitch angle (in degrees) relative to the runway slope

		where X-RAAS will start to issue runway length remaining annunciations on takeoff to warn of the runway end approaching rapidly and the need to initiate rotation immediately. This affects the advisory in section 4.6.
RAAS_stop_dist_cutoff	**1500**	Defines an upper limit (in meters) on runway length remaining for “distance remaining” callouts during landing rollout (sections 4.7 and 4.16). If the distance remaining is greater than this value, X-RAAS will not generate annunciations until the distance remaining drops below this value. The maximum value is **3000**.
RAAS_min_landing_flap	**0.5**	Minimum flap setting (relative flap handle position from **0.0** for “flaps up” to **1.0** for full “flaps down”) that is considered a valid landing flaps setting. This affects the advisory in section 4.11.
RAAS_min_takeoff_flap **RAAS_max_takeoff_flap**	**0.1** **0.75**	The minimum and maximum valid flap setting for takeoff. This affects the supplemental “FLAPS! FLAPS!” callout when lining up on a runway for takeoff in section 4.2.
RAAS_on_rwy_warn_initial **RAAS_on_rwy_warn_repeat** **RAAS_on_rwy_warn_max_n**	**60** **120** **3**	The interval at which “ON RUNWAY” callouts for extended holding on a runway are issued (see section 4.2.1). The initial delay is for the first callout, whereas the repeat delay is for any subsequent callouts from the first. The “max_n” parameter defines the total maximum number of callouts that will be issued to limit annoyance to the crew. Setting **RAAS_on_rwy_warn_max_n** to **0** will disable any “ON RUNWAY” callouts after extended holding on the runway.
RAAS_too_high_enabled	**true**	Controls whether X-RAAS will monitor glidepath angle and warn against too high approaches using the advisory described in section 4.12.
RAAS_too_fast_enabled	**true**	Controls whether X-RAAS will monitor approach speed and warn against too fast approaches using the advisory described in section 4.13.
RAAS_gpa_limit_mult **RAAS_gpa_limit_max**	**2** **8**	When glidepath angle monitoring is enabled, **RAAS_gpa_limit_mult** controls the absolute maximum glidepath angle multiplier allowed to be applied by the distance-dependent algorithm described in section 4.12. **RAAS_gpa_limit_max** provides an absolute upper boundary (in degrees) on the allowed computed glidepath angle limit. Even if the multiplier would calculate a higher limit, X-RAAS will cut the value off at this maximum threshold.
RAAS_alt_setting_enabled	**true**	Controls if altimeter setting monitoring is enabled, as described in sections 4.8 and 4.9.
RAAS_qnh_alt_enabled **RAAS_qfe_alt_enabled**	**true** **false**	When altimeter checks are enabled, when descending through transition level, these parameters determine what type of altimeter setting checks are preformed by X-RAAS. When QNH setting is allowed, X-RAAS checks to make sure that the barometric altimeter reading is within a pre-computed margin from GPS-computed elevation above mean sea level. When QFE setting is

		allowed, X-RAAS checks to make sure that the altimeter reading is within a pre-computed margin from above field elevation of the nearest airport. Setting both parameters to **true** allows either altimeter setting, whereas setting both parameters to **false** disables barometric altimeter checking on descent.
RAAS_disable_ext_view	**true**	X-RAAS mutes annunciations when it detects that the current view location is “external”, since these should only be audible when inside the cockpit. Setting this to **false** will allow annunciations to sound regardless if X-RAAS thinks your view is inside the cockpit or not.
RAAS_override_electrical	**false**	Some aircraft models do not properly set the required datarefs for X-RAAS to detect electrical power being applied to the aircraft's avionics systems. If that's the case, you can set this parameter to **true** to make X-RAAS always turn on, even if it thinks electrical power isn't available.
RAAS_override_replay	**false**	During replays, aircraft position can behave in strange and non-predictable ways, which can cause X-RAAS to give spurious annunciations. Therefore, if X-RAAS detects that the simulator is in replay mode, it will auto-inhibit for the duration of the replay. By setting this parameter to **true**, you can re-enable X-RAAS during replays.
RAAS_speak_units	**true**	X-RAAS will annunciate the units used for distance measurement during an initial distance remaining or available annunciation (e.g. "5000 FEET REMAINING" on landing). For brevity, subsequent annunciations will only annunciate the number (e.g. "4000 REMAINING"). If no distance annunciation is made for 2 or more minutes, units will again be appended to the next annunciation. By setting the parameter below to **false**, X-RAAS will never annunciate the units and instead only annunciate the numeric value.
RAAS_long_land_lim_abs **RAAS_long_land_lim_fract**	**610** **0.25**	These values determine the fraction of the runway length from the approach end of the runway where a landing should be performed, before a long landing annunciation is made (refer to section 4.15). The parameter **RAAS_long_land_lim_abs** defines the absolute longest length (in meters) from the approach runway end. The **RAAS_long_land_lim_fract** parameter defines the runway length as a fraction of the runway length. The lesser of these two values is considered the “normal” landing range. The minimum and maximum values for **RAAS_long_land_lim_fract** are 0.0 and 1.0 respectively.
RAAS_ND_alerts_enabled	**true**	Controls whether X-RAAS will issue visual alerts on the aircraft's Navigation Display (ND) or the fallback screen overlay display. Setting this to **false** does not disable aural annunciations.
RAAS_ND_alert_filter	**0**	Sets up a filter for which visual annunciations will be

		displayed on the navigation display or overlay. Valid values are: • **0**: display all annunciations • **1**: display only non-routine and caution annunciations • **2**: display only caution annunciations
RAAS_ND_alert_overlay_enabled	**true**	Provided **RAAS_ND_alerts_enabled** is set to **true**, if the aircraft does not provide proper visual alert integration, X-RAAS will attempt to display visual alerts as an overlay near the top center of the screen. Setting this parameter to false disables that fallback mechanism. It does not disable display of visual alerts on an aircraft's ND, provided the aircraft has been integrated with X-RAAS's visual alert mechanism (refer to section 8 for details on how to do this).
RAAS_ND_alert_overlay_force	**false**	Setting this parameter to **true** forces X-RAAS to display the ND alert overlay even for aircraft it thinks don't have that feature in the real world.
RAAS_ND_alert_timeout	**7**	Defines how long (in seconds) visual advisories remain on the navigation display.
RAAS_GPWS_priority_dataref	***sim/cockpit2/annunciators/GPWS***	Defines which dataref X-RAAS monitors to determine if GPWS priority override should be in effect. Refer to section 8.2 for details on this feature.
RAAS_GPWS_inop_dataref	***sim/cockpit/warnings/annunciators/GPWS***	Defines which dataref X-RAAS monitors to determine if the GPWS computer (and by consequence X-RAAS) is inoperative. Refer to section 8.2.2 for details on this feature.

6 Electrical system integration

X-RAAS is internally connected to electrical bus #1 and #2 in the aircraft (normally the “left” and “right” electrical bus) and is also subject to the master “Avionics on” switch (if installed on the aircraft). Losing power on both electrical buses or setting the master avionics switch to the “off” position will result in X-RAAS shutting down. X-RAAS requires a minimum of at least 11 Volts to be present on one of the electrical buses to operate and nominally consumes around 40 Watts of power.
In case your aircraft model is having integration problems with X-RAAS, it is possible to disable X-RAAS's electrical checks and have it always turn on, regardless of power state on the aircraft's electrical buses. See the **`RAAS_override_electrical`** parameter described in section 5.

7 Compatibility notices

7.1 Wholly incompatible aircraft

The following aircraft are known to be incompatible with X-RAAS. X-RAAS will auto-disable if it detects the aircraft is loaded.

- Leading Edge Simulations SAAB 340A

7.2 Aircraft without visual annunciations

Some aircraft in the real world do not feature integration of the visual alerts on the navigation display. To accurately model this behavior, for those aircraft, X-RAAS will avoid displaying visual alerts both on the navigation display and on the X-RAAS ND alert overlay at the top of the screen. It is possible to re-enable at least the ND alert overlay at the top of the screen by setting the **`RAAS_ND_alert_overlay_force`** configuration parameter to **`true`**. Refer to section 5 for more details. For a list of aircraft which do not feature visual alerts at all, refer to section 7.3.

7.3 Feature compatibility matrix

The following table lists aircraft-specific feature compatibility. Features and monitors not listed in the table's columns are supported on all aircraft.

Aircraft Model Name	GTO	GFO	VAND	VAO	EASM
FlightFactor 757	✔	✔	✘	✔	✘
FlightFactor 777	$✔_{GEAR}$	✔	✘	✔	$✔_{REF}$
IXEG 737-300	$✔_{GEAR}$	✔	✘	✘	✘
FlyJSim 732 Twinjet	$✔_{FLAP}$	✔	✘	✔	✘
JARDesign Airbus A320 Neo	✔	✔	✘	✔	✔
JARDesign Airbus A330-243	✔	✔	✘	✔	✔
Other aircraft	✘	✘	✘	✔	✘

Legend:

- **GTO (GPWS Terrain Override):** GPWS terrain override selection is supported. Subscripts:
  - $✔_{GEAR}$: GPWS terrain override mode is engaged using the GPWS gear override switch.
  - $✔_{FLAP}$: GPWS terrain override mode is engaged using the GPWS flap override switch.
- **GFO (GPWS Flaps Override):** GPWS flaps override selection is supported.
- **VAND (Visual Alerts on Navigation Display):** Visual alerts will display integrated in the 3D cockpit on the navigation display.
- **VAO (Visual Alerts on Overlay):** Visual alerts will display using an on-screen overlay near the top center of the screen.
- **EASM (Excessive Approach Speed Monitor):** Monitoring of excessive approach speed is supported. Refer to section 4.13 for details on this monitor. Subscripts:
  - ✔: Both the V_{REF} and V_{APP} methods are supported. Which method is used depends on the setting in the FMS. If a V_{APP} speed is set, the V_{APP} method will be used. Otherwise X-RAAS falls back to trying the V_{REF} method.
  - $✔_{REF}$: Only the V_{REF} method is supported.
  - $✔_{APP}$: Only the V_{APP} method is supported.

8 Aircraft integration guide

This section is meant for add-on aircraft developers and describes how X-RAAS can be integrated with the navigation display (ND) and GPWS of an aircraft. It provides a detailed overview of the data format as well as references to sample code which can be readily integrated into existing aircraft to simplify data parsing.

8.1 Visual alerts

8.1.1 Data format

X-RAAS signals alerts that are to be displayed on the navigation display using the **`sim/multiplayer/position/plane19_taxi_light_on`**[12] dataref. This is an integer dataref which X-RAAS sets to special values for each different message that is to be displayed on the ND. The value will remain set in this dataref for as long as the alert is to be displayed. The value is treated as a bit field with the following sections:

Bits	Description
0 – 5	**Message type** Valid values: • 0: no message present • 1: 'FLAPS' message • 2: 'TOO HIGH' message • 3: 'TOO FAST' message • 4: 'UNSTABLE' message • 5: 'TAXIWAY' message • 6: 'SHORT RUNWAY' message • 7: 'ALTM SETTING' message • 8: 'APP' message • 9: 'ON' message • 10: 'LONG LANDING' message Message types 8 and 9 ('APP' and 'ON' messages) also fill the bitfields for the runway ID, runway ID suffix and distance available.
6 – 7	**Color** Valid values: • 0: message should display in a green color (normal message). • 1: message should display in an amber color (caution message). • 2: reserved • 3: reserved
8 – 13	**Runway ID** Used by message types 8 and 9. Valid values: • 0: 'TAXIWAY'. This is used to signal “ON TAXIWAY”, by passing message type 9 and a runway ID of 0. • 1 – 36: The runway ID for runway '01' through '36'. • 37: “RWYS” value. Used when multiple runways are being approached, e.g. “APP RWYS” (message type 8, runway ID 37).
14 – 15	**Runway ID suffix** Used by message types 8 and 9. Valid values: • 0: no suffix. ND should simply show the runway ID, e.g. “36”. • 1: 'RIGHT'. ND should show runway ID with abbreviated suffix, e.g. “36R”. • 2: 'LEFT'. ND should show runway ID with abbreviated suffix, e.g. “36L”. • 3: 'CENTER'. ND should show runway ID with abbreviated suffix, e.g. “36C”.
16 – 23	**Runway length available** Used by message types 8 and 9. Runway length rounded down to the nearest 100 feet or meters. A value of '0' in this field means '*no display*'. The ND should display the value (if non-

12 The strange choice of dataref is due to an implementation quirk in FlyWithLua which does not allow X-RAAS to define custom datarefs. Therefore, X-RAAS has to reuse another dataref for this purpose.

	zero) as a fixed two-digit number (printf-like format string “%02d”).

8.1.2 Source code and message encoding examples

To assist in integrating X-RAAS into 3rd party add-on aircraft, the X-RAAS distribution package includes sample code in various programming languages to transform the raw dataref value into a formatted string suitable for display on the ND. Refer to the **`X-RAAS_api`** folder for the actual source code files.
The following table shows sample ND message values and their decoded meaning.

Dataref value	Description	ND Display
`0x00000041`	Amber 'FLAPS' message	FLAPS
`0x00000042`	Amber 'TOO HIGH' message	TOO HIGH
`0x00000043`	Amber 'TOO FAST' message	TOO FAST
`0x00000044`	Amber 'UNSTABLE' message	UNSTABLE
`0x00000045`	Amber 'TAXIWAY' message	TAXIWAY
`0x00000046`	Amber 'SHORT RUNWAY' message	SHORT RUNWAY
`0x00000047`	Amber 'ALTM SETTING' message	ALTM SETTING
`0x00002308`	Green 'APP' message, runway ID **`0x23`** (35), runway suffix 0 (“”)	APP 35
`0x00006308`	Green 'APP' message, runway ID **`0x23`** (35), runway suffix 1 (“R”)	APP 35R
`0x00002508`	Green 'APP' message, runway ID **`0x25`** (37, 'RWYS')	APP RWYS
`0x00142348`	Amber 'APP' message, runway ID **`0x23`** (35), runway suffix 0 (“”), distance available **`0x14`** (2000 feet/meters)	APP 35 20
`0x00086348`	Amber 'APP' message, runway ID **`0x23`** (35), runway suffix 1 (“R”), distance available **`0x08`** (800 feet/meters)	APP 35R 08
`0x00000049`	Amber 'ON' message, runway ID **`0x00`** ('TAXIWAY')	ON TAXIWAY
`0x00002309`	Green 'ON' message, runway ID **`0x23`** (35), runway suffix 0 (“”)	ON 35
`0x00006309`	Green 'ON' message, runway ID **`0x23`** (35), runway suffix 1 (“R”)	ON 35R
`0x00002509`	Green 'ON' message, runway ID **`0x25`** (37, 'RWYS')	ON RWYS
`0x0014E349`	Amber 'ON' message, runway ID **`0x23`** (35), runway suffix 3 (“C”), distance available **`0x14`** (2000 feet/meters)	ON 35C 20
`0x0008A349`	Amber 'ON' message, runway ID **`0x23`** (35), runway suffix 2 (“L”), distance available **`0x08`** (800 feet/meters)	ON 35L 08
`0x0000004A`	Amber 'LONG LANDING' message	LONG LANDING

8.2 GPWS

8.2.1 Audio priority override

Many aircraft models include a simulation of conventional GPWS features such as the low altitude gear/flaps or terrain ahead warnings. In the real implementation of RAAS, these warnings always have priority over RAAS annunciations. However, in the simulator, X-RAAS has no way of knowing if the aircraft's GPWS is currently issuing an alert, thus possibly sounding its own annunciations in parallel, making annunciations unintelligible.
To resolve this, you can set X-RAAS up so that it watches a particular dataref to see if it should be quiet. By default, X-RAAS watches the **`sim/cockpit2/annunciators/GPWS`** dataref used by X-Plane 10's native GPWS. You are encouraged to contact X-RAAS's author to implement an aircraft-specific override so that manual tuning is not necessary. Should you however wish to, you can change the default value in `X-RAAS.cfg` using the **`RAAS_GPWS_priority_dataref`** parameter. This should be a number (integer or float) dataref, which if set to **`0`**, means X-RAAS can issue annunciations. If set to anything else, X-RAAS will suppress annunciations. Suppressed annunciations will be restarted after the dataref is reset back to **`0`**.
Please note that X-RAAS will never write to this dataref, only read from it. Therefore, your aircraft plugin is

responsible for making sure the value is reset back to **0** once the GPWS annunciation is complete.

8.2.2 GPWS inoperative

To support simulating faults on the GPWS system, X-RAAS monitors the **sim/cockpit/warnings/annunciators/GPWS** dataref. This is used by X-Plane's built-in GPWS to signal that the GPWS computer is inoperative. If this dataref is set to **1**, X-RAAS's functions are disabled. Similar to the GPWS audio priority override described in section 8.2, you should contact X-RAAS's author to set up an aircraft-specific override to implement this for your aircraft. However, should you wish to, this dataref can also be overridden in `X-RAAS.cfg` using the **RAAS_GPWS_inop_dataref** parameter.

9 About the X-RAAS project

9.1 Author

X-RAAS was written by Sašo Kiselkov. You can contact the author at:

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9.2 Acknowledgements

The X-RAAS project would like to thank the following people for their valuable help in testing, reporting bugs and suggesting improvements to X-RAAS.

- Jean Joubert
- Kyle Madore

9.3 License

X-RAAS is open-source software distributed under the terms of the **Common Distribution and Development License**. A copy of the license text is included in the software package in the **`X-RAAS_docs/COPYING`** file. The quick'n'dirty of the terms of this license:

1. You can copy, modify, run and use X-RAAS in any way you want.
2. You can redistribute your copies (whether modified or not) and even sell X-RAAS. You can incorporate X-RAAS into your own projects (whether open-source or not).
3. If you modify X-RAAS and wish to distribute it in any way, you must share the source code for the modifications you have made to it. If you've made it part of a larger work, you don't have to share the source code for all of your work, only the bits of X-RAAS you've modified.

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