# MWIR or LWIR thermal cameras for surveillance applications?

A long-range thermal camera system is an ideal sensor for 24/7 all-weather surveillance often used in protected environments such as a border or an airport. Quite often it is difficult to decide between a thermal camera active in the mid-wave infrared spectral band (MWIR 3-5 micron) or in the long-wave infrared spectral band (LWIR 8-12 micron).

Here's a quick break down of the technical differences between the two, with comparative costs and benefits associated with each that may help you decide on the most appropriate technology between MWIR and LWIR.

Some basic physics first. The infrared spectrum is usually divided into three bands that correspond to three atmospheric transmission windows:

- SWIR = ~1-2.5μm short-wave infrared
- MWIR = ~3-5μm mid-wave infrared (thermal)
- LWIR = ~7-14μm long-wave infrared (thermal

We will focus on the last two spectral bands, MWIR and LWIR, which are referred to as the 'thermal imaging bands', as the cameras in these bands are actually making an electronic image that corresponds to the thermal gradients in the observed scene.

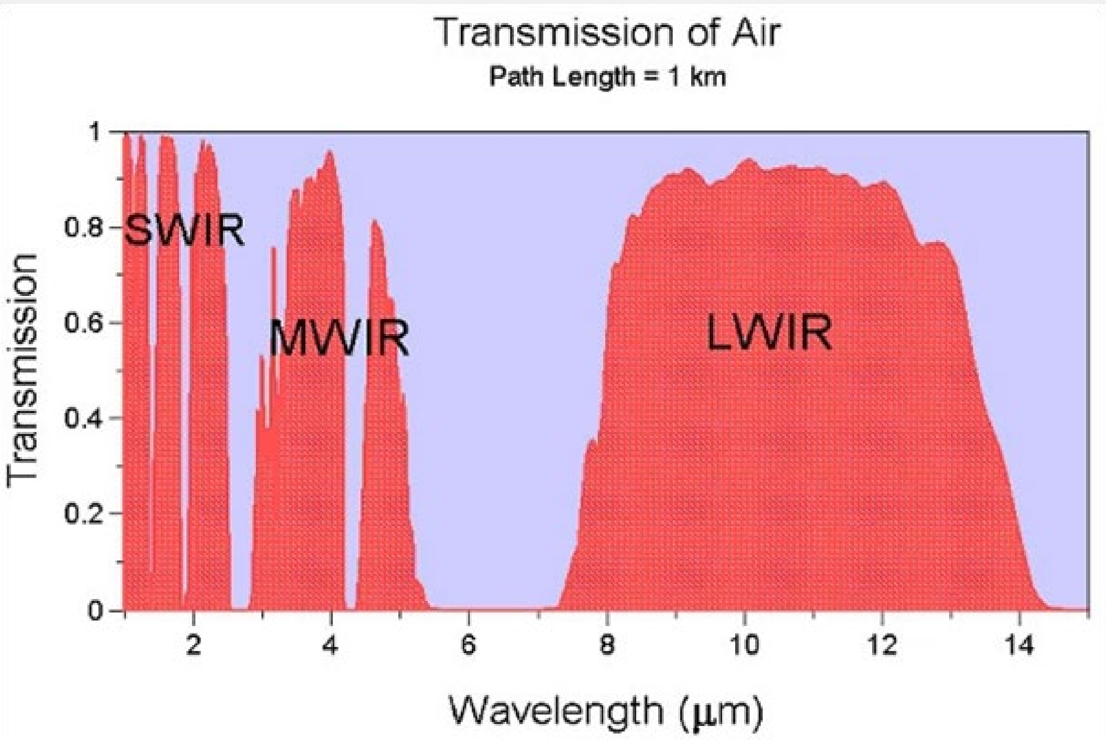


*Image courtesy of Axsys Technologies Inc.*

consult. design. integrate.

## MWIR or LWIR, which is better?

There is no easy answer, as it depends on so many factors, including:

- geographic/climatic
- overall atmospheric transmission
- target temperature
- solar effects, and
- budget.

**Geographic/climatic factors**

The world can be divided in global climatic zones. The overall scene (background) temperatures and local atmospheric properties will strongly affect sensor performance. Generally, colder climates will favour LWIR, warmer climates will favour MWIR.


*Image courtesy of Axsys Technologies Inc.*

consult. design. integrate.

### Overall atmospheric transmission

The overall atmospheric transmission depends on the local atmospheric constituents (aerosols, particles, water vapour, fog, rain etc).

MWIR systems are less affected by humidity than LWIR systems for most target ranges, so we would usually recommend MWIR cameras for applications like coastal surveillance, vessel traffic surveillance or harbour protection.

Both bands are adversely affected by fog and rain, though LWIR band has better performance than MWIR in fog conditions.

LWIR band is better than MWIR for imaging through smoke or aerosols, so LWIR is usually the chosen technology for firefighting applications and for military applications.

Nevertheless, for very long-range target detection at 10km distance or more, MWIR has greater atmospheric transmission than LWIR in most climates. For that reason, MWIR is usually the preferred choice for very long range surveillance applications.

### Target temperature (thermal flux, contrast, spectral content)

For most of the surveillance situations (man or vehicle to be detected within ambient temperature background), there is more flux (thermal energy emitted by the targets and by the environment background) available in the LWIR band than in the MWIR band at most scene temperatures, (around ambient temperatures).

However, the thermal contrast (target flux normalised to background flux), which actually makes the thermal image, is usually greater in the MWIR band, this is one of the reasons why MWIR is often the preferred choice when customers can afford it. Moreover, MWIR is also a better option if you want to detect airplanes or missiles, and the hot exhaust plumes are significantly more visible in the MWIR than in the LWIR.

### Solar effects

LWIR sees negligible solar effects while MWIR does, so LWIR imagers provide more consistent images between day time and night time. However, please make sure that your LWIR camera is 'sun immune', i.e. resistant to direct exposure to the sun, and in fact some of the low cost un-cooled microbolometers can have their detector 'burnt' by a too much or too direct exposure to the sun.

Inversely, while most of the MWIR current technologies are 'sun immune', the actual MWIR performance can be deteriorated by solar glints, for example the sun reflecting off water can hide targets in case of coastal surveillance.

### Budget

The last but not least factor is price. As often, the technology performance is proportional to the budget. This fact is globally true for thermal cameras with un-cooled LWIR cameras (very affordable today, good enough for most of the short and mid-range applications), cooled MWIR cameras (expensive, for long range surveillance) and cooled LWIR cameras (usually very expensive, for long-range application or specific military usage). There are no un-cooled MWIR cameras available for standard surveillance.

## Conclusion

In conclusion, there is no perfect choice between LWIR or MWIR to cover all surveillance scenarios, but here are some summary guidelines.

| Condition | Preferred band |
|---|---|
| High humidity | LWIR (<2.5km), MWIR (>2.5km) |
| Fog | LWIR |
| Arctic/sub-arctic | LWIR |
| Average climate | MWIR |
| Smoke/aerosols | LWIR |
| High temperature targets | MWIR |
| Very long range | MWIR |

Some sophisticated software models, for example NVTHERM in USA, can simulate the actual performance of every thermal camera in a specific surveillance scenario (atmospheric transmission, target temperature, background temperature). So, we can only recommend you ask your thermal camera supplier to run a demo to help you choose the most appropriate thermal camera system between MWIR and LWIR.

This question may become obsolete in the future of MWIR/LWIR thermal cameras that are simultaneously active in the two bands. Dual-band MWIR/LWIR cameras already exist today, but their use is highly restricted to specific military applications which are not available in the public domain.

consult. design. integrate.