What is the dead zone on a fibre OTDR.

In fibre optics, when testing with an **OTDR (Optical Time Domain Reflectometer)**, the **dead zone** refers to a region along the fibre where the OTDR cannot properly detect or resolve events (like splices, connectors, or breaks) because of the effects of a strong reflection or scattering.

There are **two main types of dead zones**:

1. **Event Dead Zone (EDZ):**
    - The shortest distance after a reflective event (like a connector) where the OTDR can detect another event.
    - It's mainly influenced by the **pulse width** of the OTDR laser and the strength of the reflection.
    - Typical range: a few meters to tens of meters.
2. **Attenuation Dead Zone (ADZ):**
    - The distance after a reflective event where the OTDR can accurately measure **loss** again.
    - Usually longer than the event dead zone.
    - Important for measuring splice losses near reflective connectors.

Causes of dead zones:

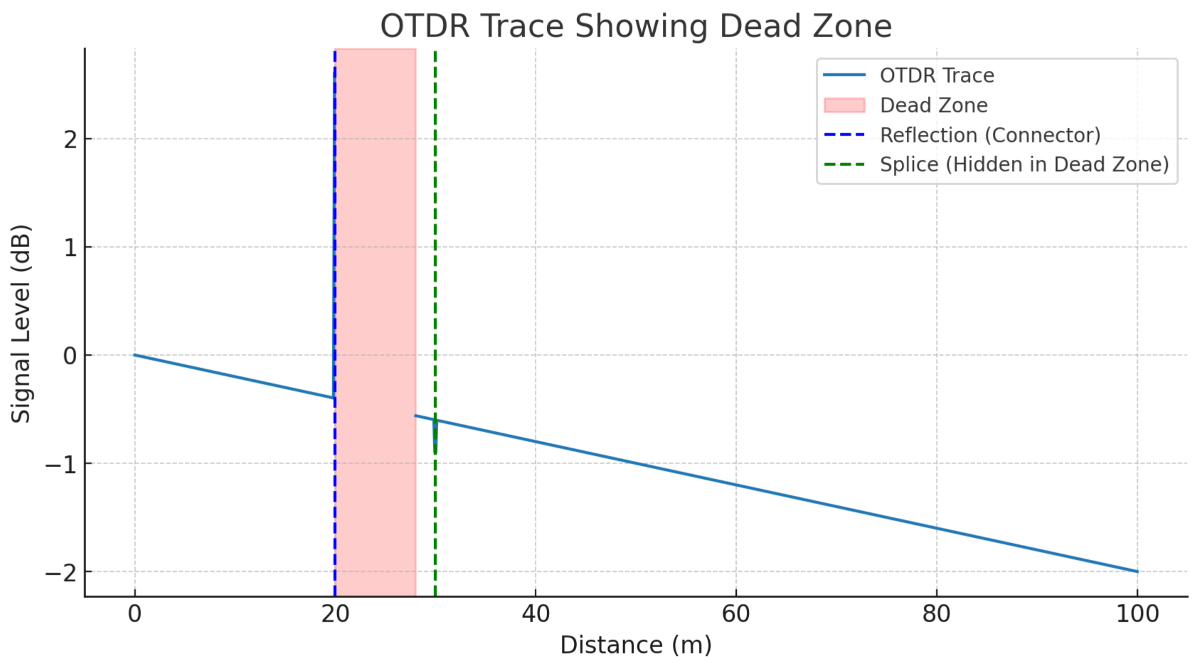
- High reflectance from connectors or breaks.
- Wide test pulse widths (narrower pulses reduce dead zones but increase noise).

Mitigation techniques:

- Use launch cables (aka pulse suppressor boxes) to push the dead zone outside the fibre under test.
- Use receive fibres to improve measurements at the far end.
- Choose the shortest suitable pulse width for better resolution.

👉 In short: The dead zone is the "blind spot" right after a strong reflection where the OTDR cannot detect or measure events accurately.

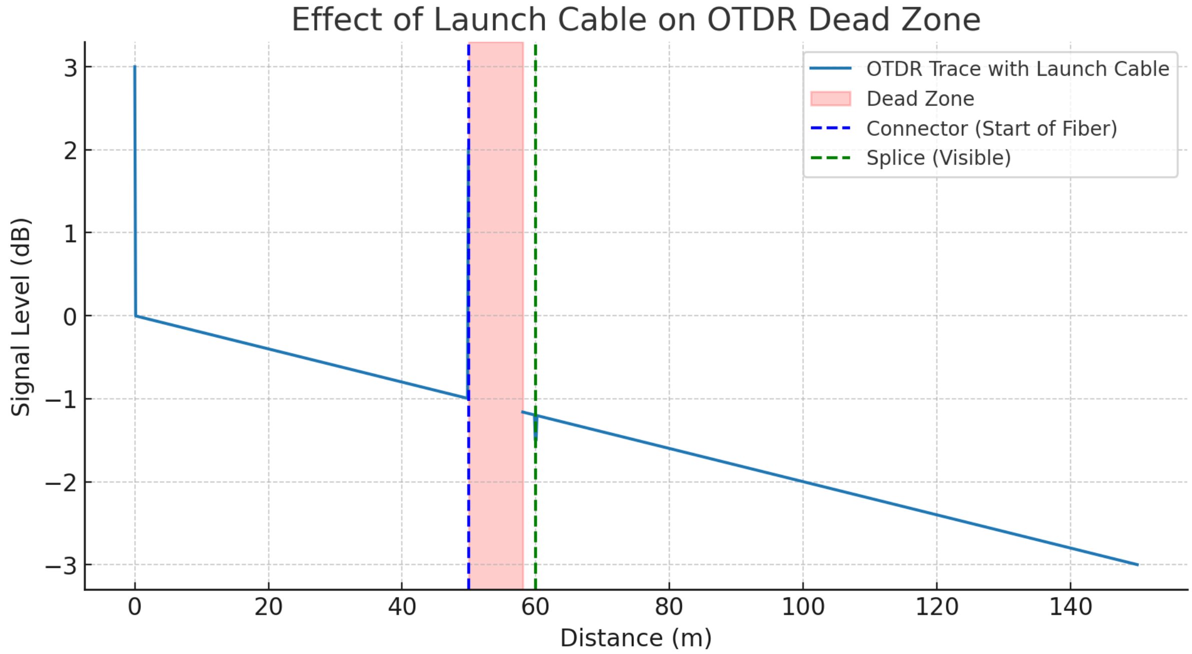
Diagram showing how the OTDR trace looks with dead zones.



Here's a diagram of an **OTDR trace** showing the **dead zone**:

- The **blue dashed line** marks a strong reflection (e.g., a connector).
- The shaded **red zone** is the dead zone where the OTDR cannot detect new events.
- The **green dashed line** shows a splice that is hidden inside the dead zone.

This illustrates why **launch cables** are used — they push reflections away from the fibre under test so that splices and losses can be measured accurately.

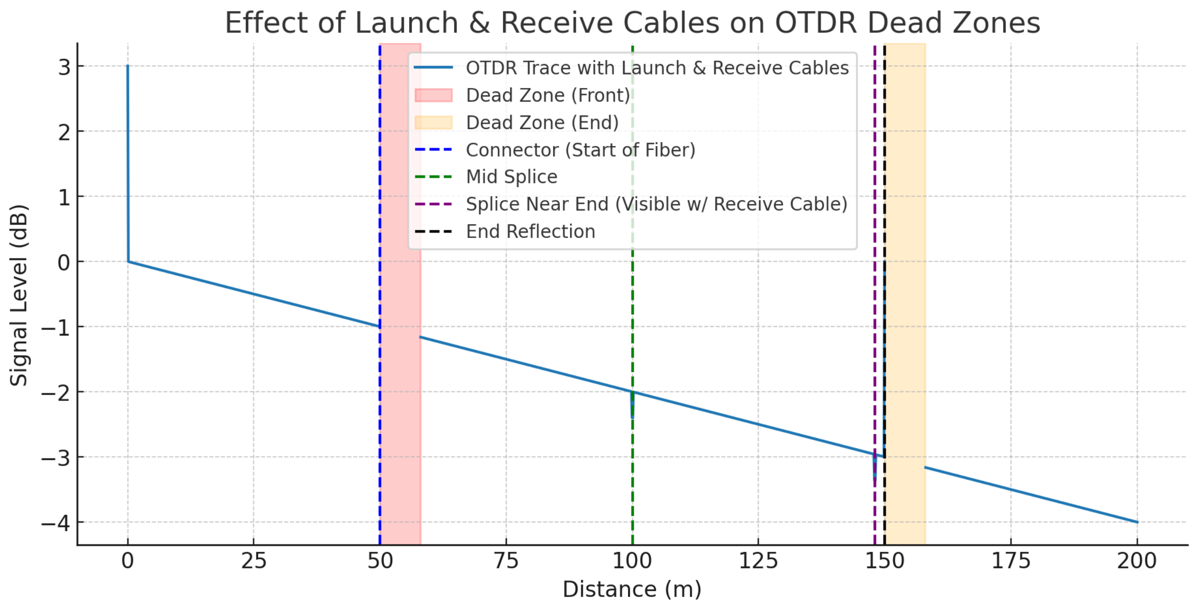


Here you can see how a **launch cable** solves the dead zone problem:

- The **blue dashed line** is the connector at the start of the fibre under test.
- The **red shaded area** is the dead zone caused by that reflection.
- Because the launch cable moved the reflection away from the OTDR port, the **green dashed line (splice at 60 m)** is now clearly visible.

Without a launch cable, that splice would have been hidden in the dead zone.

By adding a **launch cable** shifts the dead zone away from the fibre under test.



Here's the OTDR trace with **both launch and receive cables**:

- **Front end (blue line at 50 m):** The launch cable pushes the initial reflection away, so the splice at 100 m is clearly visible.
- **End of fibre (black line at 150 m):** Without a receive cable, the strong reflection would create a dead zone hiding the splice near the end.
- With the **receive cable**, the splice at **148 m (purple line)** is visible, since the dead zone falls inside the receive fibre instead of the fibre under test.

👉 In practice, technicians use **both launch and receive cables** to ensure the **entire fibre link can be tested**, including the connectors and splices at both ends.

The **pulse width** on an OTDR is the duration of the light pulse it sends into the fiber. It directly affects **dynamic range, resolution, and dead zone size**:

🔦 Effect of Pulse Width

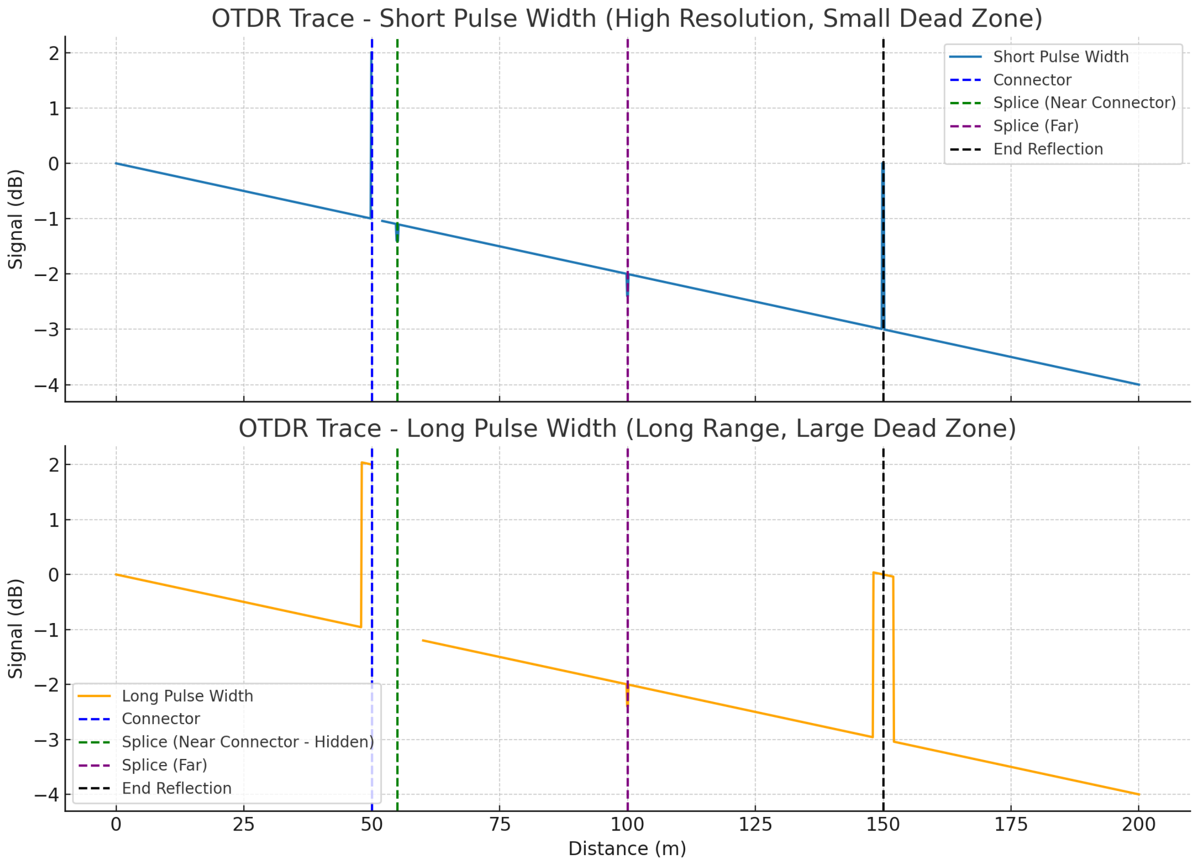
1. **Short Pulse Widths (e.g., 5–30 ns):**
    - Produce **narrow pulses** → better **spatial resolution** (you can distinguish events that are very close together).
    - **Smaller dead zones** → events close to a reflection can be detected.
    - But less optical energy per pulse → **lower dynamic range** (shorter test distance, noisier trace).
    - Best for **short fibers, patch cords, or high-resolution troubleshooting**.
2. **Long Pulse Widths (e.g., 1–10 µs):**
    - Produce **wide pulses** → worse resolution (events closer than a few meters may blur together).
    - **Larger dead zones** → splices near connectors may be hidden.
    - More optical energy → **higher dynamic range** (you can see further down long fibers).
    - Best for **long-haul testing (tens or hundreds of km)**.

⚖️ Trade-off

- Short pulses = good detail, poor reach.
- Long pulses = good reach, poor detail.
- That's why OTDRs often use **multiple test settings** (e.g., one with a short pulse for near-end detail, one with a long pulse for full length).

👉 Think of it like taking photos:

- A **short pulse** is like a high-resolution close-up photo, but in dim light (less range).
- A **long pulse** is like a floodlight photo that lights up everything far away, but the details are blurred.



Here's the comparison between **short pulse width** and **long pulse width** OTDR traces:

- **Top (Short Pulse):**
  - Small dead zone after the connector (blue line).
  - The **splice at 55 m (green line)** is visible, even though it's close to the connector.
  - Great for detail, but less range and more noise on long fibers.
- **Bottom (Long Pulse):**
  - Large dead zone after the connector.
  - The **splice at 55 m is hidden** inside the dead zone.
  - The splice at 100 m is visible, and the end reflection is stronger.
  - Great for long fibers, but near-end detail is lost.

👉 This is why technicians often run **two OTDR tests**:

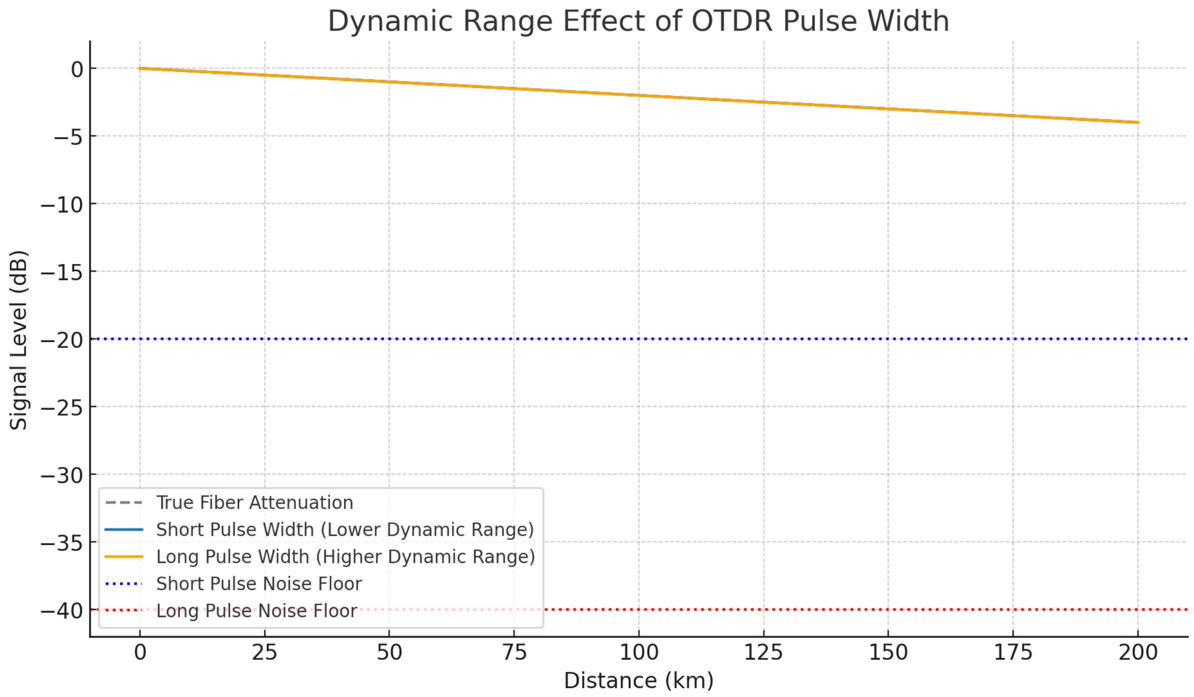
- One with a **short pulse** to see near-end connectors and splices.
- One with a **long pulse** to check the whole link length.

Here's how **pulse width affects dynamic range** on an OTDR:

- The **gray dashed line** is the "true" fibre attenuation (signal gradually dropping with distance).
- With a **short pulse** (blue trace):
    - Lower energy → the signal fades into the **noise floor** much sooner.
    - The OTDR can only "see" part of the fibre.
- With a **long pulse** (orange trace):
    - Higher energy → the signal remains above the noise floor for much longer.
    - The OTDR can measure much further down the fibre.

👉 In practice:

- Use **short pulses** for resolution near the ends.
- Use **long pulses** for long-haul fibre visibility.
- Many OTDRs even have an **auto-test mode** that runs multiple pulses and combines the results for best detail + range.



A summary chart that compares *dead zone, resolution, and dynamic range* for short vs long pulses