

UNDERSTANDING 4WD

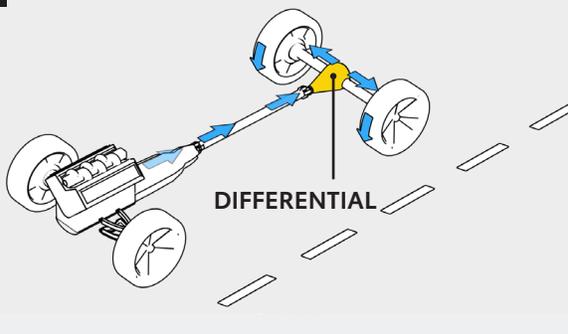


Vehicle drivetrains can be complicated. For instance, Toyota's current lineup includes **front-wheel drive (FWD)** and **rear-wheel drive (RWD)**, as well as **two different four-wheel drive (4WD) systems** and **three different all-wheel drive (AWD) systems**.

This document will go over some drivetrain basics and provide an overview of Toyota's two types of 4WD systems – explaining how they work and what makes them unique.

DRIVETRAIN BASICS

2WD

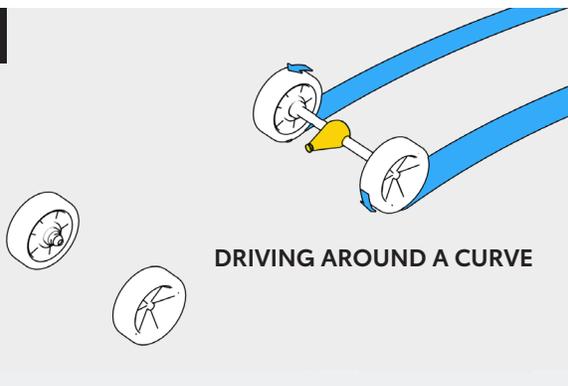


Understanding 4WD is easier when you understand the limitations of two-wheel drive (2WD).

With 2WD, engine power flows through the transmission and then out to a differential gear.

This differential is responsible for **splitting the power out to the left and right wheels** – and determining whether they lock together or rotate independently.

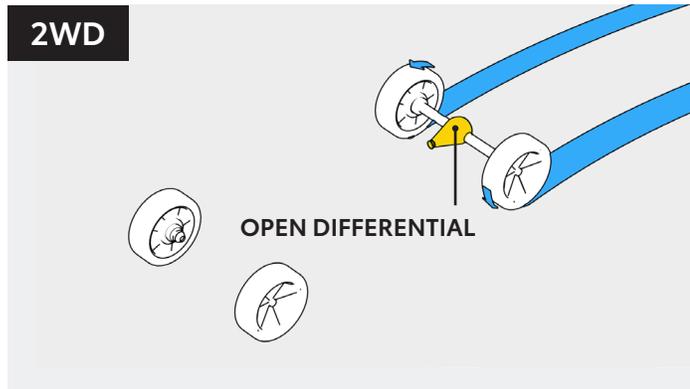
2WD



Under normal circumstances, power flow is split evenly between left and right wheels.

However, these wheels also need to be able to **spin at different speeds**, because when the vehicle goes around a curve, the **outer wheel rotates slightly faster** as it covers a wider arc.

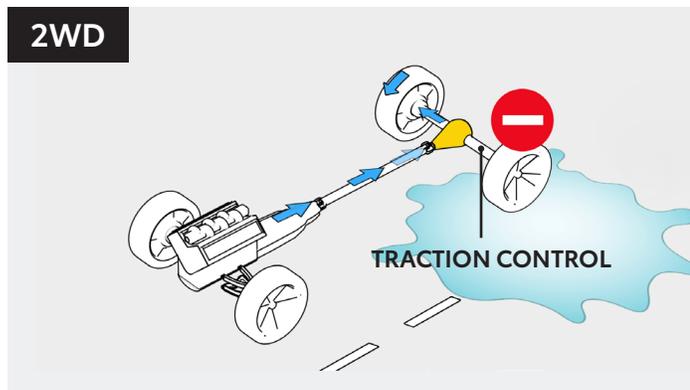
DRIVETRAIN BASICS (CONTINUED)



Most vehicles use an open differential, which allows for wheels to **spin freely and independently**.

But with this design, the power flow is always going to follow the path of least resistance.

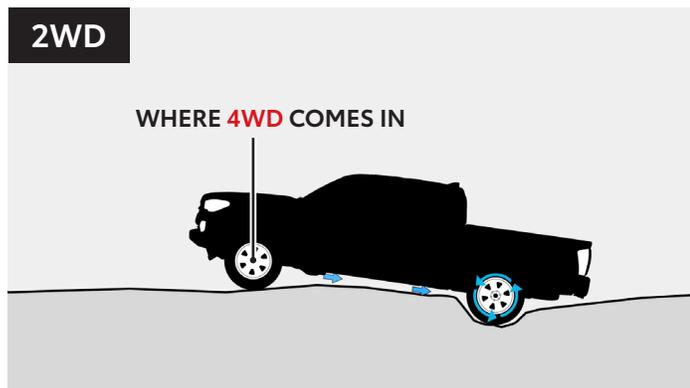
So if one wheel has no traction, the vehicle will send all its power to that wheel, **spinning it instead of powering the one with traction**.



This issue can often be mitigated with traction control, which momentarily applies the brake on the spinning wheel, sending power **back across the axle**.

Another solution is to replace the open differential with a limited-slip or locking differential.

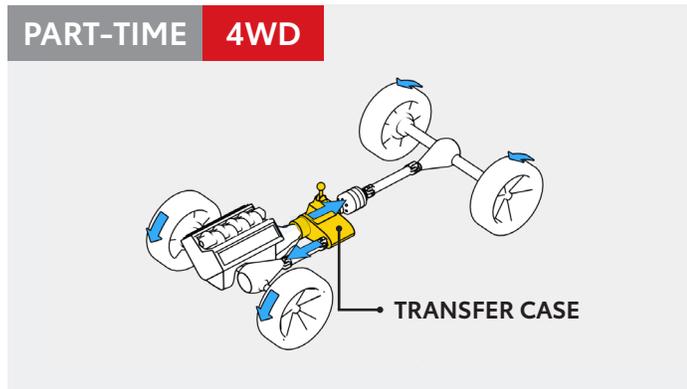
These designs can **limit the speed difference between the two wheels** – or even just **lock them together**.



But even if we maximize traction across one axle, it can sometimes still be necessary to **send power to the other axle**.

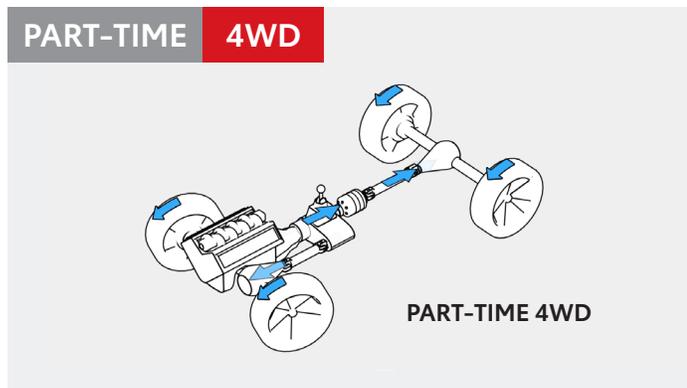
This is where 4WD comes in.

PART-TIME 4WD



4WD adds a transfer case to the driveline, enabling the vehicle to **split the power to both the rear and front axles**.

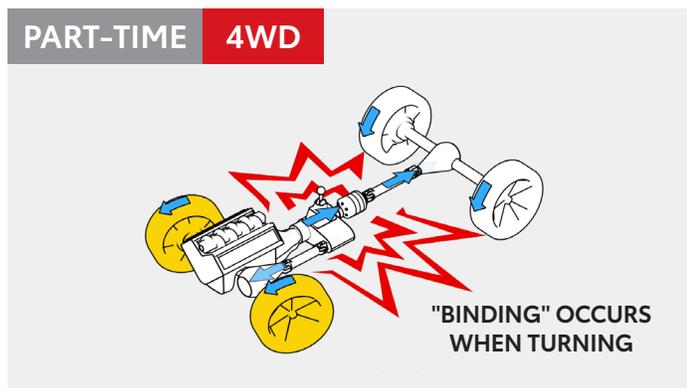
The transfer case is one of the key components that distinguishes 4WD from both 2WD and AWD.



When 4WD is engaged, the power now flows through the transmission to the transfer case, where it's split between the front and rear axles.

This **locks both axles together** so that they rotate at the same speed.

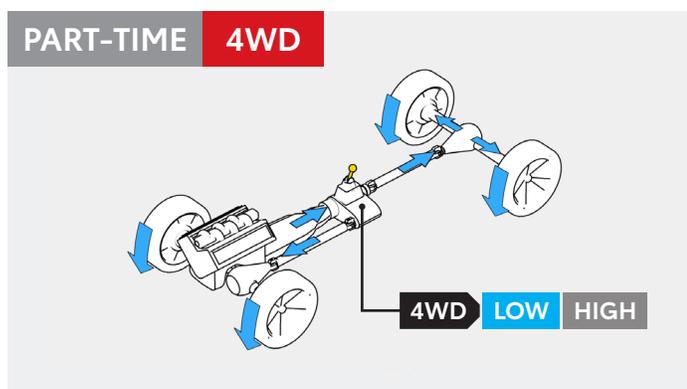
This type of locked system is called part-time 4WD.



However, when traction is good, engaging part-time 4WD can **force the wheels to slip when turning**, causing a "binding" feeling.

This happens because the front and rear axles **can't travel along different arcs** as they need to, since they're locked together at the same speed.

That's why **part-time 4WD is designed to be used on low-traction terrain** that allows the tires to slip freely.



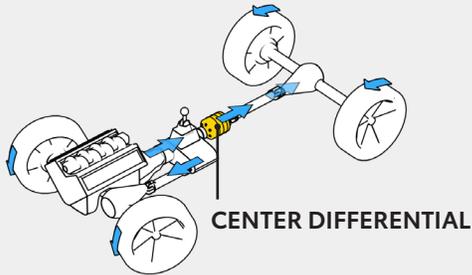
The transfer case also **provides a low-range gear setting**, another distinctive feature of 4WD.

In this "four low" mode, the transfer case can use gearing to **multiply torque to the drive wheels**, providing extra muscle to pull the vehicle up and over large obstacles.

In the default "four high" mode, the system **bypasses this low-range gear** and sends the power straight through to the drive wheels.

FULL-TIME 4WD

FULL-TIME 4WD

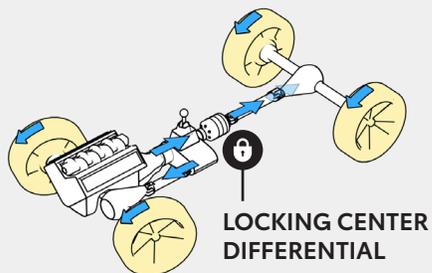


Full-time 4WD adds a center differential to eliminate the binding issue.

Like how the front and rear differentials manage power from side to side, **a center differential does that from front to rear.**

This enables the driver to **turn and maneuver with 4WD engaged** – even in high-traction situations.

FULL-TIME 4WD



All full-time 4WD Toyota models are also able to **lock the axles together** and **enable a low-range gear setting** – just like with part-time 4WD.

Select Toyota models offer Multi-mode 4WD, which allows the driver to **select a more fuel-efficient 2WD mode** in conditions where 4WD is not necessary.

The main advantage of full-time 4WD is that it's **always on and does not need to be manually engaged.**