

25 years of BMW all-wheel-drive expertise.

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1. 25 years of BMW all-wheel-drive expertise. (Short version)



The road heads inexorably into the distance, rising steeply time and again. Fortunately, the intelligent BMW xDrive all-wheel-drive system is in place to transfer the necessary propulsion to the ground. 25 years on from the market launch of the first all-wheel-drive model from BMW, the world's most successful premium carmaker has secured itself an outstanding position in the market for all-wheel-drive vehicles. One in four BMW cars sold around the world is now equipped with xDrive, the sustained success of the BMW X models playing a pivotal role in this development. In addition, the number of cars from other model series specified with all-wheel drive is steadily rising. BMW currently offers 45 models in which xDrive provides variable distribution of drive between the front and rear wheels. These models extend all the way from the BMW X models via the BMW 3 Series and BMW 5 Series ranges to the BMW 7 Series family of luxury Saloons.

1985 saw all-wheel drive offered for the first time for the BMW 3 Series – both as an extension of the model range and as an alternative to the customary BMW rear-wheel drive. By now BMW was using the transfer of power to both axles not only to optimise traction on loose surfaces and in adverse weather conditions, but also to enhance dynamic performance through corners. The latest version of the BMW xDrive all-wheel-drive system rises to this challenge more effectively than ever. Linking the all-wheel-drive system up with Integrated Chassis Management (ICM) means that all situations on the road can be recognised and evaluated to allow the necessary control interventions to be made at an early stage. These can be carried out by xDrive either on its own or in combination with Dynamic Stability Control (DSC) or Performance Control. The power is distributed quickly and with great precision to where it is needed, ensuring that the driver enjoys the handling characteristics he would expect from a BMW – even under extremely dynamic cornering.

In contrast to other manufacturers, who use all-wheel drive principally to make up for the shortfall in traction suffered by front-wheel-drive vehicles, BMW tunes its xDrive system to provide handling typical of rear-wheel drive. Even in normal situations on the road, all-wheel-drive BMW models send the lion's share of drive to the rear wheels, the same place where the brand's cars with only one driven axle turn power into optimum dynamic performance. This ensures that the hallmark BMW steering precision is virtually free from drive forces in all-wheel-drive models as well. Indeed, all-wheel drive actually enhances the driving experience through corners. In order to enable

particularly precise turn-in and a high level of directional stability, the latest-generation xDrive sends more drive to the rear axle on the way into corners. And that takes the brand's characteristic driving pleasure to a new level once again.

All-wheel-drive technology from BMW: rigorous further development, dynamic growth.

Over the last 25 years at BMW, all-wheel drive has developed from an option initially limited to selected models to a growth driver for the ongoing expansion of the model range. At the time it was launched in the second-generation BMW 3 Series, all-wheel drive was offered exclusively in conjunction with a 2.5-litre six-cylinder in-line petrol engine producing 126 kW/171 hp. Today, xDrive can be specified for the BMW 3 Series in tandem with any of three six-cylinder petrol engines, a four-cylinder petrol unit and a six-cylinder diesel powerplant.

The permanent all-wheel drive of the BMW 325iX unveiled in 1985 channelled power to the front and rear wheels at a constant 37 : 63 percent split. Visco locks in the transfer case and final drive took their cues from the difference in rotation speed between the front and rear wheels to provide virtually fixed connections if required, and in this way optimise traction and driving stability. From 1988 customers could also order a Touring variant of the BMW 325iX.

Three years later came the arrival of all-wheel drive in the BMW 5 Series, accompanied by the debut of electric control systems governing the distribution of power. The newly developed system had multi-plate clutches which could be controlled automatically and continuously to vary the usual distribution of drive in normal conditions – 36 : 64 percent between the front and rear wheels – as required. Initially, a hydraulically controlled multi-plate clutch was used at the rear axle, but this was later replaced by electronically controlled brake inputs. The control unit of the all-wheel-drive system took into account wheel speed signals from the anti-lock braking system, the rotational speed and position of the engine's throttle valves and the status of the brakes when analysing the driving situation.

From the outset the all-wheel-drive system of the BMW 525ix – fitted with a six-cylinder petrol engine developing 141 kW/192 hp – proved to be a superior concept to that of its competitors. The electronic control system allowed extremely rapid and precise reactions, which also led to neutral and safe handling characteristics in tricky conditions on wet or snow-covered roads. The first all-wheel-drive BMW 5 Series was available in both Saloon and Touring guise.

The creation of the Sports Activity Vehicle (SAV) segment opened up totally new dimensions for all-wheel drive. BMW caused a sensation with the introduction of this innovative new vehicle concept in 1999.

The BMW X5 captured the imagination of its customers with a level of dynamic performance unmatched among its off-road peers. The characteristics of the BMW all-wheel-drive system also served this set of priorities. In normal driving conditions, engine power was distributed at a ratio of 38 : 62 between the front and rear wheels via a planetary gear set, while the standard-fitted Dynamic Stability Control (DSC), Automatic Differential Brake (ADB-X) and Hill Descent Control (HDC) equipped the BMW X5 equally as well for sporty driving as for challenges off the beaten track.

Innovative vehicle concepts and xDrive give BMW the edge.

Since the SAV concept successfully established itself in the shape of the BMW X5, BMW has been constantly building on its stand-out position in the all-wheel-drive vehicle market through the introduction of new models and the further development of its drive transfer system. All-wheel drive was made available for the BMW 3 Series once again as early as 2000 – this time in conjunction with two petrol engines and one diesel unit.

In 2004 BMW picked up the pioneering baton once more when it introduced the SAV concept into another vehicle segment. With more compact dimensions than the BMW X5 and even more agile handling, the BMW X3 was likewise very much one of a kind and indeed remained the only premium model in its class for a number of years.

BMW also stole a march on its competitors in the development of all-wheel-drive technology. The newly developed xDrive all-wheel-drive system, introduced for the BMW X5 alongside the launch of the BMW X3, boasted an extremely fast-working, electronically controlled multi-plate clutch in the transfer case and linked up with the DSC driving control system. This allowed it to provide an unrivalled platform for power distribution that could be adjusted as necessary at all times. For the first time, the driving situation could be analysed not only on the basis of wheel speed, but also using data supplied by the DSC system on steering angle, accelerator position and lateral acceleration, including the driving status deduced from these parameters. This laid the foundations for xDrive to become the world's only intelligent all-wheel-drive system, a status it retains to this day. In contrast to conventional all-wheel-drive systems, which merely react to wheels that are already spinning, xDrive can identify any tendency to oversteer or understeer at an early stage and counteract it pre-emptively by adjusting the distribution of drive.

Over the years that followed it was not only the two X models that benefited from the exceptionally rapid and precisely calculated distribution of power, but also the BMW 5 Series Saloon and Touring models and the BMW 3 Series. In 2005, all-wheel-drive variants were introduced both for the fifth generation of the BMW 3 Series and for the fifth-generation BMW 5 Series launched a short time earlier.

More than 600,000 units of the first-generation BMW X3 were sold worldwide before it handed over to the new model in 2010. A little earlier the BMW X5, the second generation of which had been in production since 2006, had passed the million-unit mark.

Assured traction, superior dynamics: BMW xDrive with new calibration and Dynamic Performance Control.

The extraordinary potential of both the BMW X model concept and xDrive technology has since spawned another wave of innovations. For example, the BMW X6 – still the world's only Sports Activity Coupé – was launched in 2008, and the BMW ActiveHybrid X6 is also fitted with xDrive. Since 2009 the BMW X1 has been the only vehicle of its kind in the premium compact segment.

As in the new BMW X3, xDrive can also be combined with Performance Control in the BMW X1 to make its handling even more agile. Carefully calculated brake impulses applied to the inside rear wheel around a corner combine with a simultaneous increase in engine power to ensure that the vehicle turns in extremely quickly and precisely. The BMW X6 is fitted as standard with Dynamic Performance Control, giving it even greater scope for adjusting the distribution of power. This system teams up with xDrive to provide the most captivating expression yet of BMW's hallmark driving pleasure through corners. Dynamic Performance Control uses variable distribution of drive between the inside and outside rear wheel to enable exceptional agility and stability around corners, even under sudden load changes or in overrun.

The interplay of xDrive and Dynamic Performance Control can be experienced at its most intense in the BMW X5 M and BMW X6 M. The first high-performance sports cars with all-wheel drive to come out of BMW M GmbH are powered by an eight-cylinder engine with M TwinPower Turbo technology developing 408 kW/555 hp.

Alongside the impressive progress of the BMW X models, the range of all-wheel-drive variants of other model series has also been consistently expanding. xDrive is now available not only for the Saloon and Touring versions of the BMW 3 Series but also for the Coupé; a total of 15 model variants from the 3 Series range now have all-wheel drive. Four engine variants of the BMW 5 Series Gran Turismo are also available with xDrive. With its new set-up designed to enhance agility and precision through corners, xDrive offers a better platform than ever when it comes to providing an intensive driving experience and an ideal combination of dynamic capability and comfort. It was therefore no surprise to see all-wheel drive also being welcomed into the BMW 7 Series range. Customers can choose from three all-wheel-drive variants of the luxury Saloon – the BMW 750i xDrive, BMW 750Li xDrive and BMW 740d xDrive.

In addition, xDrive intelligent all-wheel drive is set for launch in the new sixth generation of the BMW 5 Series Saloon. The system will be available initially in the BMW 550i xDrive powered by a 300 kW/407 hp eight-cylinder engine, with two six-cylinder models and the first xDrive variants of the new BMW 5 Series Touring following in due course.

2. Variable distribution of power, wide range of applications: The history of all-wheel-drive models from BMW.



It topped the list of new models sent out to the press, yet the limelight was stolen by others. The all-wheel-drive BMW 325i "Allrad" shared its world premiere at the 1985 Frankfurt Motor Show (IAA) with the BMW 3 Series Convertible and BMW M3 sports icon. Although this was the first all-wheel-drive model to bear the BMW logo, its more modest appearance meant it was consigned to the shadows behind its more showy stablemates. Its qualities only became truly apparent once it was out on the test track, and when the action started it was seriously impressive. "The new BMW is the new champion when it comes to handling," was how testers from German car magazine "Auto Zeitung" described the first all-wheel-drive BMW 3 Series not long after that first appearance.

The all-wheel-drive pioneer from BMW was fitted with a likewise newly developed 2.5-litre six-cylinder in-line engine producing 126 kW/171 hp. The permanent all-wheel-drive system channelled the engine's power to the front and rear wheels in a 37 : 63 percent split. A special feature of the all-wheel-drive cars was their standard-fitted Anti-lock Braking System, which was fully functional in all conditions even though the car had visco locks in the central transfer case and final drive.

From 1988 the all-wheel-drive BMW 3 Series was also available as a Touring variant, the model designation having been changed by this time to BMW 325iX. A combined total of around 30,000 units of the two variants were sold up to 1993.

Variable distribution of power and electronic control – a leading concept back in 1991.

It was in 1991 that the letter X made its first appearance in the BMW 5 Series model range too as a symbol for BMW all-wheel-drive technology.

The AWD system was extensively modified for the BMW 525ix, the use of electronically controlled locks for the differentials in the transfer case and final drives now allowing variable distribution of power precisely tailored to the situation on the road. The system's control unit evaluated wheel speed data supplied by the ABS and information from the engine management and braking systems to analyse the prevailing driving conditions.

In normal driving, the power of the 141 kW/192 hp six-cylinder in-line engine was split 36 : 64 percent between the front and rear wheels. However,

on loose surfaces, in wintry road conditions and in particularly dynamic driving situations the distribution of drive was adapted as required. With its ability to intervene automatically and react quickly to changing conditions, the electronic BMW all-wheel-drive system immediately took over as the leading concept in the market. In comparison tests with other all-wheel-drive vehicles, the BMW 525ix stood out in particular with its neutral and easily controlled handling in tricky conditions. It could be ordered up to 1995 in both Saloon and Touring variants and sold around 10,000 units.

More than a niche: BMW all-wheel-drive technology spreads to a Sports Activity Vehicle.

With the new millennium just around the corner, BMW produced further evidence of its exceptional feel for innovative and futureproof vehicle concepts with the creation of a whole new category of car. The BMW X5 presented in 1999 was the world's first Sports Activity Vehicle. Its distinctive character was based primarily on dynamic qualities unrivalled in the off-road vehicle market. In contrast to conventional off-roaders, the BMW X5 had a self-supporting safety bodyshell and independent suspension. Its all-wheel-drive system distributed engine power 38 : 62 percent between the front and rear wheels. The standard-fitted Dynamic Stability Control (DSC), Automatic Differential Brake (ADB-X) and Hill Descent Control (HDC) equipped the BMW X5 to take sporty driving as well as challenges off the beaten track in its stride.

The first-generation BMW X5 saw the all-wheel-drive technology with planetary centre differential team up with an eight-cylinder petrol engine and six-cylinder diesel unit for the first time. Its fresh new combination of impressive traction, dynamics and comfort stoked up overwhelming demand for the vehicle in the USA, Europe and other markets beyond. The BMW X5 became the trailblazer for a totally new category of car, and in the years that followed, the SAV concept was also adopted by other carmakers. BMW had set the ball rolling into areas far beyond its successful ventures into market niches which had gone before. In mid-2005 the 500,000th BMW X5 rolled off the assembly line, and exactly five years later production of the car passed one million units. Both landmarks were celebrated at BMW Plant Spartanburg in the US state of South Carolina, where the second generation of the BMW X5 has also been produced since 2006.

Immediately after the successful debut of the BMW X5, all-wheel-drive variants were also added to the BMW 3 Series range. From autumn 2000 the system fitted in the first SAV was made available in model-specific form for the BMW 3 Series Saloon and BMW 3 Series Touring. The all-wheel-drive system could be ordered with a choice of two six-cylinder petrol engines and a six-cylinder diesel. Around 120,000 units of the BMW 325ix, BMW 330ix and BMW 330dx models were sold up to 2005.

The BMW xDrive intelligent all-wheel-drive system is launched in the BMW X3.

In 2004 BMW took up the pioneering mantle once again when it introduced the SAV concept into another vehicle segment. With more compact dimensions than the BMW X5 and even more agile handling, the BMW X3 was also very much one of a kind. Indeed, it remained the only premium model in its class for a number of years.

Moreover, the launch of the BMW X3 also marked the premiere of the BMW xDrive intelligent all-wheel-drive system. The system was introduced into the BMW X5 at the same time and has since represented a benchmark for the precise, need-based distribution of power. xDrive not only ensures unbeatable traction in tricky road conditions, its electronically controlled, variable distribution of power between the front and rear axle also provides greater stability and dynamic performance. The centrepiece of xDrive is an electronically controlled multi-plate clutch. In addition, the all-wheel-drive system is linked up with DSC stability technology. In this way the system can also use data supplied by the DSC sensors to help determine the optimum drive split, registering at an early stage any urge to oversteer or understeer. It is this ability to think ahead in adapting the distribution of power that has earned xDrive its status as the world's only intelligent all-wheel-drive system.

The BMW X3 likewise went on to become a trendsetter as well as the highest-selling model worldwide in its segment. By the time the first generation of the SAV handed over the baton to its successor model in autumn 2010, it had sold more than 610,000 units. The new BMW X3 is now aiming to pick up from the success of its predecessor. Other premium carmakers have since introduced models into the segment occupied by the X3, but the new model raises the bar once again with the next-stage development of xDrive in conjunction with Integrated Chassis Management (ICM), as well as enhanced agility, optimised ride comfort, and more space and variability than any rival.

BMW xDrive marches on with innovative vehicle concepts and an extended range of models.

Since it successfully established the SAV concept, BMW has been constantly building on its outstanding position in the all-wheel-drive vehicle market through both the introduction of new models and the further development of its drive transfer system. Indeed, the company has demonstrated an exceptional flair for innovation through the expansion of the BMW X model range in particular.

In spring 2008 BMW presented the world's first Sports Activity Coupé. The BMW X6, which is also produced at BMW Plant Spartanburg, embodies the trademark dynamic capability of the BMW X models in extremely concentrated form. Its design combines sporting elegance with an imposing presence, while xDrive permanent all-wheel drive joins forces for the first time

with Dynamic Performance Control – also controlled by ICM – to deliver an even more intense driving experience. Dynamic Performance Control allows variable distribution of power between the right and left rear wheel, complete with active acceleration of the outer or inner wheel in corners. This optimises handling and safety through corners, in particular, in a totally unique way. The BMW X6 – like the BMW X5 – is available with two petrol and two diesel engines with output ranging from 180 kW/245 hp to 300 kW/407 hp. The all-wheel-drive Sports Activity Coupé has also played a leading role in the market introduction of BMW-specific hybrid technology. In the BMW ActiveHybrid X6 variant, launched earlier this year, xDrive distributes the power generated by the combination of an eight-cylinder petrol engine and two electric motors. Its total system output of 357 kW/485 hp makes the BMW ActiveHybrid X6 the world's most powerful series-produced model with hybrid technology.

In addition, since 2009 the BMW M GmbH model range has included two powerful sports cars with all-wheel drive. The BMW X5 M and BMW X6 M bring the defining high-performance character of M cars into the world of BMW X models for the first time. A V8 engine with M TwinPower Turbo technology and output of 408 kW/555 hp developed specially for these two exceptionally dynamic models and a model-specific version of xDrive complete with Dynamic Performance Control form the basis for an incomparable driving experience.

Since 2009 the distinctive BMW X take on Sheer Driving Pleasure has also been available in the premium compact segment. The BMW X1 – the fourth model in the BMW X family – boasts outstanding, smile-inducing agility, wide-ranging traction-enhancing attributes, an interior which can be used in a wide variety of ways, and exceptional efficiency. The only premium vehicle of its kind is produced at the BMW plant in Leipzig and can be ordered with a selection of three petrol and three diesel engines.

From the BMW 3 Series Coupé to the BMW 7 Series luxury Saloon, xDrive ensures a very special driving experience.

Alongside the expansion of the BMW X family, both the number of model series in which xDrive is offered and the total number of all-wheel-drive models has grown steadily: today a total of 45 xDrive models are available. This extraordinary variety is the result of a model offensive which has been stepped up over the last five years in particular, and is set to continue into the future.

In 2005, all-wheel-drive variants were introduced both for the fifth generation of the BMW 3 Series and for the fifth-generation BMW 5 Series presented a short time earlier. In both model series, xDrive could be ordered initially with one diesel engine and two petrol powerplants. xDrive is now available not only for the Saloon and Touring versions of the BMW 3 Series but also for the Coupé; a total of 15 model variants from the 3 Series range now have

all-wheel drive. As well as six-cylinder petrol and diesel engines, a four-cylinder diesel can also be combined with xDrive.

BMW's xDrive system having been retuned to further enhance agility and precision through corners, it offers an even better platform than ever for providing an intense driving experience and an ideal combination of dynamic capability and comfort. It was therefore no surprise to see all-wheel drive also being introduced into the BMW 7 Series range for the first time in 2009. Customers can now choose from three all-wheel-drive variants of the luxury Saloon – the BMW 750i xDrive and BMW 750Li xDrive powered by a V8 petrol engine and the BMW 740d xDrive fitted with a six-cylinder diesel unit.

The engine range for the BMW 5 Series Gran Turismo comprises one V8 engine and three six-cylinder in-line units – and from autumn 2010 all variants can also be ordered with xDrive. The intelligent all-wheel-drive system is also set to enter the fray in the new, sixth-generation BMW 5 Series Saloon. The BMW 550i xDrive with a 300 kW/407 hp eight-cylinder engine will be offered initially, with two six-cylinder models and the first xDrive variants of the new BMW 5 Series Touring following in its footsteps in spring 2011.

3. The intelligent route to increased driving pleasure: Development and technology of the BMW xDrive all-wheel-drive system.



Safety and driving enjoyment depend on maintaining as tight a control as possible over the external forces acting on the vehicle. These two objectives are closely interlinked, which is why they both receive equal priority in the development of powertrain and chassis systems for BMW cars. A precise steering system, effective brakes that can be finely controlled, and sensitive, quick-responding suspension and damping systems play an important part in ensuring optimal control over the lateral, longitudinal and vertical forces acting on the vehicle, so that even in very sporty driving situations, or under adverse road conditions, both safety and driving pleasure are increased. On the all-wheel-drive front too, ever since the first such model was introduced BMW's aim has always been to combine improved traction and stability with enhanced dynamic driving qualities. 25 years on, the BMW xDrive all-wheel-drive system is the only such technology in the world to combine these different objectives to such a high level. Working with unsurpassed speed, adaptability and precision, the intelligent BMW all-wheel-drive system always knows exactly where to send the drive power for optimal driving dynamics – under all conditions.

BMW all-wheel-drive technology has always been designed to maximise the advantages of four-wheel drive while minimising the potential negative side effects. Conventional all-wheel-drive systems focus mainly on improving traction away from surfaced roads or in wintry conditions. The downside is that power is not always efficiently distributed, leading for example to understeer and reduced steering response during sporty cornering, reduced straightline stability or less easy manoeuvring. These drawbacks are particularly apparent when such systems are compared with the typical BMW rear-wheel-drive set-up. When developing the first all-wheel-drive system for a BMW model, the development team therefore aimed for an optimal combination of the best features of all-wheel drive with the proven benefits of the rear-wheel-drive set-up.

A proven principle for the past 25 years – for enhanced cornering dynamics plus enhanced winter safety.

The BMW 325iX model unveiled at the 1985 Frankfurt Motor Show (IAA) neatly summed up the BMW all-wheel-drive philosophy. Instead of distributing power equally between all four wheels, under normal driving conditions this system distributed 63 percent of the drive torque to the rear

wheels and 37 percent to the front wheels. This maintains the familiar BMW characteristics of precise steering response when entering a corner, high lateral stability – but without torque steer at the front wheels – and an easily controllable oversteer tendency at the limit. Under extreme or particularly dynamic driving conditions, visco locks in the transfer case and rear differential were used to vary this ratio. For example, if the rear wheels lost grip, more drive power was sent to the front wheels. It was also possible to smoothly redirect power from a spinning rear wheel to the other rear wheel. These locks were controlled automatically but did not interfere with the operation of the standard-fitted Anti-lock Braking System, which remained fully functional under all conditions.

This concept meant that, in practice, the driver was only aware of the BMW 325iX all-wheel-drive system when enjoying its benefits – for example optimised traction when accelerating out of a corner, confident traction and acceleration without wheelspin on wet roads, or exceptionally surefooted handling on snow and ice.

Electronic control splits drive power to suit the driving situation.

Ongoing development work on electronic control systems for all-wheel-drive vehicles brought advances in traction, stability and dynamics. The electronic all-wheel-drive control system of the 1991 BMW 525iX relied not only on the wheel speed information supplied by the Anti-lock Braking System but also on information about the throttle valve position and brake status to assess the current driving situation. A continuously adjustable multi-plate clutch in the transfer case then allowed the front-to-rear power distribution to be varied as necessary from the default ratio of 36 : 64, while a hydraulically controlled multi-plate clutch controlled the power flow at the rear differential so as to prevent wheelspin at one wheel.

On the BMW 525 iX, as on the BMW 325iX before it, drive to the front wheels was supplied via a toothed chain-driven auxiliary drive shaft and a shaft to the front differential, while a direct prop shaft drove the rear differential. The transfer case had an electromagnetically actuated locking function, while the locking function of the rear differential's multi-plate clutch was actuated electrohydraulically. For both systems the locking effect could be automatically varied all the way from zero to 100 percent full locking within just fractions of a second, to ensure maximum traction and stability even under difficult conditions. These precisely controllable locks always gave enough traction for moving off on low-traction or split-traction surfaces while, for ease of manoeuvring, they also allowed an indefinite amount of speed difference between the wheels.

The all-wheel-drive system introduced in 1999 in the BMW X5 marked a further advance in electronic drive torque distribution. Under normal driving conditions, the drive power in the world's first Sports Activity Vehicle was split in a ratio of 38 : 62 percent between the front and rear wheels. The power

flow was regulated by an open planetary centre differential. A traction and stability-enhancing locking effect was achieved by selective braking of individual wheels, using the BMW X5's Automatic Differential Brake (ADB-X). This system in combination with Dynamic Stability Control (DSC) and Hill Descent Control (HDC) meant the BMW X5 was equipped not only to handle a sporty driving style but also to cope with the challenges of operation away from surfaced roads.

Fast-acting, precise, proactive: the intelligent BMW xDrive all-wheel-drive system.

The next generation of the BMW all-wheel-drive system was introduced in the BMW X3 (presented in 2003) and in the BMW X5. The BMW xDrive system combined variable drive torque distribution between the front and rear wheels, controlled by an electronic multi-plate clutch, with a transverse locking function based on selective braking by the Dynamic Stability Control system (DSC). xDrive set new standards in terms of precise, fast-acting torque redistribution in line with the prevailing driving conditions. At the same time, thanks to cooperation between the xDrive and DSC functions, it was for the first time possible not only to analyse the driving situation but to use this information proactively. The risk of traction loss is identified at a very early stage, and the system prevents wheelspin at one or more wheels by varying the drive power distribution. This is why xDrive can be described as an "intelligent" all-wheel-drive system. Steadily improved over the years, xDrive offers a range of currently unique features which not only improve traction and stability in adverse road conditions but also boost cornering dynamics.

The xDrive all-wheel-drive system is now not only fitted on the BMW X models but is also optionally available for the BMW 3 Series, 5 Series and 7 Series range. Although the system is somewhat differently calibrated for each model, its basic, proven strategy is always the same – to smoothly combine BMW's well-known rear-wheel-drive qualities with the advantages of all-wheel drive. Under normal conditions, every BMW all-wheel-drive model splits the drive power in a ratio of 60 : 40 percent between the rear and front axles. This ratio can be altered almost instantly to suit changed driving conditions by adjusting the multi-plate clutch in the central transfer case, using a stepper motor. The higher the pressure on the clutch plates, the more power is transferred to the front wheels – via a chain-driven drive shaft on the X models and via a gear system on the all-wheel-drive versions of the 3 Series, 5 Series and 7 Series models. Conversely, when the clutch is completely open, all power goes to the rear wheels. The electronic control system is capable of varying the torque distribution in record-quick time. It takes just 100 milliseconds to fully open or fully close the clutch.

At the same time, the integration of xDrive with Dynamic Stability Control allows a transverse locking function to be provided. If one wheel starts to spin and is no longer transferring power to the road, it is electronically braked by

the DSC control unit. The differential is therefore able to direct more power to the wheel on the other side of the vehicle.

In addition to the speed with which torque can be redistributed, a further hallmark of the intelligent all-wheel-drive system is the precision with which it assesses the driving situation. To determine the ideal drive power distribution from the point of view of traction, stability and dynamics, the xDrive control unit takes into account a wide range of data relating to the current driving status. The link-up with the Dynamic Stability Control function in the Integrated Chassis Management system (ICM) means that, in addition to data from the engine management system, information about accelerator position, steering angle, wheel speeds and lateral acceleration can also be taken into account.

Based on this extensive information, xDrive is able to finely control the torque distribution between the front and rear wheels in such a way that engine power is never drained away by a spinning wheel or wheels but is fully utilised at all times. Integration with DSC also gives xDrive the proactive capability on which its reputation as an intelligent all-wheel-drive system is founded. Unlike conventional all-wheel-drive systems, which only react when at least one wheel is already spinning, xDrive is able to sense an incipient loss of traction even before it occurs. For example, by quickly analysing a range of vehicle dynamics parameters, xDrive is instantly able to detect if there is a risk of oversteer or understeer when cornering at speed. In the event of an understeer risk, more drive power is immediately sent to the rear wheels. This makes for sharper steering response when entering the corner – in other words, xDrive improves stability before the driver is even aware of the need. Similarly, the system's proactive capabilities allow it to correct oversteer tendencies at the earliest possible stage by directing surplus power to the front wheels. That means the benefits of all-wheel drive can be enlisted even before traction loss actually occurs.

Intelligent all-wheel drive based on variable drive power distribution also has benefits for ride comfort; due to the stabilising effect of xDrive, DSC now only needs to intervene in extreme situations. Only when optimal drive power distribution alone is insufficient to keep the vehicle on track does DSC intervene by reducing engine power and selectively braking individual wheels.

Intelligent cooperation with other functions via Integrated Chassis Management (ICM).

The interaction between xDrive, DSC and numerous other powertrain and suspension systems is coordinated by the Integrated Chassis Management system (ICM), which intelligently integrates these various systems. This high-performance electronic control system coordinates powertrain and suspension functions with split-second speed in such a way as to provide maximum stability and performance across all driving situations. As the master control module, ICM prevents mutual interference between the individual

systems and ensures that they always work in harmony to provide optimal handling. The system takes into account the various interactions between different control processes. For example, if the xDrive all-wheel-drive system is redirecting some of the drive power from the rear wheels to the front wheels, this directly affects the understeer/oversteer characteristics of the vehicle, so the ICM system will check what actions the various control systems may need to take in response to this. It will also decide whether the instructions to these systems should be issued in parallel or in sequence. For example, oversteer or understeer tendencies when cornering are corrected initially by xDrive and only at a later stage by DSC.

This systematic coordination smoothes the interaction with other chassis systems too. For example, via ICM the DSC system also works in tandem with Active Steering. When braking on a split-friction surface (μ -split braking), active steering interventions are used to help stabilise the vehicle. To achieve this, Active Steering uses traction and stability data supplied by DSC to counteract vehicle reactions caused by the difference in braking pressures between the high and low-traction sides of the vehicle.

New xDrive calibration increases manoeuvrability; Performance Control improves cornering dynamics.

The xDrive all-wheel-drive system on the latest models is calibrated for optimised driving dynamics. The benefits are particularly apparent when cornering, with more drive power being directed to the rear axle even under stable driving conditions, in order to improve agility and to prevent understeer. To optimise traction, the system immediately returns to the default 40 : 60 percent front/rear split on exiting the corner.

Performance Control improves these driving dynamics even further. Working with the xDrive control function, this electronic system uses precisely controlled braking and variable torque distribution to efficiently correct understeer on low-traction surfaces and under very dynamic cornering at the earliest signs of such tendencies, thereby improving agility. As soon as understeer is detected, the rear wheel on the inside of the turn is selectively braked in cooperation with the xDrive/DSC electronic control functions. The resulting loss of propulsion is compensated for by an increase in drive power.

Ultra-precise drive power distribution: Dynamic Performance Control.

The BMW xDrive system's ability to improve both traction and stability on the one hand and dynamic performance on the other is enhanced even further when the system is combined with Dynamic Performance Control. This system, standard on the BMW X6, BMW X5 M and BMW X6 M, provides a further variable torque split – between the left and right rear wheels. Varying the drive power distribution between the rear wheels has noticeable benefits for steering response and directional stability at all speeds. At the first signs of oversteer, xDrive reduces the amount of power sent to the oversteering

rear wheels. At the same time, Dynamic Performance Control redirects drive power from the rear wheel on the outside of the turn, where the centrifugal load is greatest, to the rear wheel on the inside of the turn. Conversely, if understeer tendencies are detected, xDrive reduces the amount of power sent to the understeering front wheels, while Dynamic Performance Control simultaneously optimises the stabilising effect by transferring more drive power to the outer rear wheel.

The stabilising action of Dynamic Performance Control is not affected if the driver lifts off the accelerator while cornering. Inside the rear differential, two superimposed planetary gear systems, each with three planets, an electrically operated multi-plate brake and a ball ramp, maintain the variable torque distribution even under sudden load changes and on overrun. Dynamic Performance Control can create a rear-wheel torque difference of up to 1,800 Newton metres. The driver experiences this intervention in the form of a noticeable increase in agility, traction and stability. The effectiveness of the system is also demonstrated by the fact that interventions by the DSC system are required much less frequently.

4. The current range of BMW models with BMW xDrive.



Model	Engine	Output
BMW X1		
BMW X1 xDrive25i	in-line six-cylinder, petrol	160 kW/218 hp
BMW X1 xDrive28i	in-line six-cylinder, petrol	190 kW/258 hp
BMW X1 xDrive18d	in-line four-cylinder, diesel	105 kW/143 hp
BMW X1 xDrive20d	in-line four-cylinder, diesel	130 kW/177 hp
BMW X1 xDrive23d	in-line four-cylinder, diesel	150 kW/204 hp
BMW X3		
BMW X3 xDrive35i	in-line six-cylinder, petrol	225 kW/306 hp
BMW X3 xDrive20d	in-line four-cylinder, diesel	135 kW/184 hp
BMW X5		
BMW X5 xDrive35i	in-line six-cylinder, petrol	225 kW/306 hp
BMW X5 xDrive50i	V8-cylinder, petrol	300 kW/407 hp
BMW X5 xDrive30d	in-line six-cylinder, diesel	180 kW/245 hp
BMW X5 xDrive40d	in-line six-cylinder, diesel	225 kW/306 hp
BMW X6		
BMW X6 xDrive35i	in-line six-cylinder, petrol	225 kW/306 hp
BMW X6 xDrive50i	V8-cylinder, petrol,	300 kW/407 hp
BMW X6 xDrive30d	in-line six-cylinder, diesel	180 kW/245 hp
BMW X6 xDrive40d	in-line six-cylinder, diesel	225 kW/306 hp
BMW ActiveHybrid X6	V8-cylinder, petrol, 2 electric synchronous motors	357 kW/485 hp
BMW M models		
BMW X5 M	V8-cylinder, petrol	408 kW/555 hp
BMW X6 M	V8-cylinder, petrol	408 kW/555 hp

BMW 3 Series Saloon		
BMW 325i xDrive	in-line six-cylinder, petrol	160 kW/218 hp
BMW 330i xDrive	in-line six-cylinder, petrol	200 kW/272 hp
BMW 335i xDrive	in-line six-cylinder, petrol	225 kW/306 hp
BMW 320d xDrive	in-line four-cylinder, diesel	135 kW/184 hp
BMW 330d xDrive	in-line six-cylinder, diesel	180 kW/245 hp
BMW 3 Series Touring		
BMW 325i xDrive	in-line six-cylinder, petrol	160 kW/218 hp
BMW 330i xDrive	in-line six-cylinder, petrol	200 kW/272 hp
BMW 335i xDrive	in-line six-cylinder, petrol	225 kW/306 hp
BMW 320d xDrive	in-line four-cylinder, diesel	135 kW/184 hp
BMW 330d xDrive	in-line six-cylinder, diesel	180 kW/245 hp
BMW 3 Series Coupé		
BMW 325i xDrive	in-line six-cylinder, petrol	160 kW/218 hp
BMW 330i xDrive	in-line six-cylinder, petrol	200 kW/272 hp
BMW 335i xDrive	in-line six-cylinder, petrol	225 kW/306 hp
BMW 320d xDrive	in-line four-cylinder, diesel	135 kW/184 hp
BMW 330d xDrive	in-line six-cylinder, diesel	180 kW/245 hp
BMW 5 Series Saloon		
BMW 535i xDrive	in-line six-cylinder, petrol	225 kW/306 hp
BMW 550i xDrive	V8-cylinder, petrol	300 kW/407 hp
BMW 530d xDrive	in-line six-cylinder, diesel	180 kW/245 hp
BMW 5 Series Touring		
BMW 535i xDrive	in-line six-cylinder, petrol	225 kW/306 hp
BMW 530d xDrive	in-line six-cylinder, diesel	180 kW/245 hp
BMW 5 Series Gran Turismo		
BMW 535i xDrive	in-line six-cylinder, petrol	225 kW/306 hp
BMW 550i xDrive	V8-cylinder, petrol	300 kW/407 hp
BMW 530d xDrive	in-line six-cylinder, diesel	180 kW/245 hp
BMW 535d xDrive	in-line six-cylinder, diesel	220 kW/300 hp
BMW 7 Series		
BMW 750i xDrive	V8-cylinder, petrol	300 kW/407 hp
BMW 750Li xDrive	V8-cylinder, petrol	300 kW/407 hp
BMW 740d xDrive	in-line six-cylinder, diesel	225 kW/306 hp