

# Introducing Spectre X

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# Introducing Spectre X

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# Introducing Spectre X

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## Purpose

This application note introduces the Spectre X simulator and illustrates how to use Spectre X for performing simulations.

## Audience

Users of Spectre X in Virtuoso® ADE or standalone mode.

## Terms

APS	Accelerated Parallel Simulator
ADE	Analog Design Environment

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## Introduction

This application note introduces Spectre X and discusses its usage and application. It describes the use model of Spectre X and how you can migrate from Spectre APS to Spectre X.

## Spectre X Simulator

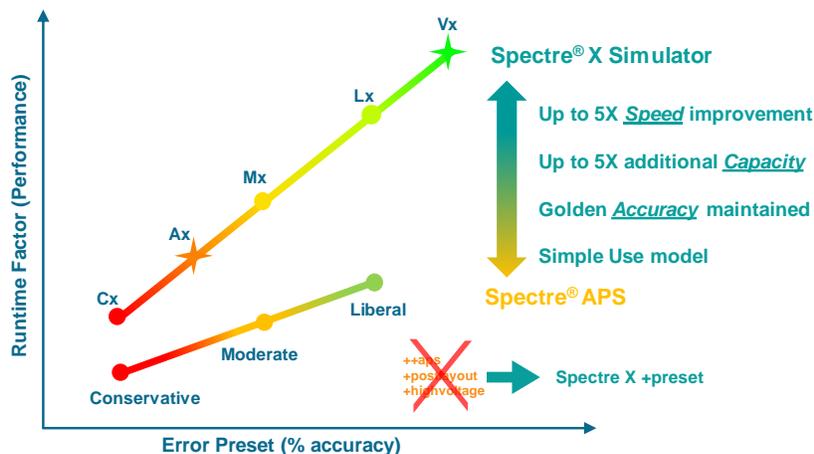
About 10 years after Spectre APS was released, Cadence decided to develop and release a new enhanced SPICE solver that provides improved performance and capacity over Spectre APS. This new solver is called Spectre X. It targets the most challenging simulation problems, including advanced node designs with complex FinFET (and other) device models, and challenging RC-dominated postlayout designs.

Spectre X provides the following two technologies:

- Single machine multi-core Spectre APS-like simulation (+preset +mt mode)
- Highly distributed single or multi-machine multi-core simulation (+xdp +preset mode)

In this application note, we will focus on the single machine multi-core +preset mode, which uses the same +mt use model as Spectre APS. We will see later that the transition from Spectre APS to Spectre X +preset mode is easy.

While there has been a lot of messaging on the Spectre X performance and capacity enhancements, another big value add of Spectre X is that it significantly simplifies the Spectre simulation use model. Those of you who know Spectre APS well, would be aware that over the past few years, Spectre APS use model got more and more complex with the introduction of ++aps, +postlayout, +highvoltage, and other advanced simulation options. With Spectre X, the Spectre simulation use model has been simplified to just five +preset simulation modes - cx, ax, mx, lx, and vx. The cx mode provides the highest accuracy, while the vx mode delivers the highest performance.



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In SPECTRE 19.1, Spectre X targets transient performance improvements for advanced node postlayout designs. Other designs may also see performance benefits; however, these benefits are not as significant as the gains for the target designs.

### Spectre X Use Model

The Spectre X simulation modes are specified on the Spectre command line. Like Spectre APS, you can set the number of cores with the `+mt` command-line option, as shown below.

```
% spectre +preset=mx input.scs +mt=4
```

Once Spectre X is enabled, you will see the following message in the Spectre logfile.

```
Spectre X preset=mx enabled.
```

This simple `+preset` use model is sufficient for most users and designs. However, for advanced users, a few additional options are available.

Spectre X automatically detects postlayout designs based on either the netlist format (extracted view, DSPF, SPEF), or the ratio of RC elements vs active devices. If a postlayout design is detected, postlayout optimization is automatically enabled that includes optimized DC operating point calculation, parasitic reduction, advanced postlayout solving, and special coupling cap handling. The following logfile message reports that postlayout optimization is enabled.

```
Spectre X Parasitic Optimization enabled.
```

Each `+preset` mode has a built-in equivalent `+postlpreset` postlayout setting, as shown below.

<code>+preset</code>		<code>cx</code>	<code>ax</code>	<code>mx</code>	<code>lx</code>	<code>vx</code>
<code>+postlpreset</code>	<code>off</code>	<code>cx</code>	<code>ax</code>	<code>mx</code>	<code>lx</code>	<code>vx</code>

For certain applications, there may be a need to manually optimize the postlayout optimization setting. You can use the `+postlpreset` command-line option for these special cases. For example, you can use the `+postlpreset` command-line option for setting more conservative postlayout settings, as compared to the `+preset` setting.

```
spectre +preset=mx +postlpreset=ax
```

You can also use the `+postlpreset` command-line option to disable postlayout optimization, as shown below.

```
spectre +preset=mx +postlpreset=off
```

The `+postlpreset` command-line option can also be used to enforce postlayout optimization, if the design is not detected as a postlayout design.

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```
spectre +preset=mx +postlpreset=mx
```

If the `+postlpreset` setting does not match the `+preset` setting, the logfile reports both settings, as shown below.

```
Spectre X preset=mx enabled.
```

```
Spectre X postlpreset=ax enabled.
```

Spectre X optimizes the simulation performance by using the default solver tolerances defined by `+preset` and ignoring any user-specified netlist solver setting. If required, advanced Spectre users may force Spectre to honor the netlist solver options with the `-preset_override` command-line option. This option can be applied globally to all solver netlist options,

```
spectre +preset=mx -preset_override
```

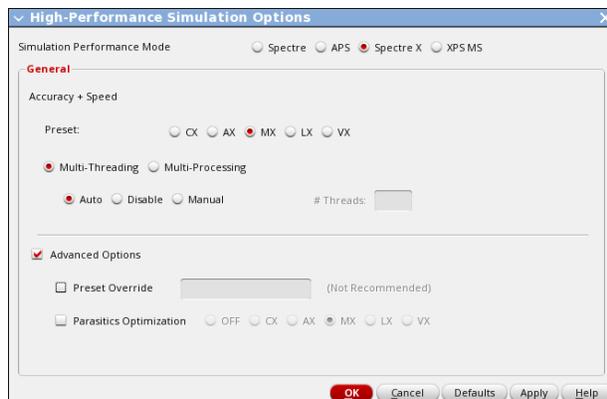
or locally to individual solver-related netlist options.

```
spectre +preset=mx -preset_override=reltol,method
```

In summary, Spectre X, for most applications, requires only one `+preset` command line option; however, advanced users have options available to further fine-tune the simulation performance and accuracy.

## Spectre X ADE user interface

Starting with IC618 ISR5, Spectre ADE supports the Spectre X solver setup in the *High-Performance Simulation Options* form. The `+postlpreset` and the `-preset_override` options can be specified under *Advanced Options*.



## Migrating from Spectre APS to Spectre X

The simple use model of Spectre X enables you to easily migrate from Spectre APS to Spectre X. You just need to check your current Spectre APS setup and determine the recommended Spectre X settings from the following table.

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APS setting	+/+cons upa	+mod hpa	++mod hpa	+/+liberal +postlayout	Functional Simulation
SpectreX preset	CX	AX	MX	LX	VX

For a pre-layout design, if you use `++aps=moderate` today, the recommended Spectre X setting would be `+preset=mx`. For a postlayout circuit, if you currently use `++aps=liberal +postlayout`, the recommended Spectre X setting is `+preset=lx`. In addition, you may want to explore the `+preset=vx` mode, since such high-performing mode does not exist in Spectre APS.

## Spectre X Application

The following table shows the results of pre- and postlayout versions of an ADC design simulated with Spectre APS and Spectre X. The design contains 300k BSIMCMG devices. The pre-layout version has 2M estimated capacitors, while the postlayout version contains 15M parasitic capacitors (mostly coupling caps) and 8M resistors. While the accuracy was confirmed by the user, the performance comparison on the same machine with the same number of cores shows the following gains.

	Spectre APS (8 core)			Spectre X (8 core)			Performance Gain
	Setting	Performance	Memory	Setting	Performance	Memory	
Pre-layout	<code>++aps=moderate +postlayout=hpa</code>	2h 21m	24GB	<code>+preset=ax</code>	48m	7GB	2.9x
Postlayout	<code>++aps=moderate +postlayout=hpa</code>	18h	91GB	<code>+preset=ax</code>	4h	39GB	4.5x

## Summary

In this application note, we introduced the Spectre X solver, discussed its usage, and learned about its application on an ADC design. If you are interested in using SpectreX, install the SPECTRE 19.1 release, and work with your Cadence support team to upgrade your licenses to Spectre 19.1. If you want to use Spectre X inside AMS Designer, you will need the Xcelium 19.03.s010 release.

## References

For more information on Spectre APS performance and accuracy optimization, refer to the following:

- [Spectre Classic Simulator, Spectre APS, Spectre X and Spectre XPS User Guide](#)

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- [Getting the Most Out of Spectre APS \(Application Note\)](#)

### Support

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