SQL Server 2022 Degree of Parallelism (DOP) Feedback!

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Agenda

- Introduction to
  - Parallel processing and CXPACKET
  - Max degree of parallelism (MAXDOP)
- SQL Server 2022 degree of parallelism (DOP) feedback

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Parallel processing

CXPACKET

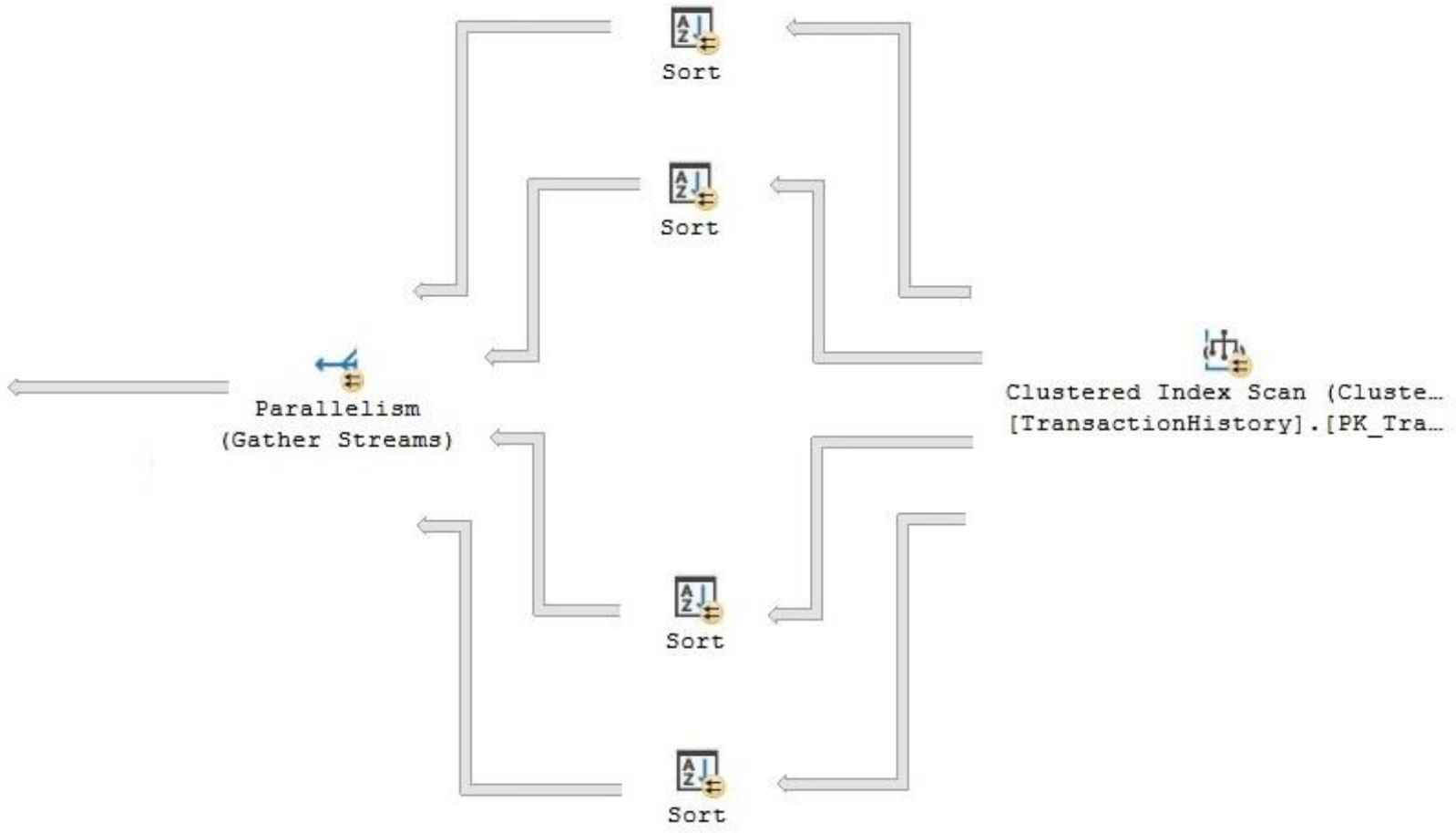
What is parallel processing?

- Parallel processing is a technique that aims to separate big tasks into more than one small task, and these small tasks will be completed by the discrete threads
- SQL Server tries to process queries that require excessive workload in a parallel manner
- Designed to be automatically
- One thread per set of rows

What is parallel processing?

- SQL Server Query Optimizer considers three settings when generating a parallel query plan:
  - Cost Threshold for Parallelism
  - Max Degree of Parallelism (MAXDOP)
  - Affinity mask

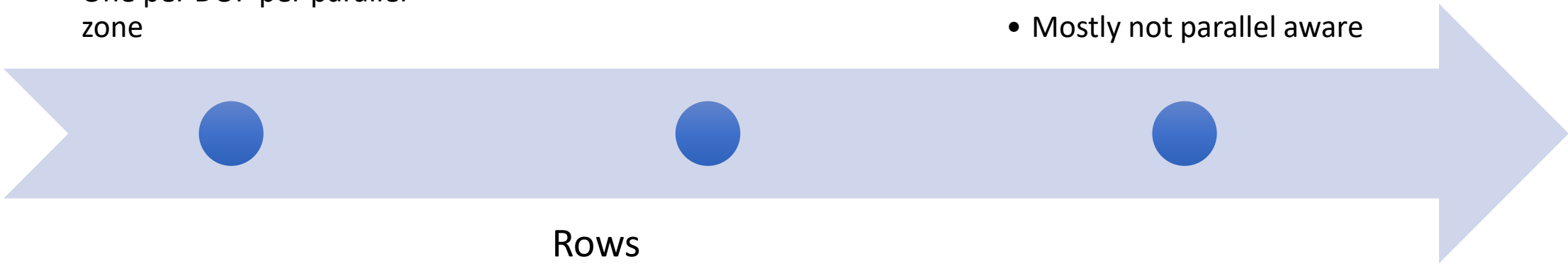
What really happens?



How it really works?

Threads

- Spun un by exchange iterators
- One per DOP per parallel zone



Iterators

- Mostly not parallel aware

Rows

- Distributed to threads
- Hash, Round robin, Broadcast, Scan

Amdahl's law

Amdahl's law is often used in parallel computing to predict the theoretical speedup when using multiple processors

$$\% \; improvement = \frac{1}{(1-p) + \frac{p}{n}}$$

p = Percent of an algorithm that can be parallelized

n = Number of processor on which the algorithm will be parallelized

Gene Amdahl

Computer architect and technology entrepreneur

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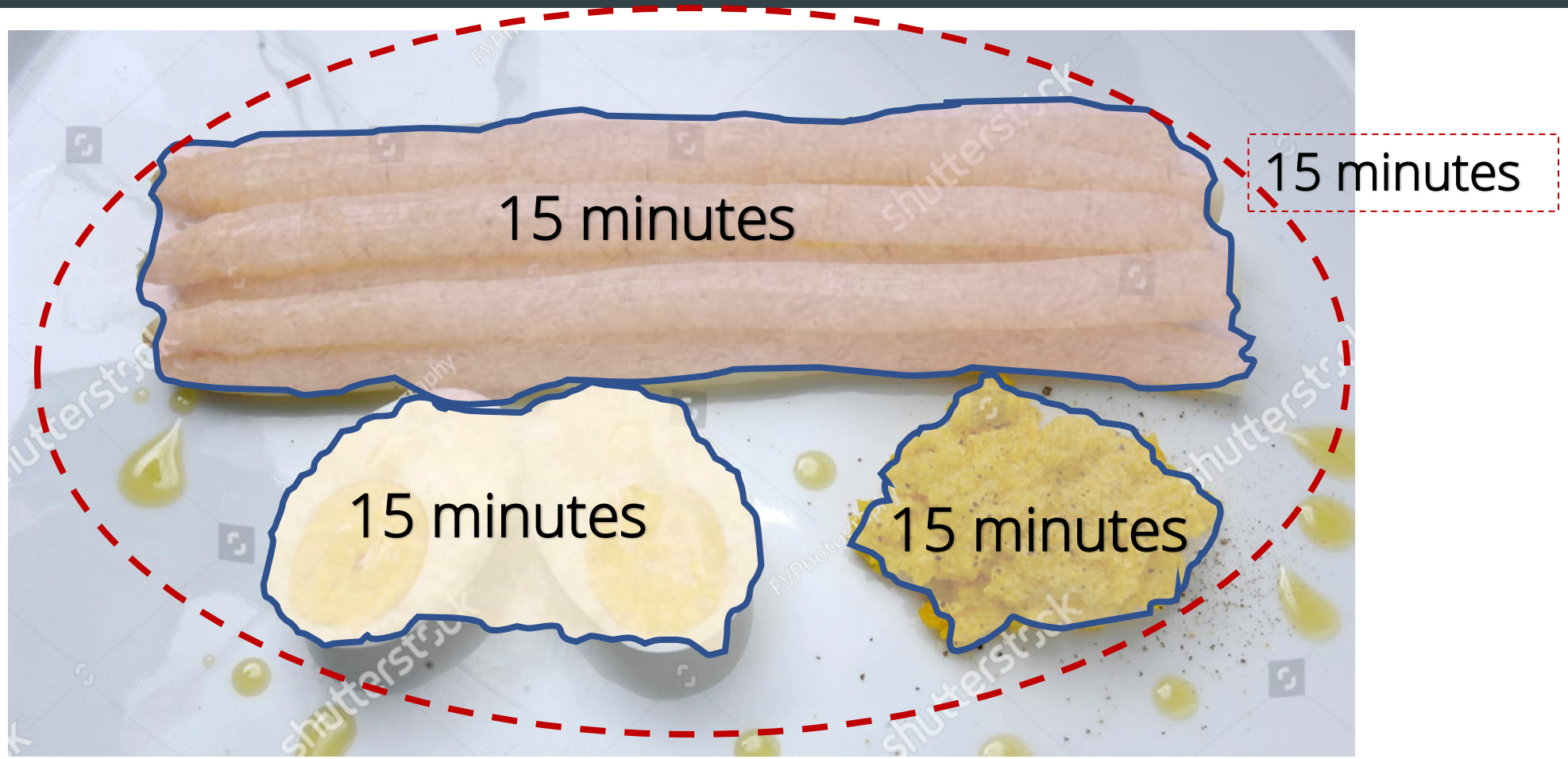
The dish of the day

The dish of the day



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The dish of the day

Hire 3 cooks, and...

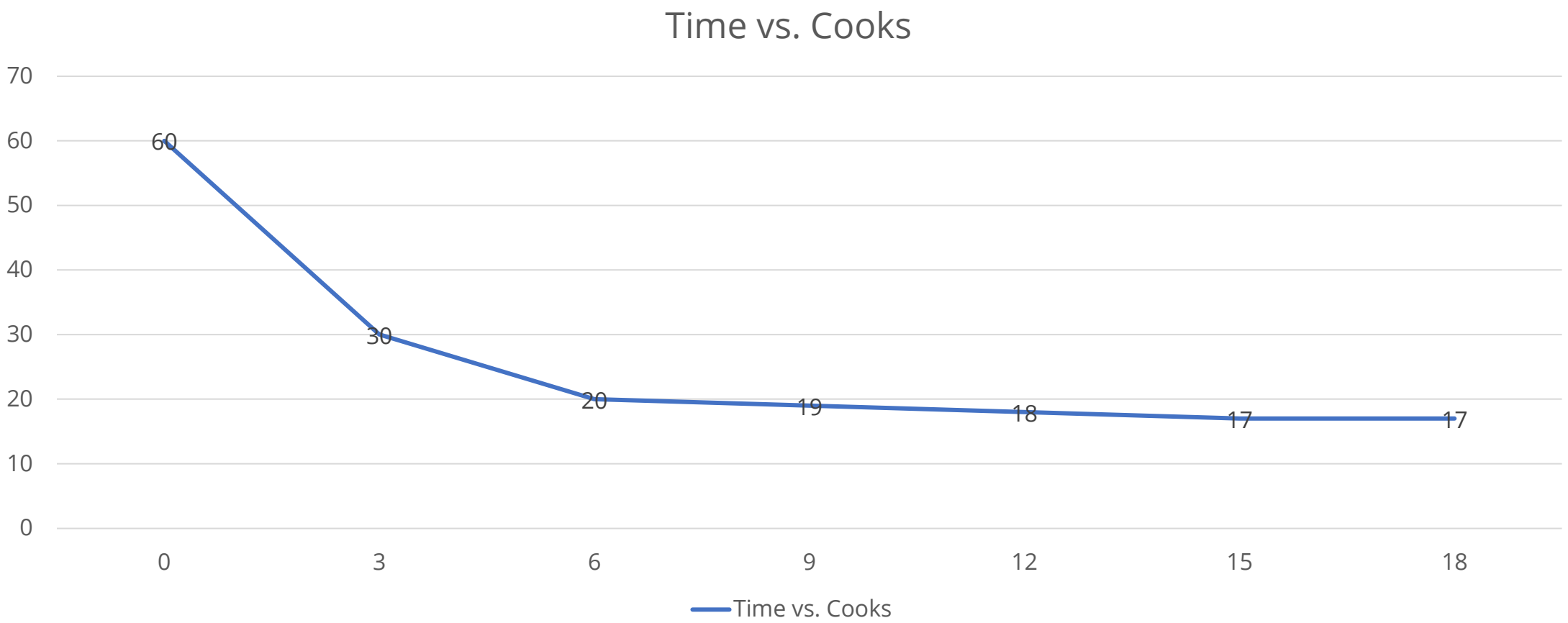
Amdahl's law in practice

- 3 of 4 parts are parallelizable, $p = 0{,}75$
- Each cook is a parallel "core" ☺, $n = 3$

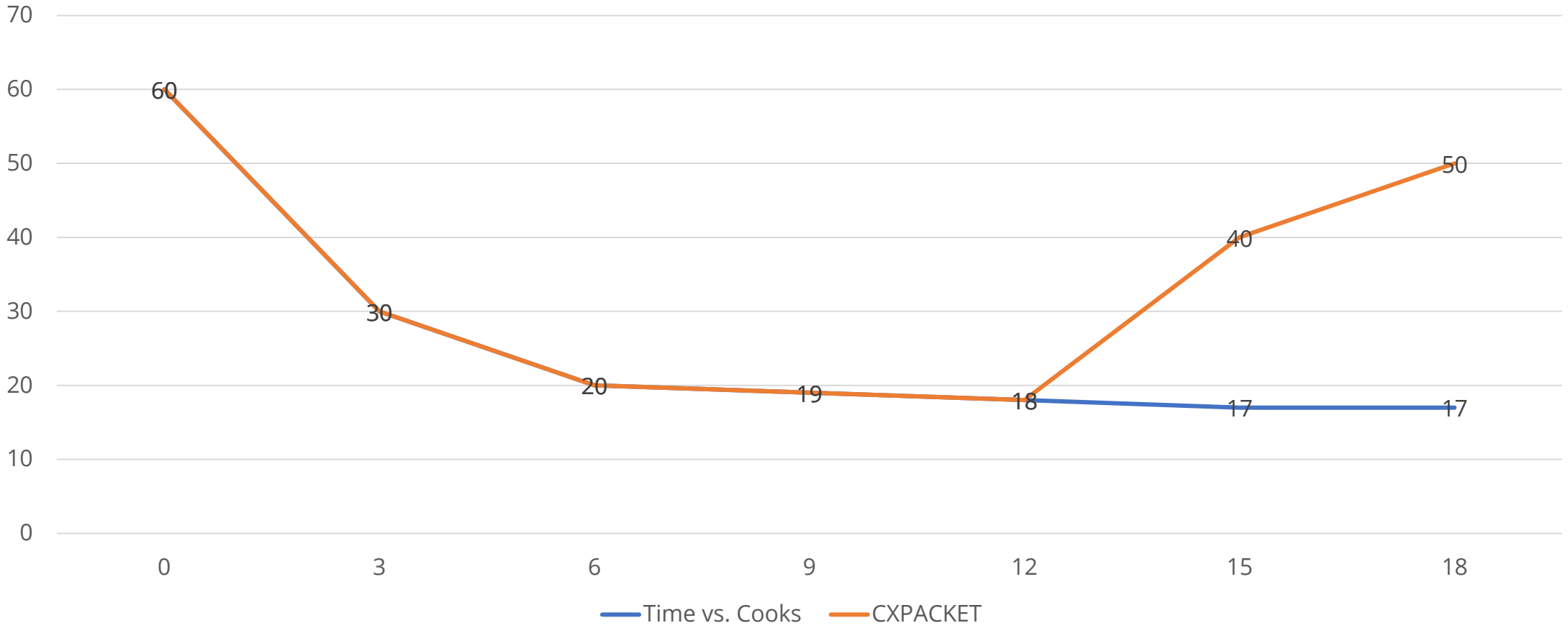
$$\frac{1}{(1 - p) + \frac{p}{n}} = \frac{1}{(1 - 0{,}75) + \frac{0{,}75}{3}} = \frac{1}{0{,}25 + 0{,}25} = \frac{1}{0{,}50} = 2$$

- With 3 cooks the preparation time of the dish drops from 60 to 30 minutes, with a 50% improvement!

Amdahl's law in practice



Amdahl's law in practice



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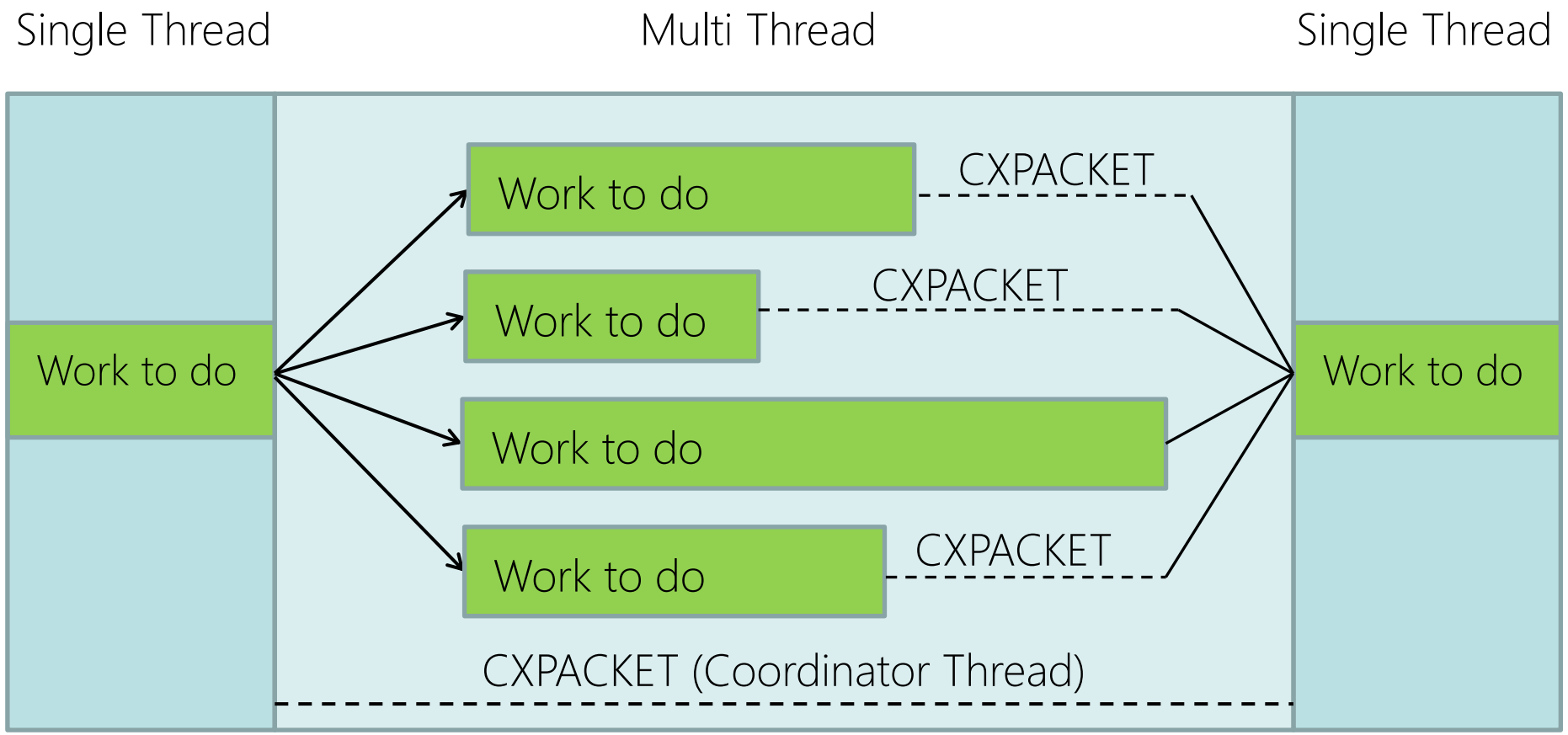
- What exactly is CXPACKET?
  - **C**lass E**X**change **Packet**s
- It occurs with Parallel Query Plans when trying to synchronize the query processor exchange iterator
- Parallelism issue through Parallel Execution Plan
- Parallel threads are not given equal amount of work to do

CXPACKET



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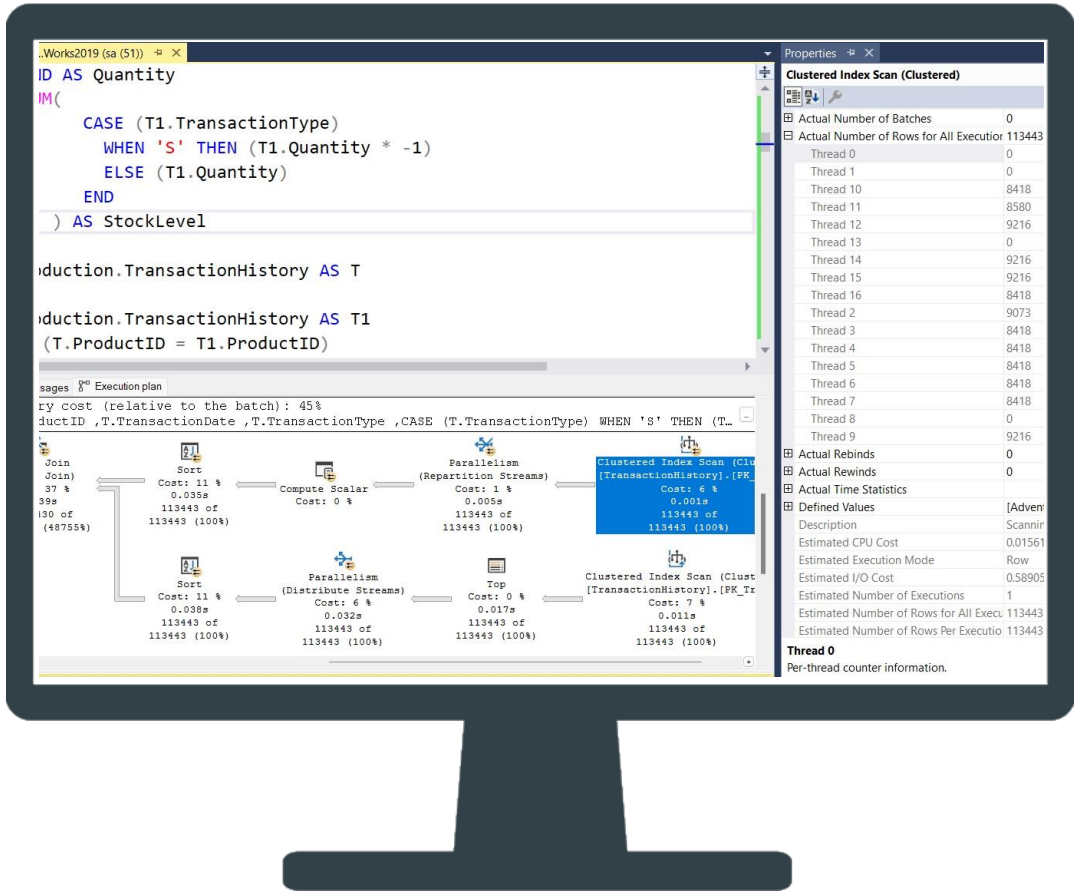

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MAXDOP

Maximum degree of parallelism

What is max degree of parallelism?

- The **maximum degree of parallelism** (MAXDOP) is a configuration option that controls the number of **processor** used to run a single statement
- When an instance of SQL Server runs on a computer that has more than one processor or CPU, the Database Engine detects whether parallelism can be used

What is max degree of parallelism?

- The degree of parallelism sets the number of processors employed to run a single statement, for each **parallel plan execution**
- You can use the max degree of parallelism (MAXDOP) option to limit the number of processors to use in parallel plan execution

MAXDOP: Before you begin

- MAXDOP is an advanced option, and it should be changed only by an experienced DBA
- Setting MAXDOP to 0 allows SQL Server to use all the available processors up to 64 processors. However, this is not the recommended value for most cases
- You can disable parallel plan setting MAXDOP to 1. However, this is not the recommended value for most cases

MAXDOP: Before you begin

- Set the MAXDOP to a number from 1 to 32.767 to specify the maximum number of processor cores that can be used
- The max degree of parallelism limit is set per task. It is not per request or per query limit
- During a parallel query execution, a single request can spawn multiple tasks up to the MAXDOP limit, and each task will use one worker and one scheduler

MAXDOP: Before you begin

- For requests that are executed in parallel, you will see multiple rows in sys.dm_os_tasks for the same combination of session_id, request_id
- If the affinity mask option is not set to the default, it may restrict the number of processors available to SQL Server on symmetric multiprocessing (SMP) systems

MAXDOP configuration

- If you are an experienced DBA ☺ you can override the max degree of parallelism server configuration value in this ways:
  - At the query level, using the MAXDOP query hint or Query Store hint
  - At the database level, using the MAXDOP database scoped configuration
  - At the workload level, using the MAX_DOP Resource Governor workload group configuration option
  - At the index statement level, using MAXDOP index option Configure Parallel Index Operations
  - At the DBCC CHECKTABLE, DBCC CHECKDB, and DBCC CHECKFILEGROUP level, you can disable parallel execution plans for these statements by using trace flag 2528

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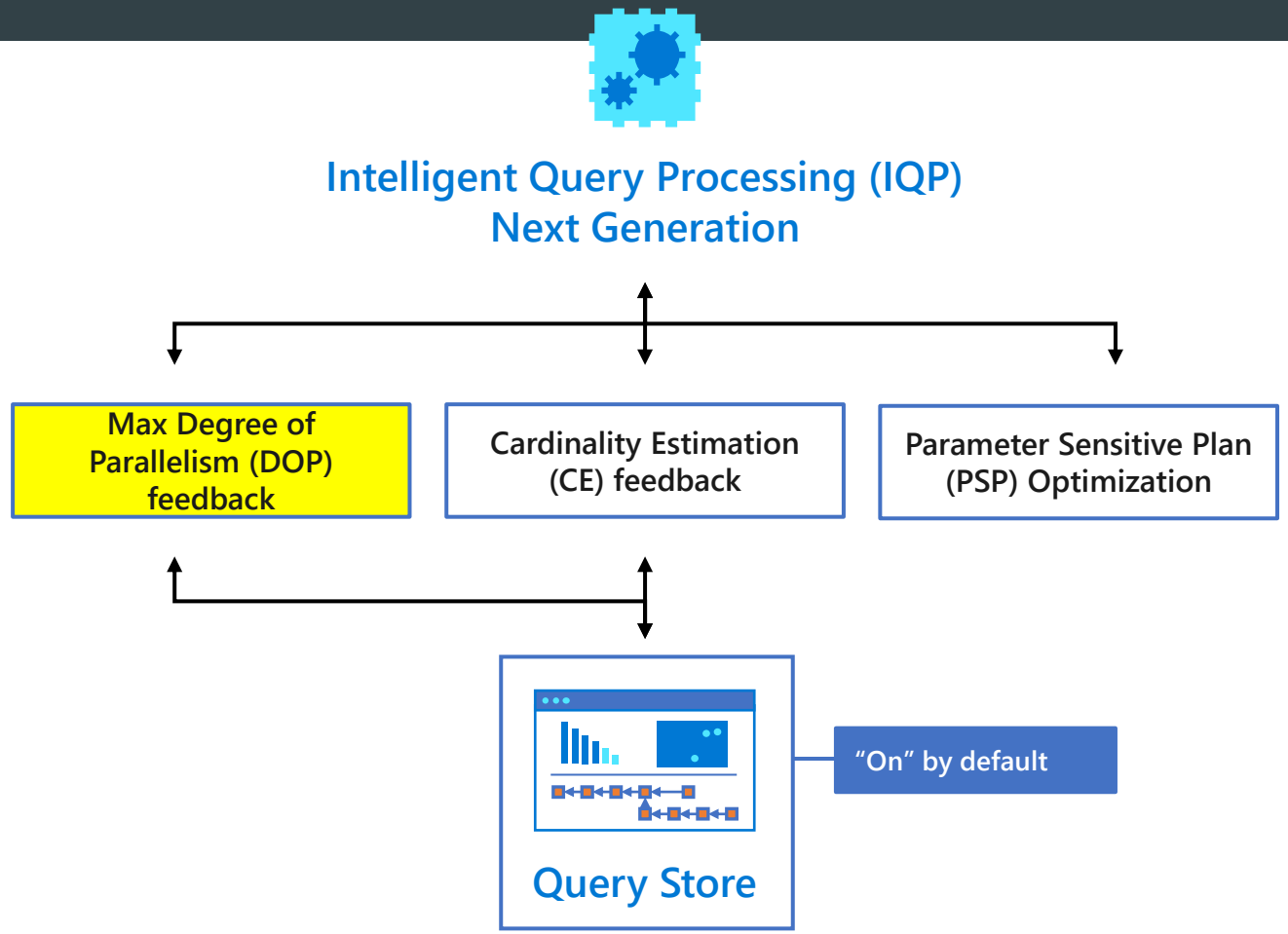
SQL Server 2022 DOP feedback

The definitive solution to the MAXDOP configuration!

Query Store and Intelligent Query Processing

- Accelerate query performance and tuning with no code changes
  - Query Store now turned on by default
  - Query Store support for read replicas from availability groups
  - Query hints to shape plans with no code changes
  - New IQP scenarios enabled through better together capabilities



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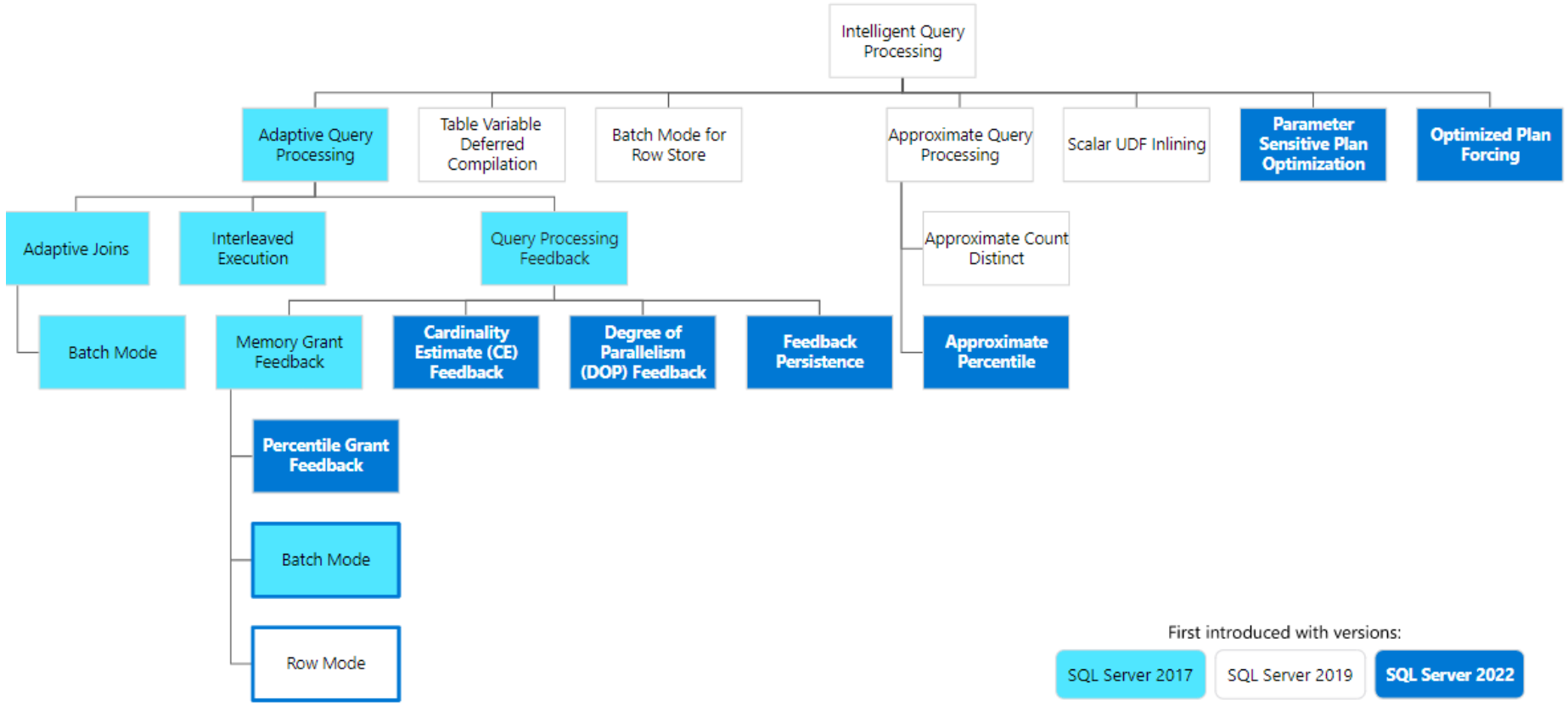
Intelligent Query Processing



Degree of Parallelism (DOP) Feedback

- DOP feedback is one of the new features of SQL Server 2022
- It is part of the family features known as Intelligent Query Processing that improve the performance of existing workloads without changes to the application code
- It addressing the scenario that occurs when an **OLTP query** is repeatedly executed in **parallel mode** and **performance issues** are encountered

Degree of Parallelism (DOP) Feedback

- DOP feedback will identify for you the **inefficiencies due to parallelism** for repeated queries, based on **query elapsed time** and **waits**
- If the use of parallelism is deemed inefficient, DOP feedback will **reduce** the degree of parallelism in the next execution of the query

Degree of Parallelism (DOP) Feedback

- The goal of DOP feedback is to **increase overall concurrency** and **reduce waits**
- Only **verified** feedbacks will be kept
- A stable correction of the DOP is checked at each recompilation of the execution plan and can may **readjust**

Monitoring the DOP feedback

- It is possible to monitor the functioning of DOP feedback through sys.query_store_plan_feedback and 6 new Extended Events
  - dop_feedback_eligible_query
  - dop_feedback_provided
  - dop_feedback_validation
  - dop_feedback_stabilized
  - dop_feedback_reverted
  - dop_feedback_analysis_stopped

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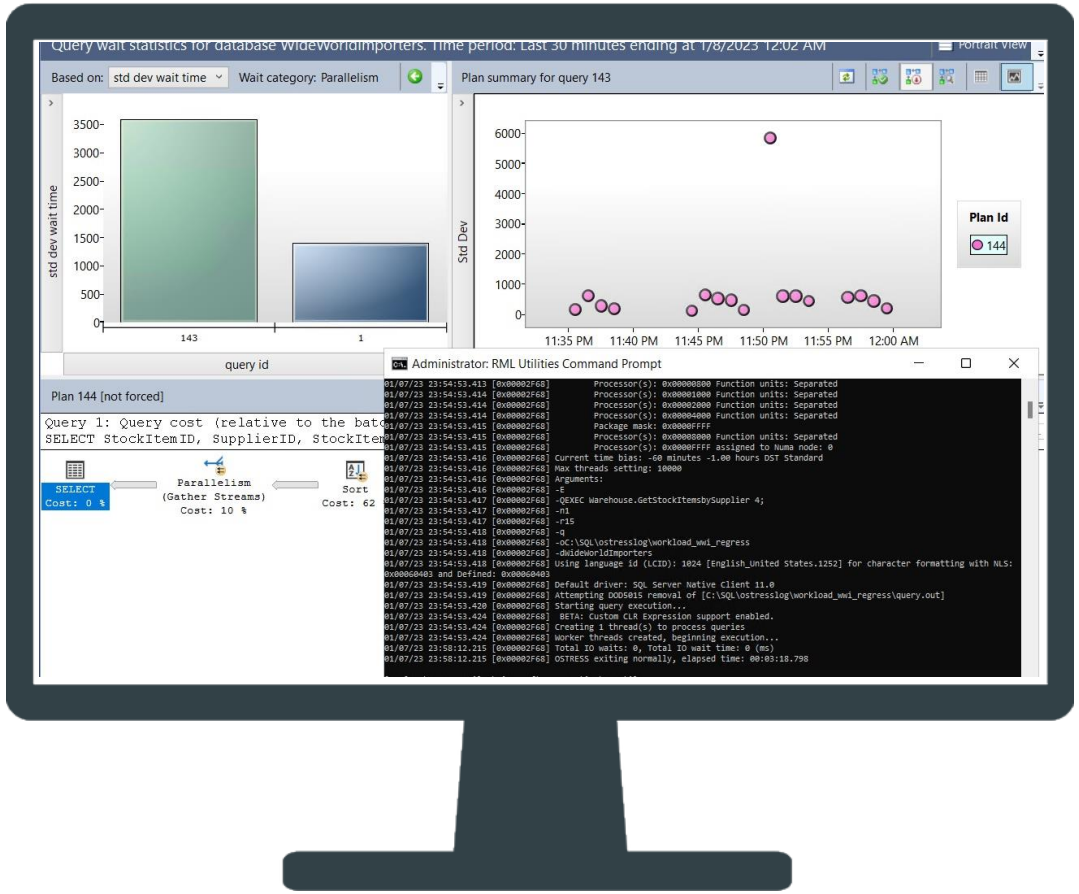

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Resources

- SQL Server 2022 Degree of Parallelism (DOP) Feedback
- Configure the max degree of parallelism Server Configuration Option
- Configure the max degree of parallelism (MAXDOP) in Azure SQL Database
- Best practices for deploying SQL Server on Amazon EC2 - Set MAXDOP for best performance
- Intelligent Query Processing (IQP)
- Azure SQL & SQL Server 2022: Intelligent Database Futures

Summary

Degree of parallelism (DOP) feedback is one of the new features of SQL Server 2022 and it is part of the Intelligent Query Processing (IQP) family features

It can **self-adjust** the MAXDOP option to avoid performance problems due to the use of parallelism in OLTP queries performed repeatedly

Q&A

Thanks!