

Prepared by Clarity Innovations, Inc.

# intel.

# Powering the Modern Classroom with Chromebooks based on Intel Processors

Exploring the effect of processors on device performance in elementary and middle school classrooms





### **Executive Summary**

Chromebook purchases by K-12 schools surged in recent years, accounting for nearly 72% of total device sales.<sup>1</sup> Laptop components including more powerful processors, larger screen sizes, and school-day battery life can have a direct impact on teaching and learning. As a result, latest Chromebooks with Intel processors are comparable to traditional PCs in terms of the types of learning experiences that are possible when every student has one in their hands. Laptop components including more powerful processors, larger screen sizes, and school-day battery life can have a direct impact on teaching and learning. As a result, latest Chromebooks with Intel processors are comparable to traditional PCs in terms of the types of learning. As a result, latest Chromebooks with Intel processors are comparable to traditional PCs in terms of the types of learning experiences that are possible when every student has one in their hands. Based on the research documented in this paper, Chromebooks with Intel® processors outperform those with MediaTek chipsets on measures that are most important to educators and students: time saving, responsiveness, app usage capabilities, multitasking, and video conferencing. With less time waiting and more time learning, Intel Chromebooks are the right device to help teachers stay productive and keep students on-task and engaged.

### A Classroom Lens on Chromebooks

The research in this report draws on testing conducted by Intel® that compares Chromebooks with Intel processors to

similar devices powered by Mediatek chips.<sup>3</sup> The device analysis ran workload metrics on common classroom activities like screen sharing, using multimedia in apps, running more than one app at a time, and web browsing. This report explores the meaning of these tests through hypothetical learning scenarios that highlight the classroom benefits of Chromebooks with Intel<sup>®</sup> processors.

Intel® Processor N100 devices "are the real deal, and they are delivering surprising usability and rock-solid battery life, too." -Chrome Unboxed<sup>4</sup>

### Similar but Not Equal

The technical specifications and capabilities of both types of processors indicate a clear choice when schools are considering purchasing student devices. Chromebooks powered by Intel® processors outperform MediaTek devices on what matters most in classrooms: *Seamless learning experiences that allow students to multitask, run more complex workloads, and collaborate with others*. All of this translates to less time waiting by students and educators and more time spent engaged in rich learning activities. The time-saving benefits of using devices with Intel processors equates to a cost savings of nearly three times the retail price of many Chromebooks over their lifespan in the classroom.



<sup>&</sup>lt;sup>1</sup> Source: <u>With ChromeOS in 2023, Google's got its eye on the enterprise</u>

<sup>&</sup>lt;sup>2</sup> Source: <u>What the Massive Shift to 1-to-1 Computing Means for Schools, in Charts</u>

<sup>&</sup>lt;sup>3</sup> See <u>www.Intel.com/PerformanceIndex</u> for workloads and configurations. Results may vary.

<sup>&</sup>lt;sup>4</sup> Source: <u>Chrome Unboxed</u>





### Time savings



### Over 29 hours saved

Chromebooks with the Intel® Processor N100 and the Intel® Processor N4500 save 29 hours of educator time compared to MediaTek Kompanio 520 and 500 processorbased devices that perform slower and waste instructional time over the course of the school

### **Cost savings**

# Over \$1,200 recovered

Wasting time is costly. The time saved using Chromebooks with the Intel® Processor N100 and the Intel<sup>®</sup> Processor N4500 leads to district savings of over \$1,200 compared to MediaTek Kompanio 520 and 500 processorbased devices over the expected life of the device.

# Effectiveness on real-world classroom applications

#### No-lag sharing



# 90% better performance

year and life of the device.

Chromebooks with the Intel® Processor N100 surpass MediaTek Kompanio 520 processor on Speedometer 2 tests when screen sharing during a video conference.

# Clear, responsive experiences

# 2.5x higher benchmark scores

Intel® Processor N100 laptops provide superior graphics performance compared to MediaTek Kompanio 520-based devices on 3DMark Slingshot tests of graphics rendering.

### Quickly run next-gen apps



Intel® Processor N4500 Chromebooks power future-ready apps like Python and Microsoft Visual Code Studio at over 40% faster

than MediaTek Kompanio 500-based devices.

### Multitask without waiting



# 55% faster response time

Intel® Processor N100 devices handle classroom workloads like importing and exporting multimedia into Google apps quicker than MediaTek Kompanio 520-based devices.





### **Choosing the Right Chromebook**

More and more K-12 schools are implementing one-to-one device programs to increase digital learning opportunities, enhance student engagement, and expand equitable access to robust apps at school and home. Even with growing evidence of positive outcomes with one-to-one programs, placing a device in the hands of every student is an expensive undertaking for many technology departments.<sup>5</sup> Not only is each device a substantial investment, but administrators must also be mindful of ongoing support and replacement costs.

Many technology decision makers choose Chromebooks because they are more affordable than laptops with similar specifications. Chromebooks often cost between \$200-\$400 and include automatic file saving, web-based management, and built-in security measures. The low price point along with streamlined support can make Chromebooks more appealing than traditional laptops while offering more features than a mobile device like a tablet.

Determining which Chromebooks to purchase is also a time-sensitive decision. Large federal funding sources like the American Rescue Plan: Elementary and Secondary School Emergency Relief Fund (ARP-ESSER) and the Emergency Connectivity Fund (ECF) are set to expire soon, so carefully considering what Chromebooks best serve students is a timely decision with budget ramifications.<sup>6,7</sup>

After over a decade on the market, schools now know that not all Chromebooks are created equal despite underlying cost and management similarities. Administrators and educators have come to expect feature sets that maximize student learning, collaboration, and creation throughout the entire school day and years down the line. Having the right device means that students can have the tools they need to develop college and career readiness skills. When poor performance affects modern learning, teachers are left frustrated and students are left without the future-ready skills they need.



<sup>5</sup> Source: <u>How Educators Feel About the Impact of Technology, in Charts</u>

- <sup>6</sup> Source: Office of Elementary & Secondary Education: Deadlines and Announcements
- <sup>7</sup> Source: Federal Communications Commission: Emergency Connectivity Fund FAQs

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# What Matters Most to Teaching and Learning

Chromebooks with processors from Intel and MediaTek				
Key Criteria <sup>8</sup>	Proven winners	The contenders		
Multitasking support for Google Workspaces	Intel® Processor N4500	MediaTek Kompanio 500 (MT8183)		
Browser performance while multitasking during a video conference	Intel® Processor N4500	MediaTek Kompanio 500 (MT8183)		
Browser performance while in a video conference	Intel® Processor N100	MediaTek Kompanio 520 (MT8186)		
Fast and responsive load times for education applications	Intel® Processor N100	MediaTek Kompanio 520 (MT8186)		
Device performance while using battery power	Intel® Processor N4500	MediaTek Kompanio 520 (MT8186)		
Educator time savings and district cost savings	Intel® Processor N100 and Intel® Processor N4500	MediaTek Kompanio 520 (MT8186) and MediaTek Kompanio 500 (MT8183)		

<sup>8</sup> Evaluation based on workloads and configurations found at <u>www.Intel.com/PerformanceIndex</u> and the Learning Scenarios documented in this paper. Results may vary.





### Methodology of this Study

In creating this study, data was collected from an independent analysis of device performance based on common industry standards including speed tests, app responsiveness, overall system performance, battery performance, and graphics rendering. Tests included:

- CrXPRT 2 for battery performance
- WebXPRT for browser performance;
- Speedometer 2 for web app responsiveness;
- 3DMark Sling Shot for graphics performance; and
- CrossMark for overall system performance and responsiveness.

This report uses hypothetical classroom scenarios that contextualize the results from the independent analysis. A variety of app workloads were tested and analyzed for speed and performance. While each workload was tested individually, this report paired workloads to align with typical classroom experiences. Additional details about the workloads and configurations can be found at <u>www.Intel.com/PerformanceIndex</u>. Results may vary.







#### Learning Scenarios and Outcomes

The following sections outline typical K–12 learning scenarios that compare the learning experience for students using devices with the featured processors. Each scenario explains the student tasks involved in the activity, highlights the test results, and describes the differences in functionality. The goal in creating these scenarios is to explore, in a more authentic fashion, how the data found in the independent analysis may impact teaching and learning in the classroom.

#### Summary of Results

#### Scenario 1: Across-the-state History

Workload	Processor	Performance	Time Saved <sup>9</sup>
App Explain Everything Test Load and export a project	Intel® Processor N100 MediaTek Kompanio 520 (MT8186)	The Intel® Processor N100 device was 197 seconds faster than the MediaTek Kompanio 520 (MT8186) device	13 hours of time saved by using the Intel® Processor N100 Chromebook
App Google Meet Test Browser performance under typical workloads <sup>10</sup>	Intel® Processor N100 MediaTek Kompanio 500 (MT8183)	The Intel® Processor N100 device's web app responsiveness performance was 131% better than the MediaTek Kompanio 500 (MT8183) device	N/A

<sup>9</sup> Calculations assume a similar workload is run 4 times per day during 3 lessons per week for 25 weeks over the four-year lifespan of the device. Evaluation based on workloads and configurations found at at <u>www.Intel.com/PerformanceIndex</u> and the Learning Scenarios documented in this paper. Results may vary.

<sup>10</sup> Source: <u>About Speedometer 2.0</u>



Scenario 2: Bridging the New School Gap					
Workload	Processor	Performance	Time Saved <sup>9</sup>		
App Google Sheets Test	Intel® Processor N4500 The Intel® Processor N4500 device was 12 seconds quicker than the MediaTek		4 hours of time saved by using the Intel® Processor N4500 Chromebook.		
Google Sheets loading time	le Sheets ng time MediaTek Kompanio 520 (MT8186)				
App Google Slides	Intel® Processor N100	The Intel® Processor N100 device saved 17 seconds compared	5.7 hours of time		
Google Slides loading time	MediaTek Kompanio 500 (MT8183)		Intel® Processor N100 Chromebook.		

Scenario	3:	Expanding	Access with	Virtual	Classes
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Workload	Processor	Performance	Time Saved <sup>9</sup>	
App GeoGebra and Google Meet Test	Intel® Processor N4500	The Intel® Processor N4500 device launched a Geogebra project while in a Google Meet call	1 hour of time saved by using the Intel® Processor N4500 Chromebook.	
GeoGebra loading time	MediaTek Kompanio 500 (MT8183)	3 seconds faster than the MediaTek Kompanio 500 (MT8183)		
<b>App</b> Microsoft Visual Code Studio	Intel® Processor N4500	The Intel® Processor N4500 device	E Z hours of time	
<b>Test</b> Completing a task in a Python program time	MediaTek Kompanio 500 (MT8183)	launched a Python program 16 seconds faster than the MediaTek Kompanio 500 (MT8183) device	5.3 nours of time saved by using the Intel® Processor N4500 Chromebook.	

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#### 4th Grade Social Studies: Across-the-state History

#### At a Glance

**Grade Level** 4th grade

#### Learning Skills

- Collaboration
- Presentation skills

#### **Applications and Tools**

- Google Meet
- Explain Everything

#### **Testing and Evaluation Highlights**

Intel<sup>®</sup> Processor N100 devices fully loaded an Explain Everything project 197 seconds faster when compared to the MediaTek Kompanio 520 (MT8186) devices.

#### Time Saved<sup>9</sup>

13 hours of time saved by using the Intel® Processor N100 Chromebook

#### Summary

Intel® Processor N4500 devices experienced 131% better web app responsiveness and less lag when screen sharing during Google Meet compared to MediaTek Kompanio 500 (MT8183) devices.



Elementary school students from two different parts of the same state are teaming up to share information about local historical sites. Even though they are physically apart, these groups are working together online to explore how the different geographic regions in their state have made major contributions to its history. They rely on their Chromebooks to connect virtually and collaborate together during their weekly STEM special. They achieve this by combining the features of Explain Everything and Google Meet, allowing them to showcase and discuss their local historical landmarks in real-time presentations. First, the students highlight local historical sites using primary resources and their own original photographs and videos curated in Explain Everything projects. Next, they present the projects to their partner class at checkpoints throughout the year using Google Meet screen sharing.





#### Transitioning from 5th to 6th Grade: Bridging the New School Gap

#### At a Glance

**Grade Level** 5th and 6th grade

#### Learning Skills

- Reflection
- Curation

#### **Applications and Tools**

- Google Sheets
- Google Slides

#### **Testing and Evaluation Highlights**

Intel® Processor N4500 devices save 12 seconds each time they open a Google Sheets spreadsheet with Google Slides running compared to MediaTek Kompanio 500 (MT8183) devices.

#### Time Saved<sup>9</sup>

4 hours of time saved by using the Intel<sup>®</sup> Processor N4500 Chromebook.

#### **Testing and Evaluation Highlights**

Intel<sup>®</sup> Processor N100 Chromebooks were able to launch Google Slides nearly 17 seconds quicker than MediaTek Kompanio 520 (MT8186) devices.

#### Time Saved<sup>9</sup>

5.7 hours of time saved by using the Intel® Processor N100 Chromebook.



The move from elementary to middle school can be a daunting experience for many students as they leave behind the comfort of familiar hallways, faces, and support systems. To ease this transition, students work on enhancing their reflective and organizational skills by creating summative learning portfolios that provide a comprehensive view of their academic achievements, personalities, and their preferred learning styles. These portfolios serve as a culmination of their elementary school journey and as an introductory glimpse for their middle school teachers. First, students use Google Sheets to gather their academic artifacts. Next, they create media-rich Google Slides to present and share their work.





#### 8th Grade Probability and Statistics: Expanding Access with Virtual Classes

#### At a Glance

**Grade Level** 8th grade

#### Learning Skills

- Mathematics and reasoning skills
- Collaboration

#### **Applications and Tools**

- Google Meet
- GeoGebra
- Microsoft Visual Studio Code

#### **Testing and Evaluation Highlights**

Intel<sup>®</sup> Processor N4500 devices save 3 seconds each time that a GeoGebra project launches while using Google Meet compared to MT8183 processors.

#### Time Saved<sup>9</sup>

1 hour of time saved by using the Intel® Processor N4500 Chromebook.

#### **Testing and Evaluation Highlights**

Intel® Processor N4500 devices save 16 seconds compared to MediaTek Kompanio 500 (MT8183) processors when opening Python programs in Microsoft Visual Studio Code.

#### Time Saved<sup>9</sup>

5.3 hours of time saved by using the Intel® Processor N100 Chromebook.



In the past, students were constrained by the courses offered at their physical school. However, today's students have greater flexibility and can enroll in classes not only across their school district or state but also across different grade levels, even advancing to high school or college-level courses. In this scenario, a middle school student utilizes her Chromebook to participate in an advanced Probability and Statistics class that her own school does not offer. First, she joins each class using Google Meet video meetings. Next, she relies on apps like GeoGebra to create learning artifacts and Python programs to analyze rich data sets.





# Conclusion

When it comes to enhancing student collaboration, creativity, and communication during learning, Chromebooks equipped with Intel® processors prove to be the superior option. Intel® Processor N100 and Intel® Processor N4500 devices consistently outperform those from MediaTek resulting in less lag while screen sharing, more responsiveness while multitasking, and better performance on workload heavy programs. These advantages make Chromebooks with Intel® processors classroom-ready devices that can handle anything that a student wants to accomplish.

The speed, responsiveness, and performance of Intel<sup>®</sup> Processor N100 and Intel<sup>®</sup> Processor N4500 Chromebooks provide more instructional opportunities when spread out over the life of a device. Instead of having to wait for apps to load or spending time troubleshooting poor performing devices, educators who work with students using Chromebooks with Intel<sup>®</sup> processors gain valuable instructional time that's spent on teaching and learning, not waiting.

When multiplied to reflect the amount of occurrences throughout a period of time like a semester, an entire school year, or the life of the device, the times become substantial<sup>11</sup>:

- Up to 29 hours of learning time recovered by using Chromebooks with Intel processors;
- The equivalent of over \$1,200 worth of the educator's time; and
- Amounting to nearly 3 times the cost of an Intel<sup>®</sup> Processor N4500 or MediaTek Kompanio 500 device.

Chromebooks equipped with Intel<sup>®</sup> processors consistently deliver better performance compared to Chromebooks with MediaTek processors. Devices with Intel<sup>®</sup> processors offer a full school day of battery life, enabling students to engage in modern classroom activities using secure, high-performing, and cost-effective devices. Students using Chromebooks with Intel<sup>®</sup> processors can experience faster performance, enhanced app functionality, collaborate effectively in various learning scenarios, and ultimately, spend more time actively participating in their learning.

See <u>www.Intel.com/PerformanceIndex</u> for workloads and configurations. Results may vary.

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<sup>11</sup> See <u>Appendix B</u> for additional details and analysis.





# Appendices

# Appendix A: Test Devices

Device	Acer Chromebook 511	HP Chromebook X360	Lenovo IdeaPad Slim 3	ASUS CM3200FV
Operating System	ChromeOS	ChromeOS	ChromeOS	ChromeOS
Processor	Intel® Processor N100	Intel® Processor N4500	MediaTek Kompanio 520 (MT8186)	MediaTek Kompanio 500 (MT8183)
Processor Frequency	3.4 GHz	1.1 GHz	2.05 GHz	2.0 GHz
Storage	32 GB	32 GB	64 GB	32 GB
Memory	4 GB	4 GB	4 GB	4 GB
Battery Capacity	50 Wh	47 Wh	47 Wh	32 Wh
Display Size	11.6 in 1366 X 768	14 in 1366 X 768	14 in 1920 X 1080	12 in 1366 X 912
Graphics	Intel® UHD Graphics	Intel® UHD Graphics	ARM Mail-G52	ARM Mail-G72
Networking	Intel® Wi-Fi 6E AX211	Intel® Wi-Fi 6 AX201	Wi-Fi 6	Wi-Fi 5
Connectivity	2 USB-C 2 USB-A	2 USB-C 1 USB -A	1 USB-C 1 USB-A	2 USB-C 1 USB-A
Price at Time of Purchase	\$363	\$280	\$319	\$284
Weight	2.98 lbs	3.57 lbs	2.87 lbs	2.51 lbs





### Appendix B: The Value of Time Saved Calculations

Calculations in the value of time saved for the first scenario are based on a typical elementary school STEM teacher employing similar learning scenarios as those outlined in this report, five classes a week for three weeks at four intervals throughout the year. Total learning time saved is based on comparison with the slowest device. See Appendix C for additional details on average U.S. teacher salary.

#### Results from 4th Grade Social Studies: Across-the-state History

	ln a single class	In five fourth grade classes a week	In a three-week unit	Repeated four times a year	In a four year device lifetime
Time saved using Intel® Processor N100 and Intel® Processor N4500 devices	197 seconds	16 minutes and 25 seconds	49 minutes and 15 sconds	3 hours and 17 minutes	13 hours and 8 minutes
Value of lost educator time	\$2.40	\$11.95	\$35.85	\$143.40	\$573.60

Calculations regarding the value of time saved in the second and third scenarios are based on educators employing similar learning scenarios as those outlined in this report, three times a week in four separate classes for 25 weeks. Total learning time saved is based on comparison with the slowest device. See Appendix C for additional details on average U.S. teacher salary.

#### Results from Transition to 6th Grade: Bridging the New School Gap

	ln a single class	In four classes a day	In three lessons a week	In 25 weeks a year	In a four year device lifetime
Time saved using Intel® Processor N100 and Intel® Processor N4500 devices	29 seconds	116 seconds	348 seconds	145 minutes	9 hours and 40 minutes
Value of lost educator time	\$0.35	\$1.41	\$4.24	\$106.12	\$424.46





#### Results from 8th Grade Probability and Statistics: Expanding Access with Virtual Classes

	ln a single class	In four classes a day	In three lessons a week	In 25 weeks a year	In a four year device lifetime
Time saved using Intel® Processor N14500 in this scenario	19 seconds	76 seconds	228 seconds	95 minutes	6 hours and 20 minutes
Value of lost educator time	\$0.23	\$0.93	\$2.78	\$69.52	\$278.10

### Appendix C: Salary Table

According to the National Education Association (NEA), the average teacher in the United States makes \$66,745 per year.<sup>12</sup> This study created the following data table based on a typical 180 instructional days, 10 non-instructional days, and an 8-hour work day.

	Days	Hours
Instructional Work Days	180	1,440
Non-Instructional Work Days	10	80
Total Contracted Days	190	1,520
Average Salary	Daily Salary	Hourly Wage
\$66,745	\$351.29	\$43.91

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