



# Digital Learning Systems Inventive Energy

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## INTERNATIONAL PATENT CLASSES (IPC): Digital Learning Systems

IPC Domain	Description
H04N21/20	Servers specifically adapted for the distribution of content, e.g. VOD servers; Operations thereof
H04N21/25	Management operations performed by the server for facilitating the content distribution or administrating data related to end-users or client devices, e.g. end-user or client device authentication or learning user preferences for recommending movies
H04N21/40	Client devices specifically adapted for the reception of, or interaction with, content, e.g. STB [set-top-box]; Operations thereof
H04N21/45	Management operations performed by the client for facilitating the reception of or the interaction with the content or administrating data related to the end-user or to the client device itself, e.g. learning user preferences for recommending movies or resolving
H04N21/262	Content or additional data distribution scheduling, e.g. sending additional data at off-peak times, updating software modules, calculating the carousel transmission frequency, delaying a video stream transmission or generating play-lists
H04N21/454	Content filtering, e.g. blocking advertisements
H04N21/466	Learning process for intelligent management, e.g. learning user preferences for recommending movies
H04N21/472	End-user interface for requesting content, additional data or services; End-user interface for interacting with content, e.g. for content reservation or setting reminders, for requesting event notification or for manipulating displayed content
H04N21/845	Structuring of content, e.g. decomposing content into time segments
H04N21/8549	Creating video summaries, e.g. movie trailer

Digital learning utilizes information technology to impart knowledge to the students. Digital learning is an instructional practice that effectively uses information technology to strengthen a student's learning experience and encompasses a wide spectrum of tools and practices such as digital learning content, access to the online database, virtual assessment, hybrid or blended learning, etc. Most of the schools and educational institutions have gladly adopted the digital learning method thereby bringing a colossal change in the educational system. Currently, most of the students are using their smartphones regularly to aid study.

We have identified following top 10 International Patent Classification (IPC) in the digital learning systems domain through the study of key patents. The overall number of Applications published in the United States Patent and Trademark Office (USPTO) and Patents granted by USPTO are given in the table below (from the year 2010 till 2017). These are total numbers granted and published by the world at large at USPTO in that specific year.

S.No	IPC Domain	Year								
		2010	2011	2012	2013	2014	2015	2016	2017	
1	H04N21/20									
	Application	1	1	39	32	3	1	1	3	
	Granted	1	1	1	3	6	12	27	49	
2	H04N21/25									
	Application	1	1	42	52	59	104	175	160	
	Granted	1	1	1	1	6	91	260	486	
3	H04N21/40									
	Application	1	1	42	35	2	1	1	10	
	Granted	1	1	1	1	5	21	44	77	
4	H04N21/45									
	Application	1	3	9	43	99	257	327	438	
	Granted	1	1	1	1	2	281	666	1134	
5	H04N21/262									
	Application	1	1	9	28	90	208	221	251	
	Granted	1	1	1	1	8	196	531	874	
6	H04N21/454									
	Application	1	1	7	19	27	57	60	51	
	Granted	1	1	1	1	1	75	136	113	
7	H04N21/466									
	Application	1	1	1	7	55	160	208	232	
	Granted	1	1	1	1	2	155	177	244	
8	H04N21/472									
	Application	1	2	35	70	241	492	424	567	
	Granted	1	1	1	1	9	432	697	709	
9	H04N21/845									
	Application	1	1	1	1	27	128	260	301	
	Granted	1	1	1	1	2	189	370	451	
10	H04N21/8549									
	Application	1	1	1	1	9	29	50	45	
	Granted	1	1	1	1	1	31	51	70	

## STATE OF ART OF ANY TECHNOLOGY USING CRAFITTI'S INVENTIVE ENERGY

**Inventive Energy (IE)** is a yearly metric of the trend of last five years of invention activity in the specific technological domain such as the digital learning systems calculated based on a number of patent applications published and a number of patents granted in the respective technological domain. **Inventive energy is a composite metric of two indices – Patent Intensity Index and Patent Activity Index.**

CRAFITTI's **INVENTIVE ENERGY** measures the pace and intensity of **inventive activity** in a particular technological field. Inventive Energy provides a true picture of the state of the art of technology as it is a **composite metric** of Patents Granted and Patent Applications published in specific technology domains annually for a period of five years.

*Inventive Energy in specific technology domains can be utilized by existing technology players, start-ups, new players, investors, VCs, Research and Development teams and technology and Product Strategy Teams to design more informed future.*

**Patent Intensity Index** of a year is measured in terms of the yearly average of a number of total patents granted and patent applications published in last 5 years. *As an analogy, the Patent Intensity Index is denoted as the **Mass** which is reflected as a number of Patents and Applications granted and published respectively in the preceding 5 years.*

**Patent Activity Index** is measured in terms of the yearly average of **relative** pace of patent applications and granted patents in the IPC domain. *As an analogy, the Patent Activity Index denotes the **Velocity** or relative pace of Patents and Applications, granted and published respectively in the preceding 5 years, with higher weightage assigned to recent years.*

For any year, the two indices include a measure of yearly averages of **last five years of a number of applications published and patents granted**. For example, for 2017, these indices use data from years 2013-2017.

### Patent Activity Index of top 10 digital learning systems IPC classes for years 2014-2017

A value of **Patent Activity Index** is less than 1.0 indicates that relative average number of applications filing is reducing compared to a number of patents being granted. **The index also gives a red, amber and green signal.** **Red** indicates the value of the index is less than 1.0. **Amber** indicates it is between 1.0 and 2.0 and **green** indicates it is above 2.0, i.e., *the number of applications being published every year on an average is more than 2 times the number of patents being granted on an average.* A higher value of patent activity index is an indication of more recent inventive activity in the domain or the specific IPC class. In turn, a higher activity index will signify a higher Inventive Energy. *Activity Index is analogous to*

*the velocity of the particle.* The PAI (Patent Activity Index) of top 10 digital learning systems IPCs for years 2014-2017 are given below.

IPC Domain	Description	BM-PAI 2014	BM-PAI 2015	BM-PAI 2016	BM-PAI 2017
H04N21/20	Servers specifically adapted for the distribution of content, e.g. VOD servers; Operations thereof	● 8.45	● 6.06	● 4.69	● 1.04
H04N21/25	Management operations performed by the server for facilitating the content distribution or administrating data related to end-users or client devices, e.g. end-user or client device authentication or learning user preferences for recommending movies	● 22.02	● 14.93	● 11.35	● 6.09
H04N21/40	Client devices specifically adapted for the reception of, or interaction with, content, e.g. STB [set-top-box]; Operations thereof	● 14.17	● 9.90	● 7.59	● 3.18
H04N21/45	Management operations performed by the client for facilitating the reception of or the interaction with the content or administrating data related to the end-user or to the client device itself, e.g. learning user preferences for recommending movies or resolving	● 32.82	● 18.77	● 13.14	● 9.60
H04N21/262	Content or additional data distribution scheduling, e.g. sending additional data at off-peak times, updating software modules, calculating the carousel transmission frequency, delaying a video stream transmission or generating play-lists	● 12.57	● 8.09	● 5.91	● 4.06
H04N21/454	Content filtering, e.g. blocking advertisements	● 17.20	● 9.87	● 6.99	● 5.03
H04N21/466	Learning process for intelligent management, e.g. learning user preferences for recommending movies	● 13.92	● 7.69	● 5.61	● 4.45
H04N21/472	End-user interface for requesting content, additional data or services; End-user interface for interacting with content, e.g. for content reservation or setting reminders, for requesting event notification or for manipulating displayed content	● 32.47	● 20.59	● 15.15	● 9.71
H04N21/845	Structuring of content, e.g. decomposing content into time segments	● 6.47	● 3.60	● 2.62	● 2.11
H04N21/8549	Creating video summaries, e.g. movie trailer	● 4.50	● 2.72	● 2.15	● 1.71

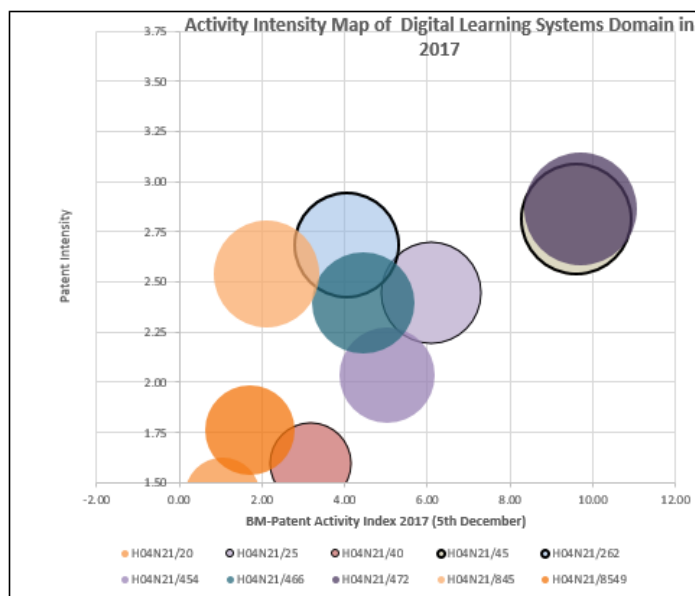
\*BM-PAI – *Bhushan Mishra Patent Activity Index* – named after its creators

As can be seen in the above table, the PAI for IPC classes H04N21/25 (Management operations performed by the server for facilitating the content distribution or administrating data related to end-users or client devices, e.g. end-user or client device authentication or learning user preferences for recommending movies); H04N21/40 (Client devices specifically adapted for the reception of, or interaction with, content, e.g. STB [set-top-box]; Operations thereof); H04N21/45 (Management operations performed by the client for facilitating the reception of or the interaction with the content or administrating data related to the end-user or to the client device itself, e.g. learning user preferences for recommending movies or resolving scheduling conflicts ); H04N21/262 (Content or additional data distribution scheduling, e.g. sending additional data at off-peak times, updating software modules, calculating the carousel transmission frequency, delaying a video stream transmission or generating play-lists); H04N21/454 (Content filtering, e.g. blocking advertisements); H04N21/466 (Learning process for intelligent management, e.g. learning user preferences for recommending movies); H04N21/472 (End-user interface for requesting content, additional data or services; End-user interface for interacting with content, e.g. for content reservation or setting reminders, for requesting event notification or for manipulating displayed content); and H04N21/845 (Structuring of content, e.g. decomposing content into time segments) is above 2.0 for years 2014, 2015, 2016 and 2017, indicated in green.

The PAI for H04N21/20 (Servers specifically adapted for the distribution of content, e.g. VOD servers; Operations thereof); and H04N21/8549 (Creating video summaries, e.g. movie trailer) is above 2.0 for years 2014-2016, indicated in green, and below 2.0 for the year 2017, indicated in amber.

*H04N21/45 and H04N21/472 are the prominent IPC classifications in the digital learning systems which talk about **management operations performed by the client for facilitating the reception of or the interaction with the content or administrating data related to the end-user or to the client device itself, e.g. learning user preferences for recommending movies or resolving scheduling conflicts; and end-user interface for requesting content, additional data or services; End-user interface for interacting with content, e.g. for content reservation or setting reminders, for requesting event notification or for manipulating displayed content** respectively. The inventive activity in H04N21/472 was higher in the year 2014, since then the patent activity has been reducing as the number of Patents being granted has started increasing. Further, the inventive activity in H04N21/45 was also higher in the year 2014, since then the patent activity has been decreasing. However, the inventive activity of H04N21/472 is still higher than other key IPC classes.*

### Activity Intensity Maps of Top 10 digital learning systems IPC classes in the year 2014 and 2017

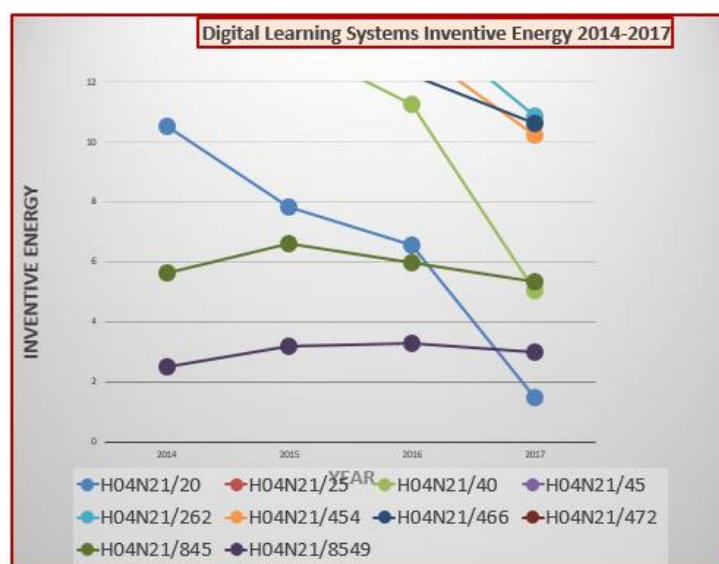


**Activity Intensity Map (AIM)** of a set of IPC classes is a Crafitti proprietary visualization of intensity in terms of a number of patents granted and patent applications published, and inventive activity in terms of relative pace of patent applications and granted patents in any IPC domain. For any year say 2014, these indices include a measure of yearly averages of last five years of a number of applications published and patents granted. For example, for 2014, these indices use data from years 2010, 2011, 2012, 2013 and 2014.

IPC Domain	Patent Activity Index				Patent Intensity				INVENTIVE ENERGY			
	IPC	BM-PAI 2014	BM-PAI 2015	BM-PAI 2016	BM-PAI 2017	2014	2015	2016	2017	2014	2015	2016
H04N21/20	● 8.45	● 6.06	● 4.69	● 1.04	1.25	1.30	1.40	1.44	10.52	7.86	6.56	1.49
H04N21/25	● 22.02	● 14.93	● 11.35	● 6.09	1.52	1.85	2.20	2.45	33.44	27.70	24.97	14.89
H04N21/40	● 14.17	● 9.90	● 7.59	● 3.18	1.26	1.34	1.49	1.60	17.78	13.30	11.28	5.07
H04N21/45	● 32.82	● 18.77	● 13.14	● 9.60	1.51	2.14	2.53	2.81	49.50	40.24	33.21	26.99
H04N21/262	● 12.57	● 8.09	● 5.91	● 4.06	1.45	2.04	2.41	2.68	18.23	16.47	14.26	10.88
H04N21/454	● 17.20	● 9.87	● 6.99	● 5.03	1.08	1.58	1.89	2.03	18.57	15.60	13.19	10.22
H04N21/466	● 13.92	● 7.69	● 5.61	● 4.45	1.15	1.89	2.19	2.39	16.04	14.50	12.26	10.65
H04N21/472	● 32.47	● 20.59	● 15.15	● 9.71	1.86	2.41	2.68	2.86	60.39	49.61	40.64	27.80
H04N21/845	● 6.47	● 3.60	● 2.62	● 2.11	0.87	1.85	2.29	2.54	5.63	6.64	6.01	5.36
H04N21/8549	● 4.50	● 2.72	● 2.15	● 1.71	0.56	1.18	1.54	1.76	2.51	3.22	3.31	3.00

### Digital Learning Systems Inventive Energy of Top 10 IPC classes

Inventive Energy for the year 2014 for IPC class H01N21/20 is simply a product of Patent Activity Index for the year 2014 (in this case a value of 8.45) and Patent Intensity for the year 2014 (in this case a value of 1.25). The Inventive Energy for the year 2014 for IPC domain H01N21/20 comes out to be  $8.45 \times 1.25 = 10.52$ , as shown in the Table. In general, the Inventive Energy of IPC class H04N21/472 (End-user interface for requesting content, additional data or services; End-user interface for interacting with content, e.g. for content reservation or setting reminders, for requesting event notification or for manipulating displayed content) is highest among these top 10 IPC classes.



## Key Findings

Due to its inherent simplicity and utilization of substantial information on published and granted patents, the present study on **the inventive energy** provides a de facto standard for enterprises active in the **digital learning systems** to evaluate the front edge of technology in various applications of the digital learning systems.

IPC class on the end-user interface for requesting content, additional data or services; an End-user interface for interacting with content, e.g., for content reservation or setting reminders, for requesting event notification or for manipulating displayed content (H04N21/472) has seen the tremendous inventive energy in the 2014-2016 Index. Other two prominent IPC classes on management operations performed by the client for facilitating the reception of or the interaction with the content or administrating data related to the end-user or to the client device itself, e.g. learning user preferences for recommending movies or resolving scheduling conflicts (H04N21/45), and client device authentication or learning user preferences for recommending movies (H04N21/25) have also been quite active among the digital learning enthusiasts and R&D teams.

One of the findings from the present inventive energy study is that the patenting activity was higher in the digital learning domain in the year 2014 to 2016. Further, there is a decrease in the patent activity in the Client devices specifically adapted for the reception of, or interaction with, content, e.g., STB [set-top-box]; Operations thereof (H04N21/40) which was higher in the year 2014-2015. Further, the filing trend in this domain is relatively better than the IPC H04N21/8549 which talks about *creating video summaries, e.g., movie trailer*.

Further, the reduction in Inventive Energy of H04N21/20 (Servers specifically adapted for the distribution of content, e.g. VOD servers; Operations thereof) from 2014 value of nearly 8.45 to the value of 1.04 in the year 2017, *indicates the trend of Patents grants has started in the period that typically brings down the Inventive Energy as it is a function of the ratio of applications published and a patent granted for the particular year*. Furthermore, the present inventive energy study identified that inventors are active to provide various digital infrastructures to establish the virtual interactive communication between the student and the instructors. The interaction between the students and instructors will always be central to the digital learning process. The instructors may need to acquire new technical skills to blend digital learning into their curriculum, but ultimately this will help the instructors to engage students, track progress, and monitor the impact of implementing the digital learning technology.

IPC classes with high Inventive Energy typically will have higher business potential and growth in digital learning systems. The Inventive Energy can be utilized to create the **digital learning systems Inventive Strategy** to find problems in high inventive energy IPC classes. This can be a leading indicator for not only any startup or disruptor but also to existing patent owners to expand and strengthen their portfolio through this guidance rather than letting serendipity and opinion about future guide their inventive effort.

As the patent examiner not only evaluate the patentability of the corresponding technology but also assess the legal aspects of the filed patent application at various levels of scrutiny before granting the patent, therefore, patent grant trends identified by the present inventive energy study in the digital learning systems will enable the decision maker with the due-diligence aspects of the digital learning systems.

Any organization willing to invest in the digital learning systems can utilize invention energy metric in general and this study in particular, as it automatically takes care of three major inputs required to understand the state of the art of digital learning systems – Patent Applications, Granted Patents and Specific IPC classes relevant to digital learning systems in a composite metric.

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