

UNITED STATES PATENT AND TRADEMARK OFFICE

BEFORE THE PATENT TRIAL AND APPEAL BOARD

AMAZON.COM, INC. and AMAZON.COM SERVICES LLC,
Petitioner,

v.

NOKIA TECHNOLOGIES OY,
Patent Owner.

Case IPR2024-00572
Patent 7,724,818

SUPPLEMENTAL DECLARATION OF MISKA HANNUKSELA

1. My name is Miska Hannuksela. I am currently the Head of Video Research at Nokia Technologies Oy (“Patent Owner” or “Nokia”). I am also a listed inventor of U.S. Patent No. 7,724,818 (“the 818 Patent”).

2. I have a doctorate in signal processing from Tampere University of Technology. My thesis was generally related to video coding and error-resilient communication, including handling of packet losses in video transmission.

3. I have published numerous articles related to video coding, video streaming, and video telecommunications, as well as many other topics. I am also a Nokia Bell Labs Fellow.

4. I have personal knowledge of the facts set forth in this Declaration. All statements made in this Declaration are true to the best of my knowledge. If called on to testify, I could and would testify competently as to the topics addressed in this Declaration. I do receive a salary from Nokia for my duties as Head of Video Research. My salary is not dependent upon the outcome of this action.

5. I previously submitted a declaration, dated July 29, 2024, explaining that on or about May 1, 2002, Ye-Kui Wang and I submitted JVT-C078 and accompanying JVT-C078 Annex A to the JVT in advance of the 3rd meeting of the Joint Video Team (JVT) of ISO/IEC MPEG & ITU-T VCEG, taking place in Fairfax, Virginia from May 6-10, 2002. As I stated in that previous declaration,

Ye-Kui Wang and I conceived of the concepts in and are the sole contributors of JVT-C078 and accompanying JVT-C078 Annex A. I understand that JVT-C078 and accompanying JVT-C078 Annex A have been marked by counsel as Exhibits 2003 and 2004 in this proceeding.

6. The subject matter of JVT-C078 and accompanying JVT-C078 Annex A includes the invention by Ye-Kui Wang and me that was filed with the United States Patent and Trademark Office on April 30, 2003, which later issued as the 818 Patent.

7. The invention by Ye-Kui Wang and me, which is described in the 818 Patent, relates to a hierarchical parameter set data structure for video coding parameters. Parameters for a sequence would go in a sequence parameter set. Most of the values of the parameters for a picture would go in a picture parameter set. And at least one of the values of the parameters for a picture would go in a slice header. We had this idea and were confident it would work at least by the time we wrote it down and publicly proposed it on or about May 1, 2002, in JVT-C078 and accompanying JVT-C078 Annex A.

8. In the 818 Patent, we provided an example of a sequence parameter set in Table 1, which we also called an Independent GOP Parameter Set. The table lists examples of sequence parameters. The table was not meant to be

comprehensive or to require that a sequence parameter set contain those exact entries.

9. In the 818 Patent, we also provided an example of a picture parameter set in Table 2, which lists examples of picture parameters. The table was not meant to be comprehensive or to require that a picture parameter set contain those exact entries.

10. In the 818 Patent, we also provided examples of a slice parameter set (Table 3) and a presentation parameter set (Table 4), each with example entries that are not meant to be comprehensive or required to contain those exact entries.

11. I am not an attorney and do not have opinions about the legal interpretation of claim language. But in reading the 818 Patent claims, there is no language that states that a slice parameter set or a presentation parameter set must be included. I have been informed by attorneys that the 818 Patent therefore allows, but does not require, additional parameter sets beyond the sequence parameter set and picture parameter set stated in the claims.

12. The subject matter of the 818 Patent is what Ye-Kui Wang and I invented and included in our H.264 Standardization proposal documents JVT-C078 and accompanying JVT-C078 Annex A.

13. For example, Figure 1 of JVT-C078 is identical to Figure 1 of the 818 Patent. For another example, Table 3.4.2 of JVT-C078 (sequence parameter set) is

nearly identical to Table 1 of the 818 Patent. For another example, Table 3.5.1 of JVT-C078 (picture parameter set) is nearly identical to Table 2 of the 818 Patent. For another example, Table 3.6.1 of JVT-C078 is nearly identical to Table 3 of the 818 Patent. For another example, Table 3.7.1 of JVT-C078 is nearly identical to Table 4 of the 818 Patent.

14. Similar to the 818 Patent, while we provided example entries in each of the parameter set tables described in JVT-C078, those tables were not meant to be comprehensive or to require that any specific parameter set contain the exact entries listed there as examples.

15. For example, Table 3.5.1 of JVT-C078 for the picture parameter set includes `picture_width_in_MBs_minus_1` and `picture_height_in_MBs_minus_1`. As we acknowledged in section 3.5.3 of JVT-C078, these parameters could be alternatively included in the sequence parameter set depending on whether the parameters ultimately would be allowed to change within a sequence or not.

16. Our invention of the 818 Patent, just like our description in JVT-C078, was not limited only to those specific parameters or parameter values being in the specific parameter sets that we list in our examples.

17. I understood at that time that our invention would work with more parameters, fewer parameters, or different parameters than the examples that we listed in our parameter sets.

18. Moreover, at the time, I understood that our invention would work with only a sequence parameter set, picture parameter set, and slice header, even though our proposal documents described an additional slice parameter set and presentation parameter set.

19. For example, in Section 3.10 Examples of JVT-C078, we list an example where only the sequence parameter set and picture parameter set are “coded and conveyed.” This is shown on page 10 of JVT-C078. While there is a place holder parameter_set_id for a presentation_parameter_set listed in the picture parameter set example table, in this example there is no presentation parameter set that is actually coded and conveyed to the decoder. Therefore, it is not received or used by the decoder. We are showing in this example an instance where it is not necessarily the case that all four of the sequence parameter set, picture parameter set, slice parameter set, and presentation parameter set need to be coded and conveyed to the decoder.

20. A key part of our invention was having multiple parameter sets, including a sequence parameter set and a picture parameter set. This is what we wrote down and publicly proposed in JVT-C078.

21. Prior to our invention, there was only a single parameter set concept, which was introduced in VCEG-N52, as we explained in the 818 Patent at column 1, lines 48-56 (I’ll note that the 818 Patent mistakenly lists VCEG-N55, but the

correct number is VCEG-N52). As we explained in the 818 Patent, VCEG-N52 eliminated the sequence header and picture header structures used in previous video coding standards at that time to store the sequence and picture parameters, respectively, and instead created a single parameter set for all of the sequence and picture parameters (and some slice parameters, as well). Unlike the sequence headers and picture headers, which were transmitted in band at predefined bitstream locations with respect to coded video data, the single parameter set could be transmitted out of band and separately from the rest of the video bitstream, which VCEG-N52 stated would be more reliable (page 3 of VCEG-N52).

22. However, Ye-Kui Wang and I discovered a problem with VCEG-N52's single parameter set concept. As we explained in the 818 Patent, for example at column 6, lines 50-59, with all of the sequence and picture parameters in a single parameter set, the entire parameter set must be transmitted any time even a single parameter value needed to be updated or changed. This results in a large amount of wasted resources and bandwidth to transmit parameter values that did not change.

23. For example, in VCEG-N52, in order to update the value of even a single picture parameter, which may change within a sequence of pictures, the entire parameter set must be transmitted. This would include all of the sequence parameters, which do not change within the sequence.

24. In view of this problem, Ye-Kui Wang and I invented the novel data structure hierarchy of having multiple parameter sets, including a sequence parameter set and a picture parameter set. Our invention allowed updating the values of picture parameters without having to transmit unchanged sequence parameters. This improved overall compression efficiency.

25. As shown by VCEG-N52, others in the field at the time had moved away from sequence headers and picture headers, and were advocating for consolidation of parameters into a single parameter set in order to transmit all of the parameters at one time (for example, the first bullet on page 8 of VCEG-N52).

26. Ye-Kui Wang and I were the first to discover the inefficiencies with the single parameter set concept and to propose multiple different parameter sets. After our proposal in JVT-C078 and JVT-C078 Annex A, others copied our idea of multiple parameter sets and proposed slightly tweaked versions of our idea at the next JVT meeting (for example, JVT-D087 by Sony).

27. Another key part of our invention was that at least one of the values of a picture parameter should use the slice header instead of the picture parameter set. This is because some values of picture parameters may change frequently, such as in every single picture, for example, the frame number (also called frame_num in the H.264 video coding standard that Ye-Kui Wang and I were working on at the time). If the frame number that is used for decoding pictures was only included in

the picture parameter set, then each picture in the video sequence would need its own unique picture parameter set to be transmitted for every picture. That kind of picture parameter set could never be used for more than one picture. That would result in overly repetitive transmissions of many picture parameters that did not change from picture to picture. That would not be efficient.

28. In JVT-C078 Annex A, we included a number of picture parameters in the slice header whose value would not change for a given picture. These include “picture type”, “temporal reference”, “picture structure”, and “picture number.”

29. I have been informed by counsel and understand that the Petitioner in this proceeding has stated that Gary Sullivan was the first to propose including the frame_num in the slice header in an email dated May 25, 2002, and which I understand has been marked as Exhibit 1026 in this proceeding. That is incorrect. I personally invented the definition of frame_num for H.264 and proposed that it be included in the slice header in JVT-C078 and JVT-C078 Annex A.

30. Specifically, prior to JVT-C078 Annex A, there was a parameter called Picture Number that was defined “for each coded and transmitted picture in transmission order.” This is shown in the redlined version of JVT-C078 Annex A, which I understand is marked as Exhibit 1027. I changed this definition to be “for each coded picture in coding order” instead. This new defined parameter was later

named “frame_num.” As seen on page 31 of JVT-C167 (which was the draft of the H.264 Standard at the end of the JVT Meeting where I presented JVT-C078 and JVT-C078 Annex A), the new frame_num parameter in the slice header, which I defined, appears for the first time.

31. I understand that JVT-C167 has been marked as Exhibit 2020 in this proceeding.

32. JVT-C167 states on the first page that it was generated on May 10, 2002. Around that time, it was available at least to everyone who participated in the 3rd meeting of the JVT in Fairfax, Virginia from May 6-10, 2002. It is currently available to anyone in the public, along with all of the other documents from the JVT meetings, at least on the ITU FTP (<https://www.itu.int/wftp3/av-arch/jvt-site/>).

33. Since the “frame_num” as I defined it appears in the slice header in JVT-C078 Annex A by Ye-Kui Wang and me, and in JVT-C167, which memorialized the “frame_num” term, it was not first introduced by Gary Sullivan weeks later on May 25, 2002. It was first introduced for H.264 by myself and Ye-Kui Wang in JVT-C078 Annex A.

34. Another part of our invention was that the slice header included a parameter set identifier (such as a picture parameter set identifier) to associate the slice header with the parameter sets used for decoding pictures. While the example

we provided in JVT-C078 Annex A gives the example of slice parameter set ID, Section 3.9 Slice Header on page 9 of JVT-C078 is more general and includes any “parameter set identifier in the slice header.” This includes, for example, a picture parameter set identifier.

35. Another part of our invention was that the picture parameter set included a parameter set identifier or identifiers (such as a sequence parameter set identifier) to associate the picture parameter set with the other parameter sets used for decoding pictures. The examples we provided in JVT-C078 were a sequence parameter set identifier and presentation parameter set identifier.

36. We proposed our invention in JVT-C078 and JVT-C078 Annex A to the JVT for incorporation into the H.264 Standard. We were confident at the time that our invention would work and would improve the compression efficiency of video coding.

37. Although we proposed four parameter sets at that time, we were confident at the time that our invention would work with just a sequence parameter set and picture parameter set and slice header, and would improve the compression efficiency of video coding.

38. On May 2, 2002, (in Finland time zone) I uploaded JVT-C078 and JVT-C078 Annex A to the JVT dropbox and emailed the JVT experts group to let everyone know that those documents were now available on the JVT FTP for

everyone to see. I have been informed by counsel that Mr. Karsten Suehring, who was the H.264 software coordinator at that time, maintained an archive of that email, which I have reviewed and understand has been marked by counsel as Exhibit 2048 in this proceeding. The original JVT-C078 and JVT-C078 Annex A that I submitted are still publicly available on the ITU FTP today.

39. During the 3rd meeting of the JVT in Fairfax, Virginia from May 6-10, 2002, I presented our proposal in JVT-C078 and JVT-C078 Annex A. This is memorialized on page 29 of JVT-C001d3, which is the Report from that meeting, written by Gary Sullivan, Ajay Luthra, and Thomas Wiegand. I have been informed by counsel that JVT-C001d3 has been marked as Exhibit 2005 in this proceeding.

40. JVT-C001d3 was available at least to everyone in the JVT group shortly after the meeting ended on May 10, 2002. It is currently available to anyone in the public, along with all of the other documents from the JVT meetings, at least on the ITU FTP (<https://www.itu.int/wftp3/av-arch/jvt-site/>).

41. As explained in the JVT Report on page 29 of JVT-C001d3, our proposal for the sequence parameter set was immediately adopted, but the other “proposed parameters were considered potentially unnecessary.” In other words, our picture parameter set was not immediately adopted by the JVT group.

42. After the 3rd meeting of the JVT in May 2002, Ye-Kui Wang and I continued to work diligently on our parameter sets proposal. We decided to focus our efforts on adding more detail to the picture parameter set and slice header syntax. We worked on these details up until the next JVT meeting in July 2002.

43. We drafted these additional details in a proposal document JVT-D094, dated July 17, 2002, and which I presented at the 4th meeting of the JVT in Klagenfurt, Austria from July 22-26, 2002. I understand that JVT-D094 has been marked by counsel as Exhibit 2006 in this proceeding.

44. While JVT-D094 lists an additional author, Mr. Young-Kwon Lim, he did not contribute to the parameter sets or slice header ideas that Ye-Kui Wang and I invented in JVT-C078 and JVT-C078 Annex A. Mr. Lim contributed only to the Section 6 Architecture part of JVT-D094, which is unrelated to the 818 Patent invention by Ye-Kui Wang and me.

45. In JVT-D094, Ye-Kui Wang and I again proposed our invention of the 818 Patent, which we originally proposed in JVT-C078. In the JVT-D094 proposal, we focused on having a sequence parameter set, picture parameter set, and slice header. While we again provided specific examples of parameters to be included in the picture parameter set and slice header, these examples were not meant to be comprehensive or to require that any specific parameter set or slice header contain the exact entries listed there as examples.

46. For example, on page 4 of JVT-D094, in the second bullet, we referred back to our proposal in JVT-C078 that the slice header include a picture parameter set id while the picture parameter set include a sequence parameter set id, which we referred to as an example of “nesting the identifiers.” In JVT-D094, Ye-Kui Wang and I acknowledged that “the bit-rate saving was considered as negligible” when compared to an alternative example of having both the sequence parameter set id and picture parameter set id included in the slice header. Nevertheless, we proposed both alternatives that would equally work.

47. On page 7 of JVT-D094, we continued to have the frame_num in the slice header, as I defined in JVT-C078 Annex A, but now acknowledged that the new name of the parameter was frame_num.

48. On July 17, 2002, (in Finland time zone) Ye-Kui Wang or I uploaded JVT-D094 to the JVT dropbox and emailed the JVT experts group to let everyone know that it was now available on the JVT FTP for everyone to see. I have been informed by counsel that Mr. Karsten Suehring, who was the H.264 software coordinator at that time, maintained an archive of that email, which I have reviewed and understand has been marked by counsel as Exhibit 2049 in this proceeding.

49. The same JVT-D094 that we wrote and uploaded in 2002 is also currently available to anyone in the public, along with all of the other documents

from the JVT meetings, at least on the ITU FTP (<https://www.itu.int/wftp3/av-arch/jvt-site/>).

50. During the 4th meeting of the JVT in Klagenfurt, Austria from July 22-26, 2002, I presented our proposal in JVT-D094. This is memorialized on page 32 of JVT-D001d0, which is the Report from that meeting, written by Gary Sullivan, Ajay Luthra, and Thomas Wiegand, which expressly refers to our “picture parameter set” and “slice header” proposals. I have been informed by counsel that JVT-D001d0 has been marked as Exhibit 2007 in this proceeding.

51. JVT-D001d0 was available at least to everyone in the JVT group shortly after the meeting ended on July 26, 2002. It is currently available to anyone in the public, along with all of the other documents from the JVT meetings, at least on the ITU FTP (<https://www.itu.int/wftp3/av-arch/jvt-site/>).

52. We proposed our invention of the 818 Patent in JVT-D094 to the JVT for incorporation into the H.264 Standard. We were confident at the time that our invention would work and would improve the compression efficiency of video coding.

53. As explained on page 32 of that JVT-D001d0 meeting report, our proposal JVT-D094 was “Covered in high-level syntax output.” And as explained on pages 50-51 and 57 of the JVT-D001d0 meeting report, the high-level syntax output document was JVT-D145. There are also revisions to the meeting report

(JVT-D001d1 and JVT-D001d2) available on the ITU FTP today that reflect the same information as in JVT-D001d0.

54. I was the contact person for the JVT-D145 document, which was the output proposal of a special high-level syntax breakout group at the JVT meeting. I was the chair of that breakout group, and I personally recall from that breakout group that JVT-D145 incorporated the ideas proposed by Ye-Kui Wang and me in JVT-C078, JVT-C078 Annex A, and JVT-D094. Therefore, JVT-D145 incorporated our invention of the 818 Patent. This can be seen from the sequence parameter set, picture parameter set, and slice header syntax on pages 2-4 and throughout the JVT-D145 document.

55. I have been informed by counsel and understand that the Petitioner in this proceeding may argue that Sony's proposal in JVT-D087 was adopted instead of our JVT-C078, JVT-C078 Annex A, and JVT-D094 proposals. That is incorrect. I was the chair of the breakout group that produced JVT-D145. Sony's proposal in JVT-D087 for a "slice parameter set" was not adopted, as neither JVT-D145 nor the H.264 Standard include a "slice parameter set." It is our picture parameter set from JVT-C078, JVT-C078 Annex A, and JVT-D094 that was adopted into JVT-D145 and the H.264 Standard.

56. JVT-D145 states on its first page that it was generated on July 25, 2002. JVT-D145 was available at least to everyone in the JVT group around that

time. It is currently available to anyone in the public, along with all of the other documents from the JVT meetings, at least on the ITU FTP

(<https://www.itu.int/wftp3/av-arch/jvt-site/>).

57. JVT-D145 was adopted and incorporated into the next working draft of the H.264 Standard at that time, which was memorialized as JVT-D157. JVT-D157 is dated on the cover page as August 10, 2002, which was shortly after the 4th meeting of the JVT in Klagenfurt, Austria. I have been informed by counsel that JVT-D157 has been marked as Exhibit 2026 in this proceeding.

58. It was my understanding at the time that once our invention of the 818 Patent had been adopted into the H.264 Standard that Mr. Karsten Suehring would coordinate the implementation of our invention into the H.264 Reference Software, which provided a working encoder and decoder software implementation. As the software coordinator for the JVT, Mr. Suehring had the authorization and approval of Ye-Kui Wang and myself to implement our invention into the H.264 Reference Software.

59. As explained on pages 58-59 of the JVT-D001d0 meeting report, the JVT (including Ye-Kui Wang and myself) specifically instructed Mr. Suehring to schedule the implementation of our adopted inventions into the H.264 Reference Software.

60. As the software coordinator, Mr. Suehring typically assigned out code implementations and then coordinated the overall integration of the code into a working H.264 Reference Software.

61. Because I was the chair of the high-level syntax breakout group and the contact person for JVT-D145, Mr. Suehring initially assigned me to implement all of the code for JVT-D145. However, JVT-D145 included many other concepts beyond the invention of the 818 Patent that I was not the author of, so I informed Mr. Suehring that I could not implement JVT-D145 as requested. Instead, I delegated implementation of JVT-D145 (including our invention of the 818 Patent) to Mr. Suehring to find someone else to implement the code on behalf of Ye-Kui Wang and me.

62. I have been informed by counsel that Mr. Suehring maintained an archive of my email to him, which I have reviewed and understand has been marked by counsel as Exhibit 2068 in this proceeding.

63. Following my delegation of implementation to him, Mr. Suehring eventually involved Dr. Stephan Wenger to code the JVT-D145 implementation, including the invention of the 818 Patent, on behalf of Ye-Kui Wang and me.

64. During Dr. Wenger's implementation of JVT-D145, he contacted Ye-Kui Wang and me to ask about certain features related to the high-level syntax. This demonstrated to me that he understood that he was implementing JVT-D145,

including the invention of the 818 Patent, on behalf of Ye-Kui Wang and me. Mr. Suehring and Dr. Wenger had the authorization and approval of Ye-Kui Wang and me to implement our invention into the H.264 Reference Software.

65. I have been informed by counsel that Mr. Suehring maintained an archive of emails that include correspondence between Dr. Wenger, Ye-Kui Wang, and me that were forwarded to him, which I have reviewed and understand has been marked by counsel as Exhibit 2435 in this proceeding. I am also informed by counsel that the final email in the thread between Dr. Wenger and Mr. Suehring was originally in German and that the Exhibit was a certified translation. However, the part that was in German was only between Dr. Wenger and Mr. Suehring, which I never saw. The important correspondence between Dr. Wenger, Ye-Kui Wang, and me was in English.

66. Eventually, the H.264 Reference Software version that included JVT-D145 was completed, and Mr. Suehring circulated the code to the JVT group on December 24, 2002. Mr. Suehring stated in that email: “We now have a software that supports picture and sequence parameter sets.”

67. Although I was already confident that our invention would work in the code as we intended it to, I knew that Mr. Suehring also tested the code as a part of his job duties. It was my expectation when we authorized and delegated the code implementation to Mr. Suehring that he would test, debug, and ensure that it

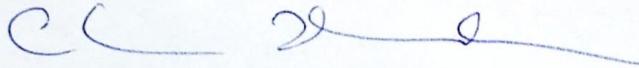
would work as intended in the adopted proposals. Mr. Suehring confirmed that he did so in his emails. Therefore, based upon receiving that email, at that time I understood that we had a working implementation of our adopted JVT proposals, including the invention that would become the 818 Patent.

68. I have been informed by counsel that Mr. Suehring maintained an archive of that email, which I have reviewed and understand has been marked by counsel as Exhibits 2450 and 2451 in this proceeding.

69. I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code.

Executed this 28th day of January, 2025.

Respectfully submitted,

A handwritten signature in blue ink, consisting of a series of loops and a long horizontal stroke.

Miska Hannuksela