

Exhibit D9 – Invalidity of U.S. Patent No. 8,982,691 in view of Park – “Design of a dynamic path protection mechanism in MPLS networks”

INVALIDITY CLAIM CHART

Invalidity of U.S. Patent No. 8,982,691 in view of Park – “Design of a dynamic path protection mechanism in MPLS networks”

“Design of a dynamic path protection mechanism in MPLS networks”(“Park”) was published on July 19, 2007, from an application filed on January 18, 2006. Park therefore constitutes prior art under at least 35 U.S.C. §§ 102(a), 102(b) and 102(e). Park anticipates and/or renders obvious the Asserted Claims of the U.S. Patent No. 8,982,691, either alone or in combination with one or more of the references identified in Defendant’s Cover Pleading.

To the extent WSOU argues that any element below is not disclosed by Park, a person of ordinary skill in the art would have found it obvious to combine the teachings of Park with the background knowledge of a person of ordinary skill in the art and/or the additional references, and exemplary teachings, set forth in Appendix D.

The chart below provides representative examples of where each element of each claim is found within Park. Citations are meant to be exemplary, not exhaustive, and Defendant reserves the right to identify and discuss additional portions of the reference in support of its contentions and/or to rebut arguments made by WSOU. Citations to figures, drawings, tables, and the like include reference to any accompanying or related text. All internal cross references are meant to incorporate the cross-referenced material as if fully set forth therein.

It is Defendant’s position that WSOU’s Preliminary Infringement Contentions have not established that any accused product or service infringes any valid claim. Thus, Defendant’s statements below should not be treated as an admission, implication, or suggestion that Defendant agrees with WSOU regarding either the scope, construction, or interpretation of any of the Asserted Claims or the infringement theories advanced by WSOU in its Preliminary Infringement Contentions, including whether any Asserted Claim satisfies 35 U.S.C. §§ 101 or 112. In certain cases, Defendant specifies non-limiting examples of where its application of the prior art is based on WSOU’s apparent application of the claim element. These statements are not intended to suggest that Defendant agrees with WSOU’s application of any claim term, suggest a proposed construction at this stage of the case, or suggest that construction is needed, as the parties are not required to exchange terms for construction or proposed constructions until a later date.

WSOU has yet to identify any limitation of the Asserted Claims that it contends is not anticipated and/or rendered obvious by Park. Defendant therefore expressly reserves the right to respond to any such contention, including by identifying additional obviousness combinations, if WSOU makes any such contention.

Where Defendant states that Park “discloses” a limitation, that disclosure may be express, implicit, and/or inherent.

Exhibit D9 – Invalidity of U.S. Patent No. 8,982,691 in view of Park – “Design of a dynamic path protection mechanism in MPLS networks”

Claim	Disclosure
[1pre] A method performed by a network processor of a Multiprotocol Label Switching (MPLS) label switch router for providing a Backup Label Switched Path (LSP) to a Bypass LSP already established for a Protected Primary LSP, the method comprising the steps of:	To the extent the preamble is limiting, Park discloses a method performed by a network processor of a Multiprotocol Label Switching (MPLS) label switch router for providing a Backup Label Switched Path (LSP) to a Bypass LSP already established for a Protected Primary LSP. <i>See, e.g.:</i> In this paper, we propose a dynamic MPLS path protection. which needs not extend signaling protocol and can support high reliability with bypassing traffic beyond the failures quickly. The proposed mechanism chooses an appropriate path from already established paths instead of not setting-up new backup path dynamically. By such characteristics, the proposed mechanism shows a high reliability for fast path protection is capable. <i>(Page No. 01)</i> 2.2 Path Protection In MPLS networks, an LSP path is setup by signaling protocols as LDP (Label Distribution Protocol)/CR-LDP (Constraint Routing Label Distribution Protocol)/RSVP-TE(RSW-Traffic Engineering). An LSR monitors the already setup LSP path. In case of the LSR detects failure, signaling protocol notifies such failure to upstream nodes and neighbor nodes. The LSR is called PLR (Point of Local Repair). <i>(Page No. 02)</i> Among signaling protocols, LDP transmits failure information by using label request abort label withdraw, label release and notification messages. On the other hands, RSP-TE protocol transmits failure information by using path error and reservation error messages. After an LSR receives failure notification, it is trying to setup new LSP by signaling protocol overcoming network failure. In path protection mechanism, newly established LSP is called an alternative path which to protect the primary path. <i>(Page No. 02)</i> The diagram shows a network topology for MPLS path protection. It features several routers represented by icons with an 'X'. A primary path is shown at the top, consisting of three routers connected in a line. A failure is indicated by a large 'X' on the link between the first and second routers. An alternative path is shown below it, consisting of three routers connected in a line. The diagram is labeled 'End-to-end path protection' and 'Local protection'. Figure 3. MPLS path protection

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	The path protection can be divided into two mechanisms depending on the time when backup LSP is established: pre-failure protection and post-failure protection. Figure 3 shows these two methods [8,9] The pre-failure protection mechanism needs to explicitly configure a backup path for a primary path regardless of failure. Though this mechanism guarantees that traffic quickly bypass failure in network, it wastes network resources. Another mechanism suggests sharing a backup path with N primary paths. However, such mechanism 'has a disadvantage that it is difficult to manage the primary paths and the backup path, also cannot guarantee reliability in case of failure in two all paths. (Page No. 02) For providing fast path protection, pre-failure path protection mechanisms are also classified into end-to-end protection and local protection according to protection range. In the end-to-end protection, PLR which the node detect failure notifies to upstream nodes. As the result, the ingress node gets the information about failure. For bypassing the failure point, it transmits the traffic to a pre-configured backup LSP and reconfigures the primary path. This end-to-end protection mechanism cannot guarantee fast path protection because of notifying process. (Page No. 03) In local path protection, every node needs to pre-establish a backup LSP for any node may be PLR. After an LSR detects the failure, the PLR uses such a backup LSP first bypassing failure. And the PLR transmits failure notification to an ingress node in order to setting-up another primary path. This mechanism needs to extend RSVP-TE protocol, like as RRO(record route object) to setup backup LSP to next hop(Nhop) for link fault and next next hop(NNhops) for node fault [5]. In Figure 4, one LSP(R1-R2-R3-R4-R5-R6) can be protected by five small backup LSPs. (Page No. 03) 4. Dynamic path protection mechanism In this section, we propose a dynamic path protection mechanism which needs not extend signaling protocol. For fast path protection, an implementation method of our proposed mechanism is explained. 4.1 Dynamic path protection Our dynamic path protection mechanism chooses the alternative path which is temporary path to minimize loss. For reliability of the path protection mechanism largely depends on duration setting-up a backup LSP. In our mechanism, one of working LSPs is used as an alternative path in any PLR

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	which detect failure. Traffic is bypassed on the chosen running LSP after the corresponding MPLS forwarding tables are changed. The proposed mechanism selects one of LSPs which have the same destination as the primary LSP does. If there are many LSPs, only one LSP are selected by the following order: 1 The LSP which has the least utilization. 2 The LSP with the least RX/TX packets in any interface, if utilization of each LSP is not known. 3 The best effort LSP, if there is still a tie. 4 The LSP which is not selected as a backup LSP before, if there is still a tie. 5 One LSP at random if there is still a tie. Figure 5. Example of path failure Figure 5 shows that there are three LSPs to same destination R5: R1-R2-R3-R4-R5, R1-R2- R6-R7-R4-R5, R1-R2-R8-R9-R10-R4-R5. (Page No. 03) In-Segment Table <table><tr><th>Intf</th><th>Label</th><th>OP Code</th><th>BA Table</th><th>XC index</th><th>Target</th><th>Pbase</th></tr><tr><td>a</td><td>14</td><td>swap</td><td>.</td><td>1</td><td>1</td><td>.</td></tr><tr><td>a</td><td>10</td><td>swap</td><td>.</td><td>2</td><td>1</td><td>.</td></tr><tr><td>a</td><td>19</td><td>swap</td><td>.</td><td>3</td><td>1</td><td>.</td></tr><tr><td colspan="7">⋮</td></tr></table> Out-Segment Table <table><tr><th>XC Index</th><th>Out port</th><th>Label 1</th><th>Qbase</th><th>PHB Table</th><th>NH MAC</th></tr><tr><td>1</td><td>1</td><td>15</td><td>.</td><td>.</td><td>M1</td></tr><tr><td>2</td><td>2</td><td>11</td><td>.</td><td>.</td><td>M2</td></tr><tr><td>3</td><td>3</td><td>20</td><td>.</td><td>.</td><td>M3</td></tr><tr><td colspan="6">⋮</td></tr></table> Figure 6. MPLS forwarding information in transit node R2	Intf	Label	OP Code	BA Table	XC index	Target	Pbase	a	14	swap	.	1	1	.	a	10	swap	.	2	1	.	a	19	swap	.	3	1	.	⋮							XC Index	Out port	Label 1	Qbase	PHB Table	NH MAC	1	1	15	.	.	M1	2	2	11	.	.	M2	3	3	20	.	.	M3	⋮					
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	The node R2 is a transit node in each LSP, has in/out-segment tables. R2 transmits packets with changing their labels to "11", "15" and "20" according their different upstream. In ordinary situation, when the ingress router R1 forwards a packet down the LSP, it imposes a label "14" and transmits the packet to R2 in the forwarding plane. The transit node R2 swaps "14" to "11" and sends it to R3. When R2 receive packets with label "10" and "19" it swap "15", "20" and forward to R6 and R8. The In/out-segment tables for the forwarding plane are shown in Figure 6. (Page No. 03) Figure 7. MPLS forwarding information in transit node R2 after detecting failure 4.2 Implementation of our path protection in PLR When the primary path(R1-R2-R3-R4-R5) fails at node R3 or link R2-R3, R2 detect failure and become PLR. If the PLR R2 selects R6-R7-R4-R5 as an alternative LSP, R2 modifies out-segment and deletes primary LSP entry in the in-segment table. R2 is transit node for primary LSP R1-R2-R3-R4-R5. If the PLR is ingress, it changes ftn table. The figure 7 shows in/out-segment tables when R2 runs as RLR. (Page No. 04) When the PLR has both primary path failure and backup path failure, it selects another backup LSP we just mentioned. If the PLR R2 has two failures: R1-R2-R3-R4-R5 for primary path and R1-R2-R6-R7-R4-R5 for secondary path, it can select other backup LSP to R1-R2-R8-R9- R10-R4-R5 LSP. (Page No. 04) The proposed MPLS path protection mechanism has benefits that can switch over quickly from the primary path to an alternative path and can share a secondary LSP depending on path protection policy. (Page No. 04) The proposed mechanism can guarantee that bypass traffic quickly and need not extend signaling protocols. And it can share the backup LSP with several primary LSPs. Also it can protect multiple

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[1a] protecting the Primary LSP against dual failures, comprising:	failures at the same time. <i>(Page No. 04)</i> Park discloses protecting the Primary LSP against dual failures. <i>See, e.g.:</i> 4.1 Dynamic path protection Our dynamic path protection mechanism chooses the alternative path which is temporary path to minimize loss. For reliability of the path protection mechanism largely depends on duration setting-up a backup LSP. In our mechanism, one of working LSPs is used as an alternative path in any PLR which detect failure. Traffic is bypassed on the chosen running LSP after the corresponding MPLS forwarding tables are changed. The proposed mechanism selects one of LSPs which have the same destination as the primary LSP does. If there are many LSPs, only one LSP are selected by the following order: 1 The LSP which has the least utilization. 2 The LSP with the least RX/TX packets in any interface, if utilization of each LSP is not known. 3 The best effort LSP, if there is still a tie. 4 The LSP which is not selected as a backup LSP before, if there is still a tie. 5 One LSP at random if there is still a tie. Figure 5. Example of path failure Figure 5 shows that there are three LSPs to same destination R5: R1-R2-R3-R4-R5, R1-R2- R6-R7-R4-R5, R1-R2-R8-R9-R10-R4-R5. <i>(Page No. 03)</i>

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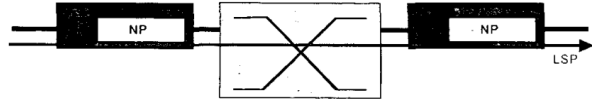
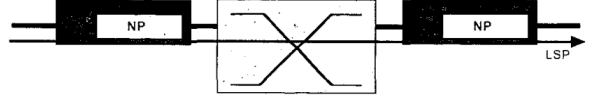
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[1b] establishing the Bypass LSP for the Protected Primary LSP having a Point of Local Repair node and a Merge Point node;	Park discloses establishing the Bypass LSP for the Protected Primary LSP having a Point of Local Repair node and a Merge Point node. <i>See, e.g.:</i> 4.1 Dynamic path protection Our dynamic path protection mechanism chooses the alternative path which is temporary path to minimize loss. For reliability of the path protection mechanism largely depends on duration setting-up a backup LSP. In our mechanism, one of working LSPs is used as an alternative path in any PLR which detect failure. Traffic is bypassed on the chosen running LSP after the corresponding MPLS forwarding tables are changed. The proposed mechanism selects one of LSPs which have the same destination as the primary LSP does. If there are many LSPs, only one LSP are selected by the following order: 1 The LSP which has the least utilization. 2 The LSP with the least RX/TX packets in any interface, if utilization of each LSP is not known. 3 The best effort LSP, if there is still a tie. 4 The LSP which is not selected as a backup LSP before, if there is still a tie. 5 One LSP at random if there is still a tie.

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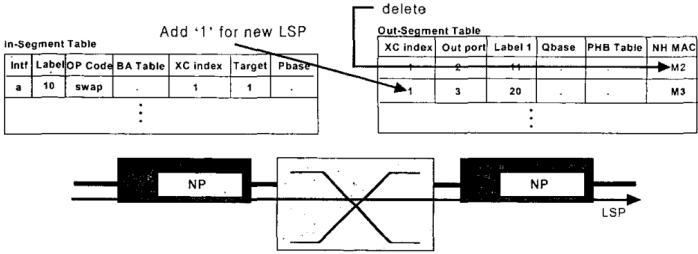
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[1c] obtaining the nodes traversed by an end-to-end path of said Bypass LSP from said Point of Local Repair Node to said Merge Point node;	Park discloses obtaining the nodes traversed by an end-to-end path of said Bypass LSP from said Point of Local Repair Node to said Merge Point node. <i>See, e.g.:</i>

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	4.1 Dynamic path protection Our dynamic path protection mechanism chooses the alternative path which is temporary path to minimize loss. For reliability of the path protection mechanism largely depends on duration setting-up a backup LSP. In our mechanism, one of working LSPs is used as an alternative path in any PLR which detect failure. Traffic is bypassed on the chosen running LSP after the corresponding MPLS forwarding tables are changed. The proposed mechanism selects one of LSPs which have the same destination as the primary LSP does. If there are many LSPs, only one LSP are selected by the following order: 1 The LSP which has the least utilization. 2 The LSP with the least RX/TX packets in any interface, if utilization of each LSP is not known. 3 The best effort LSP, if there is still a tie. 4 The LSP which is not selected as a backup LSP before, if there is still a tie. 5 One LSP at random if there is still a tie. Figure 5. Example of path failure Figure 5 shows that there are three LSPs to same destination R5: R1-R2-R3-R4-R5, R1-R2- R6-R7-R4-R5, R1-R2-R8-R9-R10-R4-R5. (Page No. 03)

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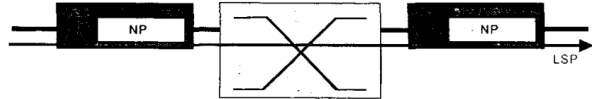
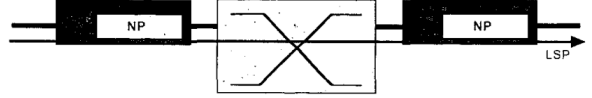
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[1d] generating a request to a path calculator using the nodes traversed by said end-to-end path of said Bypass LSP for a disjoint path connecting said Point of Local Repair Node to said Merge Point node;	Park discloses generating a request to a path calculator using the nodes traversed by said end-to-end path of said Bypass LSP for a disjoint path connecting said Point of Local Repair Node to said Merge Point node. <i>See, e.g.:</i> In this paper, we propose a dynamic MPLS path protection. which needs not extend signaling protocol and can support high reliability with bypassing traffic beyond the failures quickly. The proposed mechanism chooses an appropriate path from already established paths instead of not setting-up new backup path dynamically. By such characteristics, the proposed mechanism shows a high reliability for fast path protection is capable. <i>(Page No. 01)</i> 2.2 Path Protection In MPLS networks, an LSP path is setup by signaling protocols as LDP (Label Distribution Protocol)/CR-LDP (Constraint Routing Label Distribution Protocol)/RSVP-TE(RSW-Traffic Engineering). An LSR monitors the already setup LSP path. In case of the LSR detects failure, signaling protocol notifies such failure to upstream nodes and neighbor nodes. The LSR is called PLR (Point of Local Repair). <i>(Page No. 02)</i> Among signaling protocols, LDP transmits failure information by using label request abort label withdraw, label release and notification messages. On the other hands, RSP-TE protocol transmits failure information by using path error and reservation error messages. After an LSR receives

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	R4-R5, R1-R2-R8-R9-R10-R4-R5. (Page No. 03) In-Segment Table <table><tr><th>Intf</th><th>Label</th><th>OP Code</th><th>BA Table</th><th>XC index</th><th>Target</th><th>Pbase</th></tr><tr><td>a</td><td>14</td><td>swap</td><td>.</td><td>1</td><td>1</td><td>.</td></tr><tr><td>a</td><td>10</td><td>swap</td><td>.</td><td>2</td><td>1</td><td>.</td></tr><tr><td>a</td><td>19</td><td>swap</td><td>.</td><td>3</td><td>1</td><td>.</td></tr><tr><td colspan="7">⋮</td></tr></table> Out-Segment Table <table><tr><th>XC index</th><th>Out port</th><th>Label 1</th><th>Qbase</th><th>PHB Table</th><th>NH MAC</th></tr><tr><td>1</td><td>1</td><td>15</td><td>.</td><td>.</td><td>M1</td></tr><tr><td>2</td><td>2</td><td>11</td><td>.</td><td>.</td><td>M2</td></tr><tr><td>3</td><td>3</td><td>20</td><td>.</td><td>.</td><td>M3</td></tr><tr><td colspan="6">⋮</td></tr></table> Figure 6. MPLS forwarding information in transit node R2 The node R2 is a transit node in each LSP, has in/out-segment tables. R2 transmits packets with changing their labels to "11", " 15" and "20" according their different upstream. In ordinary situation, when the ingress router R1 forwards a packet down the LSP, it imposes a label "14" and transmits the packet to R2 in the forwarding plane. The transit node R2 swaps "14" to "11" and sends it to R3. When R2 receive packets with label "10" and "19" it swap "15", "20" and forward to R6 and R8. The In/out-segment tables for the forwarding plane are shown in Figure 6. (Page No. 03) In-Segment Table <table><tr><th>Intf</th><th>Label</th><th>OP Code</th><th>BA Table</th><th>XC index</th><th>Target</th><th>Pbase</th></tr><tr><td>a</td><td>10</td><td>swap</td><td>.</td><td>1</td><td>1</td><td>.</td></tr><tr><td colspan="7">⋮</td></tr></table> Out-Segment Table <table><tr><th>XC index</th><th>Out port</th><th>Label 1</th><th>Qbase</th><th>PHB Table</th><th>NH MAC</th></tr><tr><td>1</td><td>3</td><td>20</td><td>.</td><td>.</td><td>M3</td></tr><tr><td colspan="6">⋮</td></tr></table> delete Add '1' for new LSP Figure 7. MPLS forwarding information in transit node R2 after detecting failure 4.2 Implementation of our path protection in PLR When the primary path(R1-R2-R3-R4-R5) fails at node R3 or link R2-R3, R2 detect failure and become PLR. If the PLR R2 selects R6-R7-R4-R5 as an alternative LSP, R2 modifies out-segment and deletes primary LSP entry in the in-segment table. R2 is transit node for primary LSP R1-R2-R3-R4-R5. If the PLR is ingress, it changes ftn table. The figure 7 shows in/out-segment tables	Intf	Label	OP Code	BA Table	XC index	Target	Pbase	a	14	swap	.	1	1	.	a	10	swap	.	2	1	.	a	19	swap	.	3	1	.	⋮							XC index	Out port	Label 1	Qbase	PHB Table	NH MAC	1	1	15	.	.	M1	2	2	11	.	.	M2	3	3	20	.	.	M3	⋮						Intf	Label	OP Code	BA Table	XC index	Target	Pbase	a	10	swap	.	1	1	.	⋮							XC index	Out port	Label 1	Qbase	PHB Table	NH MAC	1	3	20	.	.	M3	⋮					
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	when R2 runs as RLR. <i>(Page No. 04)</i> When the PLR has both primary path failure and backup path failure, it selects another backup LSP we just mentioned. If the PLR R2 has two failures: R1-R2-R3-R4-R5 for primary path and R1-R2-R6-R7-R4-R5 for secondary path, it can select other backup LSP to R1-R2-R8-R9- R10-R4-R5 LSP. <i>(Page No. 04)</i> The proposed MPLS path protection mechanism has benefits that can switch over quickly from the primary path to an alternative path and can share a secondary LSP depending on path protection policy. <i>(Page No. 04)</i> The proposed mechanism can guarantee that bypass traffic quickly and need not extend signaling protocols. And it can share the backup LSP with several primary LSPs. Also it can protect multiple failures at the same time. <i>(Page No. 04)</i>
[1f] in response to determining that a fully disjoint path connecting said Point of Local Repair Node to said Merge Point node is available, signaling, to at least one other MPLS label switch router, said fully disjoint path as the Backup LSP to said Bypass LSP.	Park discloses, in response to determining that a fully disjoint path connecting said Point of Local Repair Node to said Merge Point node is available, signaling, to at least one other MPLS label switch router, said fully disjoint path as the Backup LSP to said Bypass LSP. <i>See, e.g.:</i> In this paper, we propose a dynamic MPLS path protection. which needs not extend signaling protocol and can support high reliability with bypassing traffic beyond the failures quickly. The proposed mechanism chooses an appropriate path from already established paths instead of not setting-up new backup path dynamically. By such characteristics, the proposed mechanism shows a high reliability for fast path protection is capable. <i>(Page No. 01)</i> 2.2 Path Protection In MPLS networks, an LSP path is setup by signaling protocols as LDP (Label Distribution Protocol)/CR-LDP (Constraint Routing Label Distribution Protocol)/RSVP-TE(RSW-Traffic Engineering). An LSR monitors the already setup LSP path. In case of the LSR detects failure, signaling protocol notifies such failure to upstream nodes and neighbor nodes. The LSR is called PLR (Point of Local Repair). <i>(Page No. 02)</i> Among signaling protocols, LDP transmits failure information by using label request abort label

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	withdraw, label release and notification messages. On the other hands, RSP-TE protocol transmits failure information by using path error and reservation error messages. After an LSR receives failure notification, it is trying to setup new LSP by signaling protocol overcoming network failure. In path protection mechanism, newly established LSP is called an alternative path which to protect the primary path. (Page No. 02) Figure 3. MPLS path protection The path protection can be divided into two mechanisms depending on the time when backup LSP is established: pre-failure protection and post-failure protection. Figure 3 shows these two methods [8,9] The pre-failure protection mechanism needs to explicitly configure a backup path for a primary path regardless of failure. Though this mechanism guarantees that traffic quickly bypass failure in network, it wastes network resources. Another mechanism suggests sharing a backup path with N primary paths. However, such mechanism 'has a disadvantage that it is difficult to manage the primary paths and the backup path, also cannot guarantee reliability in case of failure in two all paths. (Page No. 02) For providing fast path protection, pre-failure path protection mechanisms are also classified into end-to-end protection and local protection according to protection range. In the end-to-end protection, PLR which the node detect failure notifies to upstream nodes. As the result, the ingress node gets the information about failure. For bypassing the failure point, it transmits the traffic to a pre-configured backup LSP and reconfigures the primary path. This end-to-end protection mechanism cannot guarantee fast path protection because of notifying process. (Page No. 03) In local path protection, every node needs to pre-establish a backup LSP for any node may be PLR. After an LSR detects the failure, the PLR uses such a backup LSP first bypassing failure. And the PLR transmits failure notification to an ingress node in order to setting-up another primary path. This mechanism needs to extend RSVF-TE protocol, like as R.RO(record route object) to setup

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	backup LSP to next hop(Nhop) for link fault and next next hop(NNhops) for node fault [5]. In Figure 4, one LSP(R1-R2-R3-R4-R5-R6) can be protected by five small backup LSPs. (Page No. 03) 4. Dynamic path protection mechanism In this section, we propose a dynamic path protection mechanism which needs not extend signaling protocol. For fast path protection, an implementation method of our proposed mechanism is explained. 4.1 Dynamic path protection Our dynamic path protection mechanism chooses the alternative path which is temporary path to minimize loss. For reliability of the path protection mechanism largely depends on duration setting-up a backup LSP. In our mechanism, one of working LSPs is used as an alternative path in any PLR which detect failure. Traffic is bypassed on the chosen running LSP after the corresponding MPLS forwarding tables are changed. The proposed mechanism selects one of LSPs which have the same destination as the primary LSP does. If there are many LSPs, only one LSP are selected by the following order: 1 The LSP which has the least utilization. 2 The LSP with the least RX/TX packets in any interface, if utilization of each LSP is not known. 3 The best effort LSP, if there is still a tie. 4 The LSP which is not selected as a backup LSP before, if there is still a tie. 5 One LSP at random if there is still a tie. The diagram illustrates a network topology for path protection. A primary path consists of routers R1, R2, R3, R4, and R5. A backup path consists of routers R1, R2, R6, R7, R4, and R5. R2 is labeled as a PLR (Primary Label Switching Path). A failure is indicated on the link between R2 and R3, represented by a crossed-out line. The diagram shows how traffic can be rerouted from the primary path to the backup path upon failure. Figure 5. Example of path failure

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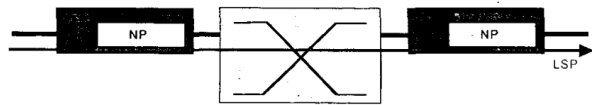
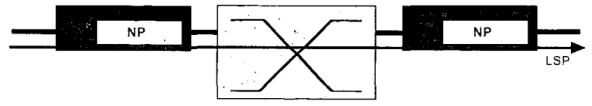
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	Figure 5 shows that there are three LSPs to same destination R5: R1-R2-R3-R4-R5, R1-R2- R6-R7-R4-R5, R1-R2-R8-R9-R10-R4-R5. (Page No. 03) <table><caption>In-Segment Table</caption><tr><th>Intf</th><th>Label</th><th>OP Code</th><th>BA Table</th><th>XC index</th><th>Target</th><th>Pbase</th></tr><tr><td>a</td><td>14</td><td>swap</td><td>.</td><td>1</td><td>1</td><td>.</td></tr><tr><td>a</td><td>10</td><td>swap</td><td>.</td><td>2</td><td>1</td><td>.</td></tr><tr><td>a</td><td>19</td><td>swap</td><td>.</td><td>3</td><td>1</td><td>.</td></tr><tr><td colspan="7">⋮</td></tr></table> <table><caption>Out-Segment Table</caption><tr><th>XC index</th><th>Out port</th><th>Label 1</th><th>Qbase</th><th>PHB Table</th><th>NH MAC</th></tr><tr><td>1</td><td>1</td><td>15</td><td>.</td><td>.</td><td>M1</td></tr><tr><td>2</td><td>2</td><td>11</td><td>.</td><td>.</td><td>M2</td></tr><tr><td>3</td><td>3</td><td>20</td><td>.</td><td>.</td><td>M3</td></tr><tr><td colspan="6">⋮</td></tr></table>  Figure 6. MPLS forwarding information in transit node R2 The node R2 is a transit node in each LSP, has in/out-segment tables. R2 transmits packets with changing their labels to "11", " 15" and "20" according their different upstream. In ordinary situation, when the ingress router R1 forwards a packet down the LSP, it imposes a label "14" and transmits the packet to R2 in the forwarding plane. The transit node R2 swaps "14" to "11" and sends it to R3. When R2 receive packets with label "10" and "19" it swap "15", "20" and forward to R6 and R8. The In/out-segment tables for the forwarding plane are shown in Figure 6. (Page No. 03) <table><caption>In-Segment Table</caption><tr><th>Intf</th><th>Label</th><th>OP Code</th><th>BA Table</th><th>XC index</th><th>Target</th><th>Pbase</th></tr><tr><td>a</td><td>10</td><td>swap</td><td>.</td><td>1</td><td>1</td><td>.</td></tr><tr><td colspan="7">⋮</td></tr></table> Add '1' for new LSP <table><caption>Out-Segment Table</caption><tr><th>XC index</th><th>Out port</th><th>Label 1</th><th>Qbase</th><th>PHB Table</th><th>NH MAC</th></tr><tr><td>1</td><td>2</td><td>11</td><td>.</td><td>.</td><td>M2</td></tr><tr><td>1</td><td>3</td><td>20</td><td>.</td><td>.</td><td>M3</td></tr><tr><td colspan="6">⋮</td></tr></table>  Figure 7. MPLS forwarding information in transit node R2 after detecting failure 4.2 Implementation of our path protection in PLR When the primary path(R1-R2-R3-R4-R5) fails at node R3 or link R2-R3, R2 detect failure and become PLR. If the PLR R2 selects R6-R7-R4-R5 as an alternative LSP, R2 modifies out-segment and deletes primary LSP entry in the in-segment table. R2 is transit node for primary LSP R1-R2-	Intf	Label	OP Code	BA Table	XC index	Target	Pbase	a	14	swap	.	1	1	.	a	10	swap	.	2	1	.	a	19	swap	.	3	1	.	⋮							XC index	Out port	Label 1	Qbase	PHB Table	NH MAC	1	1	15	.	.	M1	2	2	11	.	.	M2	3	3	20	.	.	M3	⋮						Intf	Label	OP Code	BA Table	XC index	Target	Pbase	a	10	swap	.	1	1	.	⋮							XC index	Out port	Label 1	Qbase	PHB Table	NH MAC	1	2	11	.	.	M2	1	3	20	.	.	M3	⋮					
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[2] A method as claimed in claim 1, wherein said path calculator is a constraint based shortest path first calculator.	<i>See claim 1 supra.</i> Park discloses that said path calculator is a constraint based shortest path first calculator. <i>See, e.g.:</i> In this paper, we propose a dynamic MPLS path protection. which needs not extend signaling protocol and can support high reliability with bypassing traffic beyond the failures quickly. The proposed mechanism chooses an appropriate path from already established paths instead of not setting-up new backup path dynamically. By such characteristics, the proposed mechanism shows a high reliability for fast path protection is capable. <i>(Page No. 01)</i> 2.2 Path Protection In MPLS networks, an LSP path is setup by signaling protocols as LDP (Label Distribution Protocol)/CR-LDP (Constraint Routing Label Distribution Protocol)/RSVP-TE(RSW-Traffic Engineering). An LSR monitors the already setup LSP path. In case of the LSR detects failure, signaling protocol notifies such failure to upstream nodes and neighbor nodes. The LSR is called

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	Figure 7. MPLS forwarding information in transit node R2 after detecting failure 4.2 Implementation of our path protection in PLR When the primary path(R1-R2-R3-R4-R5) fails at node R3 or link R2-R3, R2 detect failure and become PLR. If the PLR R2 selects R6-R7-R4-R5 as an alternative LSP, R2 modifies out-segment and deletes primary LSP entry in the in-segment table. R2 is transit node for primary LSP R1-R2-R3-R4-R5. If the PLR is ingress, it changes ftn table. The figure 7 shows in/out-segment tables when R2 runs as RLR. (Page No. 04) When the PLR has both primary path failure and backup path failure, it selects another backup LSP we just mentioned. If the PLR R2 has two failures: R1-R2-R3-R4-R5 for primary path and R1-R2-R6-R7-R4-R5 for secondary path, it can select other backup LSP to R1-R2-R8-R9- R10-R4-R5 LSP. (Page No. 04) The proposed MPLS path protection mechanism has benefits that can switch over quickly from the primary path to an alternative path and can share a secondary LSP depending on path protection policy. (Page No. 04) The proposed mechanism can guarantee that bypass traffic quickly and need not extend signaling protocols. And it can share the backup LSP with several primary LSPs. Also it can protect multiple failures at the same time. (Page No. 04)
[3a] A method as claimed in claim 1, wherein in response to determining that the fully disjoint path connecting said Point of Local Repair Node to	See claim 1 <i>supra</i>. Park discloses determining that the fully disjoint path connecting said Point of Local Repair Node to said Merge Point node is not available.

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said Merge Point node is not available,	See, e.g.: In this paper, we propose a dynamic MPLS path protection. which needs not extend signaling protocol and can support high reliability with bypassing traffic beyond the failures quickly. The proposed mechanism chooses an appropriate path from already established paths instead of not setting-up new backup path dynamically. By such characteristics, the proposed mechanism shows a high reliability for fast path protection is capable. (Page No. 01) 2.2 Path Protection In MPLS networks, an LSP path is setup by signaling protocols as LDP (Label Distribution Protocol)/CR-LDP (Constraint Routing Label Distribution Protocol)/RSVP-TE(RSW-Traffic Engineering). An LSR monitors the already setup LSP path. In case of the LSR detects failure, signaling protocol notifies such failure to upstream nodes and neighbor nodes. The LSR is called PLR (Point of Local Repair). (Page No. 02) Among signaling protocols, LDP transmits failure information by using label request abort label withdraw, label release and notification messages. On the other hands, RSP-TE protocol transmits failure information by using path error and reservation error messages. After an LSR receives failure notification, it is trying to setup new LSP by signaling protocol overcoming network failure. In path protection mechanism, newly established LSP is called an alternative path which to protect the primary path. (Page No. 02) The diagram illustrates MPLS path protection in a network. It shows a sequence of nodes (routers) connected by links. A primary path is shown, and an alternative path is established to bypass a failure (indicated by a large 'X' on a link). The diagram is labeled 'End-to-end path protection' and 'Local protection'. Figure 3. MPLS path protection The path protection can be divided into two mechanisms depending on the time when backup LSP is established: pre-failure protection and post-failure protection. Figure 3 shows these two methods [8,9] The pre-failure protection mechanism needs to explicitly configure a backup path for a primary

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	path regardless of failure. Though this mechanism guarantees that traffic quickly bypass failure in network, it wastes network resources. Another mechanism suggests sharing a backup path with N primary paths. However, such mechanism 'has a disadvantage that it is difficult to manage the primary paths and the backup path, also cannot guarantee reliability in case of failure in two all paths. (Page No. 02) For providing fast path protection, pre-failure path protection mechanisms are also classified into end-to-end protection and local protection according to protection range. In the end-to-end protection, PLR which the node detect failure notifies to upstream nodes. As the result, the ingress node gets the information about failure. For bypassing the failure point, it transmits the traffic to a pre-configured backup LSP and reconfigures the primary path. This end-to-end protection mechanism cannot guarantee fast path protection because of notifying process. (Page No. 03) In local path protection, every node needs to pre-establish a backup LSP for any node may be PLR. After an LSR detects the failure, the PLR uses such a backup LSP first bypassing failure. And the PLR transmits failure notification to an ingress node in order to setting-up another primary path. This mechanism needs to extend RSVP-TE protocol, like as R.RO(record route object) to setup backup LSP to next hop(Nhop) for link fault and next next hop(NNhops) for node fault [5]. In Figure 4, one LSP(R1-R2-R3-R4-R5-R6) can be protected by five small backup LSPs. (Page No. 03) 4. Dynamic path protection mechanism In this section, we propose a dynamic path protection mechanism which needs not extend signaling protocol. For fast path protection, an implementation method of our proposed mechanism is explained. 4.1 Dynamic path protection Our dynamic path protection mechanism chooses the alternative path which is temporary path to minimize loss. For reliability of the path protection mechanism largely depends on duration setting-up a backup LSP. In our mechanism, one of working LSPs is used as an alternative path in any PLR which detect failure. Traffic is bypassed on the chosen running LSP after the corresponding MPLS forwarding tables are changed. The proposed mechanism selects one of LSPs which have the same destination as the primary LSP does. If there are many LSPs, only one LSP are selected by the following order:

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	1 The LSP which has the least utilization. 2 The LSP with the least RX/TX packets in any interface, if utilization of each LSP is not known. 3 The best effort LSP, if there is still a tie. 4 The LSP which is not selected as a backup LSP before, if there is still a tie. 5 One LSP at random if there is still a tie. Figure 5. Example of path failure Figure 5 shows that there are three LSPs to same destination R5: R1-R2-R3-R4-R5, R1-R2- R6-R7- R4-R5, R1-R2-R8-R9-R10-R4-R5. (Page No. 03) <table><caption>In-Segment Table</caption><thead><tr><th>Intf</th><th>Label</th><th>OP Code</th><th>BA Table</th><th>XC index</th><th>Target</th><th>Pbase</th></tr></thead><tbody><tr><td>a</td><td>14</td><td>swap</td><td>.</td><td>1</td><td>1</td><td>.</td></tr><tr><td>a</td><td>10</td><td>swap</td><td>.</td><td>2</td><td>1</td><td>.</td></tr><tr><td>a</td><td>19</td><td>swap</td><td>.</td><td>3</td><td>1</td><td>.</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td><td></td></tr></tbody></table> <table><caption>Out-Segment Table</caption><thead><tr><th>XC index</th><th>Out port</th><th>Label 1</th><th>Qbase</th><th>PHB Table</th><th>NH MAC</th></tr></thead><tbody><tr><td>1</td><td>1</td><td>15</td><td>.</td><td>.</td><td>M1</td></tr><tr><td>2</td><td>2</td><td>11</td><td>.</td><td>.</td><td>M2</td></tr><tr><td>3</td><td>3</td><td>20</td><td>.</td><td>.</td><td>M3</td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td></tr><tr><td></td><td></td><td></td><td></td><td></td><td></td></tr></tbody></table> Figure 6. MPLS forwarding information in transit node R2 The node R2 is a transit node in each LSP, has in/out-segment tables. R2 transmits packets with changing their labels to "11", " 15" and "20" according their different upstream. In ordinary situation, when the ingress router R1 forwards a packet down the LSP, it imposes a label "14" and transmits the packet to R2 in the forwarding plane. The transit node R2 swaps "14" to "11" and sends it to R3. When R2 receive packets with label "10" and "19" it swap "15", "20" and forward to	Intf	Label	OP Code	BA Table	XC index	Target	Pbase	a	14	swap	.	1	1	.	a	10	swap	.	2	1	.	a	19	swap	.	3	1	.															XC index	Out port	Label 1	Qbase	PHB Table	NH MAC	1	1	15	.	.	M1	2	2	11	.	.	M2	3	3	20	.	.	M3												
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[3b] in response to determining that a partially disjoint path connecting said	See claim 1 <i>supra</i> .

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Claim	Disclosure
Point of Local Repair Node to said Merge Point node is available, signaling, to at least one other MPLS label switch router, said partially disjoint path as the Backup LSP to said Bypass LSP.	Park discloses, in response to determining that a partially disjoint path connecting said Point of Local Repair Node to said Merge Point node is available, signaling, to at least one other MPLS label switch router, said partially disjoint path as the Backup LSP to said Bypass LSP <i>See, e.g.:</i> In this paper, we propose a dynamic MPLS path protection. which needs not extend signaling protocol and can support high reliability with bypassing traffic beyond the failures quickly. The proposed mechanism chooses an appropriate path from already established paths instead of not setting-up new backup path dynamically. By such characteristics, the proposed mechanism shows a high reliability for fast path protection is capable. (Page No. 01) 2.2 Path Protection In MPLS networks, an LSP path is setup by signaling protocols as LDP (Label Distribution Protocol)/CR-LDP (Constraint Routing Label Distribution Protocol)/RSVP-TE(RSW-Traffic Engineering). An LSR monitors the already setup LSP path. In case of the LSR detects failure, signaling protocol notifies such failure to upstream nodes and neighbor nodes. The LSR is called PLR (Point of Local Repair). (Page No. 02) Among signaling protocols, LDP transmits failure information by using label request abort label withdraw, label release and notification messages. On the other hands, RSP-TE protocol transmits failure information by using path error and reservation error messages. After an LSR receives failure notification, it is trying to setup new LSP by signaling protocol overcoming network failure. In path protection mechanism, newly established LSP is called an alternative path which to protect the primary path. (Page No. 02) Figure 3. MPLS path protection

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	The path protection can be divided into two mechanisms depending on the time when backup LSP is established: pre-failure protection and post-failure protection. Figure 3 shows these two methods [8,9] The pre-failure protection mechanism needs to explicitly configure a backup path for a primary path regardless of failure. Though this mechanism guarantees that traffic quickly bypass failure in network, it wastes network resources. Another mechanism suggests sharing a backup path with N primary paths. However, such mechanism 'has a disadvantage that it is difficult to manage the primary paths and the backup path, also cannot guarantee reliability in case of failure in two all paths. (Page No. 02) For providing fast path protection, pre-failure path protection mechanisms are also classified into end-to-end protection and local protection according to protection range. In the end-to-end protection, PLR which the node detect failure notifies to upstream nodes. As the result, the ingress node gets the information about failure. For bypassing the failure point, it transmits the traffic to a pre-configured backup LSP and reconfigures the primary path. This end-to-end protection mechanism cannot guarantee fast path protection because of notifying process. (Page No. 03) In local path protection, every node needs to pre-establish a backup LSP for any node may be PLR. After an LSR detects the failure, the PLR uses such a backup LSP first bypassing failure. And the PLR transmits failure notification to an ingress node in order to setting-up another primary path. This mechanism needs to extend RSVP-TE protocol, like as RRO(record route object) to setup backup LSP to next hop(Nhop) for link fault and next next hop(NNhops) for node fault [5]. In Figure 4, one LSP(R1-R2-R3-R4-R5-R6) can be protected by five small backup LSPs. (Page No. 03) 4. Dynamic path protection mechanism In this section, we propose a dynamic path protection mechanism which needs not extend signaling protocol. For fast path protection, an implementation method of our proposed mechanism is explained. 4.1 Dynamic path protection Our dynamic path protection mechanism chooses the alternative path which is temporary path to minimize loss. For reliability of the path protection mechanism largely depends on duration setting-up a backup LSP. In our mechanism, one of working LSPs is used as an alternative path in any PLR

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	The proposed mechanism can guarantee that bypass traffic quickly and need not extend signaling protocols. And it can share the backup LSP with several primary LSPs. Also it can protect multiple failures at the same time. <i>(Page No. 04)</i>
[4a] A method as claimed in claim 3, wherein in response to determining that a partially disjoint path connecting said Point of Local Repair Node to said Merge Point node is not available, then	<i>See claim 1 supra.</i> Park discloses determining that a partially disjoint path connecting said Point of Local Repair Node to said Merge Point node is not available. <i>See, e.g.:</i> In this paper, we propose a dynamic MPLS path protection. which needs not extend signaling protocol and can support high reliability with bypassing traffic beyond the failures quickly. The proposed mechanism chooses an appropriate path from already established paths instead of not setting-up new backup path dynamically. By such characteristics, the proposed mechanism shows a high reliability for fast path protection is capable. <i>(Page No. 01)</i> 2.2 Path Protection In MPLS networks, an LSP path is setup by signaling protocols as LDP (Label Distribution Protocol)/CR-LDP (Constraint Routing Label Distribution Protocol)/RSVP-TE(RSW-Traffic Engineering). An LSR monitors the already setup LSP path. In case of the LSR detects failure, signaling protocol notifies such failure to upstream nodes and neighbor nodes. The LSR is called PLR (Point of Local Repair). <i>(Page No. 02)</i> Among signaling protocols, LDP transmits failure information by using label request abort label withdraw, label release and notification messages. On the other hands, RSP-TE protocol transmits failure information by using path error and reservation error messages. After an LSR receives failure notification, it is trying to setup new LSP by signaling protocol overcoming network failure. In path protection mechanism, newly established LSP is called an alternative path which to protect the primary path. <i>(Page No. 02)</i>

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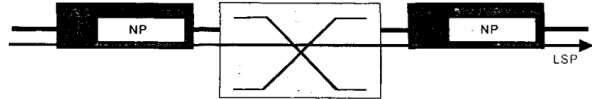
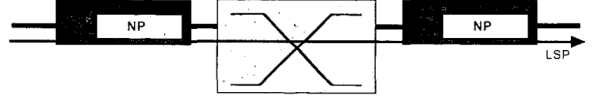
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[4b] signaling an error on the attempt to provide a Backup LSP.	<i>See claim 1 supra.</i> Park discloses determining that a partially disjoint path connecting said Point of Local Repair Node to said Merge Point node is not available. <i>See, e.g.:</i> In this paper, we propose a dynamic MPLS path protection. which needs not extend signaling protocol and can support high reliability with bypassing traffic beyond the failures quickly. The proposed mechanism chooses an appropriate path from already established paths instead of not setting-up new backup path dynamically. By such characteristics, the proposed mechanism shows a high reliability for fast path protection is capable. <i>(Page No. 01)</i> 2.2 Path Protection In MPLS networks, an LSP path is setup by signaling protocols as LDP (Label Distribution Protocol)/CR-LDP (Constraint Routing Label Distribution Protocol)/RSVP-TE(RSW-Traffic Engineering). An LSR monitors the already setup LSP path. In case of the LSR detects failure, signaling protocol notifies such failure to upstream nodes and neighbor nodes. The LSR is called PLR (Point of Local Repair). <i>(Page No. 02)</i> Among signaling protocols, LDP transmits failure information by using label request abort label withdraw, label release and notification messages. On the other hands, RSP-TE protocol transmits

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	failure information by using path error and reservation error messages. After an LSR receives failure notification, it is trying to setup new LSP by signaling protocol overcoming network failure. In path protection mechanism, newly established LSP is called an alternative path which to protect the primary path. (Page No. 02) Figure 3. MPLS path protection The path protection can be divided into two mechanisms depending on the time when backup LSP is established: pre-failure protection and post-failure protection. Figure 3 shows these two methods [8,9] The pre-failure protection mechanism needs to explicitly configure a backup path for a primary path regardless of failure. Though this mechanism guarantees that traffic quickly bypass failure in network, it wastes network resources. Another mechanism suggests sharing a backup path with N primary paths. However, such mechanism 'has a disadvantage that it is difficult to manage the primary paths and the backup path, also cannot guarantee reliability in case of failure in two all paths. (Page No. 02) For providing fast path protection, pre-failure path protection mechanisms are also classified into end-to-end protection and local protection according to protection range. In the end-to-end protection, PLR which the node detect failure notifies to upstream nodes. As the result, the ingress node gets the information about failure. For bypassing the failure point, it transmits the traffic to a pre-configured backup LSP and reconfigures the primary path. This end-to-end protection mechanism cannot guarantee fast path protection because of notifying process. (Page No. 03) In local path protection, every node needs to pre-establish a backup LSP for any node may be PLR. After an LSR detects the failure, the PLR uses such a backup LSP first bypassing failure. And the PLR transmits failure notification to an ingress node in order to setting-up another primary path. This mechanism needs to extend RSVP-TE protocol, like as RRO(record route object) to setup backup LSP to next hop(Nhop) for link fault and next next hop(NNhops) for node fault [5]. In

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[5a] A method as claimed in claim 1 after said obtaining step, comprising further steps of: procuring a Shared Risk Link Groups (SRLG) associated with the nodes traversed by the end-to-end path of said Bypass LSP from said Point of Local Repair Node to said Merge Point node; and	<i>See claim 1 supra.</i> Park discloses procuring a Shared Risk Link Groups (SRLG) associated with the nodes traversed by the end-to-end path of said Bypass LSP from said Point of Local Repair Node to said Merge Point node. <i>See, e.g.:</i> In this paper, we propose a dynamic MPLS path protection. which needs not extend signaling protocol and can support high reliability with bypassing traffic beyond the failures quickly. The proposed mechanism chooses an appropriate path from already established paths instead of not setting-up new backup path dynamically. By such characteristics, the proposed mechanism shows a high reliability for fast path protection is capable. <i>(Page No. 01)</i> 2.2 Path Protection In MPLS networks, an LSP path is setup by signaling protocols as LDP (Label Distribution Protocol)/CR-LDP (Constraint Routing Label Distribution Protocol)/RSVP-TE(RSW-Traffic Engineering). An LSR monitors the already setup LSP path. In case of the LSR detects failure, signaling protocol notifies such failure to upstream nodes and neighbor nodes. The LSR is called

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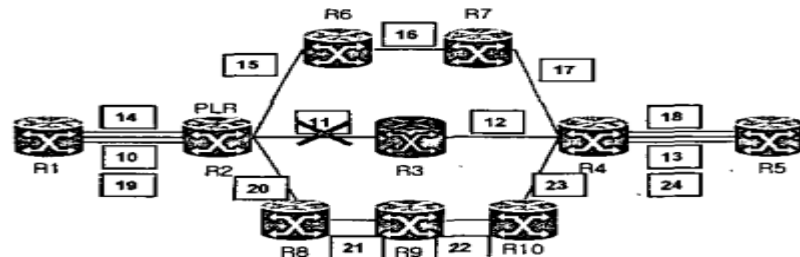
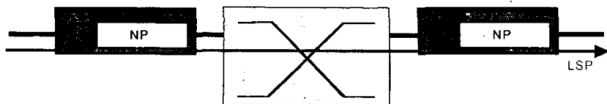
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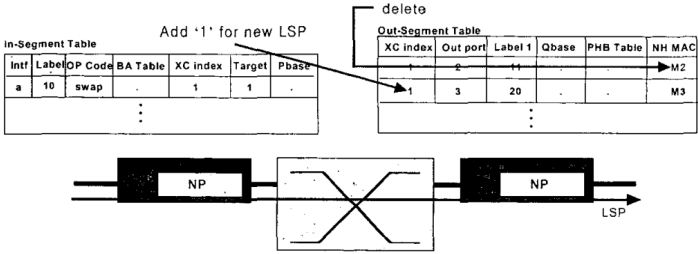
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[5b] providing said Shared Risk Link Groups as part of said generating a request step to said calculator for use in calculating said disjoint path.	<i>See claim 1 supra.</i> Park discloses providing said Shared Risk Link Groups as part of said generating a request step to said calculator for use in calculating said disjoint path. <i>See, e.g.:</i>

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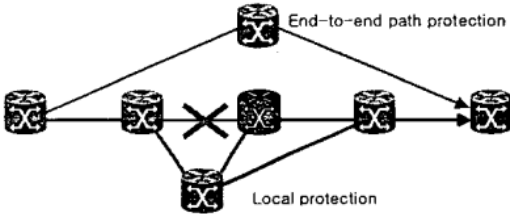
Claim	Disclosure
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	2 The LSP with the least RX/TX packets in any interface, if utilization of each LSP is not known. 3 The best effort LSP, if there is still a tie. 4 The LSP which is not selected as a backup LSP before, if there is still a tie. 5 One LSP at random if there is still a tie. Figure 5. Example of path failure Figure 5 shows that there are three LSPs to same destination R5: R1-R2-R3-R4-R5, R1-R2- R6-R7- R4-R5, R1-R2-R8-R9-R10-R4-R5. (Page No. 03) <table><caption>In-Segment Table</caption><thead><tr><th>Intrf</th><th>Label</th><th>OP Code</th><th>BA Table</th><th>XC index</th><th>Target</th><th>Pbase</th></tr></thead><tbody><tr><td>a</td><td>14</td><td>swap</td><td>.</td><td>1</td><td>1</td><td>.</td></tr><tr><td>a</td><td>10</td><td>swap</td><td>.</td><td>2</td><td>1</td><td>.</td></tr><tr><td>a</td><td>19</td><td>swap</td><td>.</td><td>3</td><td>1</td><td>.</td></tr><tr><td colspan="7">⋮</td></tr></tbody></table> <table><caption>Out-Segment Table</caption><thead><tr><th>XC Index</th><th>Out port</th><th>Label 1</th><th>Qbase</th><th>PHB Table</th><th>NH MAC</th></tr></thead><tbody><tr><td>1</td><td>1</td><td>15</td><td>.</td><td>.</td><td>M1</td></tr><tr><td>2</td><td>2</td><td>11</td><td>.</td><td>.</td><td>M2</td></tr><tr><td>3</td><td>3</td><td>20</td><td>.</td><td>.</td><td>M3</td></tr><tr><td colspan="6">⋮</td></tr></tbody></table> Figure 6. MPLS forwarding information in transit node R2 The node R2 is a transit node in each LSP, has in/out-segment tables. R2 transmits packets with changing their labels to "11", " 15" and "20" according their different upstream. In ordinary situation, when the ingress router R1 forwards a packet down the LSP, it imposes a label "14" and transmits the packet to R2 in the forwarding plane. The transit node R2 swaps "14" to "11" and sends it to R3. When R2 receive packets with label "10" and "19" it swap "15", "20" and forward to R6 and R8. The In/out-segment tables for the forwarding plane are shown in Figure 6. (Page No.	Intrf	Label	OP Code	BA Table	XC index	Target	Pbase	a	14	swap	.	1	1	.	a	10	swap	.	2	1	.	a	19	swap	.	3	1	.	⋮							XC Index	Out port	Label 1	Qbase	PHB Table	NH MAC	1	1	15	.	.	M1	2	2	11	.	.	M2	3	3	20	.	.	M3	⋮					
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[6pre] A non-transitory machine readable storage medium encoded with	To the extent the preamble is limiting, Park discloses a non-transitory machine readable storage medium encoded with instructions for execution by a network processor of a Multiprotocol Label

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instructions for execution by a network processor of a Multiprotocol Label Switching (MPLS) label switch for providing a Backup Label Switched Path (LSP) to a Bypass LSP already established for a Protected Primary LSP, the medium comprising:	Switching (MPLS) label switch for providing a Backup Label Switched Path (LSP) to a Bypass LSP already established for a Protected Primary LSP. <i>See claim element [1pre] supra.</i> <i>See, e.g.:</i> In this paper, we propose a dynamic MPLS path protection. which needs not extend signaling protocol and can support high reliability with bypassing traffic beyond the failures quickly. The proposed mechanism chooses an appropriate path from already established paths instead of not setting-up new backup path dynamically. By such characteristics, the proposed mechanism shows a high reliability for fast path protection is capable. <i>(Page No. 01)</i> 2.2 Path Protection In MPLS networks, an LSP path is setup by signaling protocols as LDP (Label Distribution Protocol)/CR-LDP (Constraint Routing Label Distribution Protocol)/RSVP-TE(RSW-Traffic Engineering). An LSR monitors the already setup LSP path. In case of the LSR detects failure, signaling protocol notifies such failure to upstream nodes and neighbor nodes. The LSR is called PLR (Point of Local Repair). <i>(Page No. 02)</i> Among signaling protocols, LDP transmits failure information by using label request abort label withdraw, label release and notification messages. On the other hands, RSP-TE protocol transmits failure information by using path error and reservation error messages. After an LSR receives failure notification, it is trying to setup new LSP by signaling protocol overcoming network failure. In path protection mechanism, newly established LSP is called an alternative path which to protect the primary path. <i>(Page No. 02)</i>

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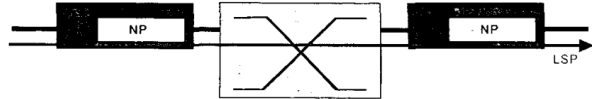
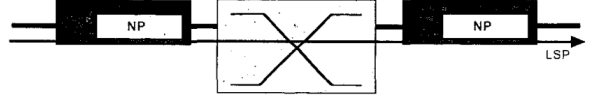
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	When the PLR has both primary path failure and backup path failure, it selects another backup LSP we just mentioned. If the PLR R2 has two failures: R1-R2-R3-R4-R5 for primary path and R1-R2-R6-R7-R4-R5 for secondary path, it can select other backup LSP to R1-R2-R8-R9- R10-R4-R5 LSP. <i>(Page No. 04)</i> The proposed MPLS path protection mechanism has benefits that can switch over quickly from the primary path to an alternative path and can share a secondary LSP depending on path protection policy. <i>(Page No. 04)</i> The proposed mechanism can guarantee that bypass traffic quickly and need not extend signaling protocols. And it can share the backup LSP with several primary LSPs. Also it can protect multiple failures at the same time. <i>(Page No. 04)</i>
[6a] instructions for protecting the Primary LSP against dual failures, comprising:	<i>See claim element [1a] supra.</i>
[6b] instructions for establishing the Bypass LSP for the Protected Primary LSP having a Point of Local Repair node and a Merge Point node;	<i>See claim element [1b] supra.</i>
[6c] instructions for obtaining the nodes traversed by an end-to-end path of said Bypass LSP from said Point of Local Repair Node to said Merge Point node;	<i>See claim element [1c] supra.</i>
[6d] instructions for generating a request to a path calculator using the nodes traversed by said end-to-end path of said Bypass LSP for a disjoint path connecting said Point of Local Repair Node to	<i>See claim element [1d] supra.</i>

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Claim	Disclosure
said Merge Point node;	
[6e] instructions for receiving a response from said path calculator; and	<i>See claim element [1e] supra.</i>
[6f] in response to determining that a fully disjoint path connecting said Point of Local Repair Node to said Merge Point node is available, instructions for signaling, to at least one other MPLS label switch router, said fully disjoint path as the Backup LSP to said Bypass LSP.	<i>See claim element [1f] supra.</i>
[7] A non-transitory machine readable storage medium as claimed in claim 6, wherein the instructions specify that said path calculator is a constraint based shortest path first calculator.	<i>See claims 1, 2, and 6 supra.</i>
[8a] A non-transitory machine readable storage medium as claimed in claim 6, wherein in response to determining that the fully disjoint path connecting said Point of Local Repair Node to said Merge Point node is not available,	<i>See claims 1, [3a], and 6 supra.</i>
[8b] in response to determining that a partially	<i>See claims 1, [3b], and 6 supra.</i>

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disjoint path connecting said Point of Local Repair Node to said Merge Point node is available, signaling, to at least one other MPLS label switch router, said partially disjoint path as the Backup LSP to said Bypass LSP.	
[9] A non-transitory machine readable storage medium as claimed in claim 6, wherein in response to determining that a partially disjoint path connecting said Point of Local Repair Node to said Merge Point node is not available, signaling an error on the attempt to provide a Backup LSP.	<i>See claims 1, 4, and 6 supra.</i>
[10a] A non-transitory machine readable storage medium as claimed in claim 6, wherein the instructions specify after said obtaining step further steps of: procuring a Shared Risk Link Groups (SRLG) associated with the nodes traversed by the end-to-end path of said Bypass LSP from said Point of Local Repair Node to said	<i>See claims 1, [5a], and 6 supra.</i>

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Merge Point node; and [10b] providing said Shared Risk Link Groups as part of said generating a request step to said calculator for use in calculating said disjoint path.	<i>See</i> claims 1, [5b], and 6 <i>supra</i> .