─────────── MODULE *Protocols* ───────────

EXTENDS *TLC*

─────────── MODULE *E2AP* ───────────

Message type constants

CONSTANTS
    E2Setup,
    E2SetupResponse,
    E2SetupFailure

CONSTANTS
    ResetRequest,
    ResetResponse

CONSTANTS
    RICSubscriptionRequest,
    RICSubscriptionResponse,
    RICSubscriptionFailure

CONSTANTS
    RICSubscriptionDeleteRequest,
    RICSubscriptionDeleteResponse,
    RICSubscriptionDeleteFailure

CONSTANTS
    RICControlRequest,
    RICControlResponse,
    RICControlFailure,
    RICServiceUpdate

CONSTANTS
    E2ConnectionUpdate,
    E2ConnectionUpdateAcknowledge,
    E2ConnectionUpdateFailure

CONSTANTS
    E2NodeConfigurationUpdate,
    E2NodeConfigurationUpdateAcknowledge,
    E2NodeConfigurationUpdateFailure

LOCAL *messageTypes* $\triangleq$
    {*E2Setup*,
     E2SetupResponse,
     E2SetupFailure,
     ResetRequest,
     ResetResponse,
     RICSubscriptionRequest,
     RICSubscriptionResponse,
     RICSubscriptionFailure,
     RICSubscriptionDeleteRequest,

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$RICSubscriptionDeleteResponse,$
$RICSubscriptionDeleteFailure,$
$RICControlRequest,$
$RICControlResponse,$
$RICControlFailure,$
$RICServiceUpdate,$
$E2ConnectionUpdate,$
$E2ConnectionUpdateAcknowledge,$
$E2ConnectionUpdateFailure,$
$E2NodeConfigurationUpdate,$
$E2NodeConfigurationUpdateAcknowledge,$
$E2NodeConfigurationUpdateFailure\}$

Failure cause constants

CONSTANTS
$MiscFailureUnspecified,$
$MiscFailureControlProcessingOverload,$
$MiscFailureHardwareFailure,$
$MiscFailureOMIntervention$

CONSTANTS
$ProtocolFailureUnspecified,$
$ProtocolFailureTransferSyntaxError,$
$ProtocolFailureAbstractSyntaxErrorReject,$
$ProtocolFailureAbstractSyntaxErrorIgnoreAndNotify,$
$ProtocolFailureMessageNotCompatibleWithReceiverState,$
$ProtocolFailureSemanticError,$
$ProtocolFailureAbstractSyntaxErrorFalselyConstructedMessage$

CONSTANTS
$RICFailureUnspecified,$
$RICFailureRANFunctionIDInvalid,$
$RICFailureActionNotSupported,$
$RICFailureExcessiveActions,$
$RICFailureDuplicateAction,$
$RICFailureDuplicateEvent,$
$RICFailureFunctionResourceLimit,$
$RICFailureRequestIDUnknown,$
$RICFailureInconsistentActionSubsequentActionSequence,$
$RICFailureControlMessageInvalid,$
$RICFailureCallProcessIDInvalid$

CONSTANTS
$RICServiceFailureUnspecified,$
$RICServiceFailureFunctionNotRequired,$
$RICServiceFailureExcessiveFunctions,$
$RICServiceFailureRICResourceLimit$

CONSTANTS

$TransportFailureUnspecified,$
$TransportFailureTransportResourceUnavailable$

LOCAL $failureCauses \triangleq$
$\{MiscFailureUnspecified,$
$MiscFailureControlProcessingOverload,$
$MiscFailureHardwareFailure,$
$MiscFailureOMIntervention,$
$ProtocolFailureUnspecified,$
$ProtocolFailureTransferSyntaxError,$
$ProtocolFailureAbstractSyntaxErrorReject,$
$ProtocolFailureAbstractSyntaxErrorIgnoreAndNotify,$
$ProtocolFailureMessageNotCompatibleWithReceiverState,$
$ProtocolFailureSemanticError,$
$ProtocolFailureAbstractSyntaxErrorFalselyConstructedMessage,$
$RICFailureUnspecified,$
$RICFailureRANFunctionIDInvalid,$
$RICFailureActionNotSupported,$
$RICFailureExcessiveActions,$
$RICFailureDuplicateAction,$
$RICFailureDuplicateEvent,$
$RICFailureFunctionResourceLimit,$
$RICFailureRequestIDUnknown,$
$RICFailureInconsistentActionSubsequentActionSequence,$
$RICFailureControlMessageInvalid,$
$RICFailureCallProcessIDInvalid,$
$RICServiceFailureUnspecified,$
$RICServiceFailureFunctionNotRequired,$
$RICServiceFailureExcessiveFunctions,$
$RICServiceFailureRICResourceLimit,$
$TransportFailureUnspecified,$
$TransportFailureTransportResourceUnavailable\}$

$Protocol \triangleq [t \in messageTypes \mapsto t]$

$Cause \triangleq [c \in failureCauses \mapsto c]$

LOCAL $IsValidE2Setup(m) \triangleq$ TRUE

LOCAL $IsValidE2SetupResponse(m) \triangleq$ TRUE

LOCAL $IsValidE2SetupFailure(m) \triangleq$ TRUE

LOCAL $IsValidResetRequest(m) \triangleq$ TRUE

LOCAL $IsValidResetResponse(m) \triangleq$ TRUE

LOCAL $IsValidRICSubscriptionRequest(m) \triangleq$ TRUE

LOCAL $IsValidRICSubscriptionResponse(m) \triangleq$ TRUE

LOCAL $IsValidRICSubscriptionFailure(m) \triangleq$ TRUE

LOCAL $IsValidRICSubscriptionDeleteRequest(m) \triangleq$ TRUE

LOCAL $IsValidRICSubscriptionDeleteResponse(m) \triangleq$ TRUE

LOCAL $IsValidRICSubscriptionDeleteFailure(m) \triangleq$ TRUE

LOCAL $IsValidRICControlRequest(m) \triangleq$ TRUE

LOCAL $IsValidRICControlResponse(m) \triangleq$ TRUE

LOCAL $IsValidRICControlFailure(m) \triangleq$ TRUE

LOCAL $IsValidRICServiceUpdate(m) \triangleq$ TRUE

LOCAL $IsValidE2ConnectionUpdate(m) \triangleq$ TRUE

LOCAL $IsValidE2ConnectionUpdateAcknowledge(m) \triangleq$ TRUE

LOCAL $IsValidE2ConnectionUpdateFailure(m) \triangleq$ TRUE

LOCAL $IsValidE2NodeConfigurationUpdate(m) \triangleq$ TRUE

LOCAL $IsValidE2NodeConfigurationUpdateAcknowledge(m) \triangleq$ TRUE

LOCAL $IsValidE2NodeConfigurationUpdateFailure(m) \triangleq$ TRUE

LOCAL $IsValidMessage(m) \triangleq$
$\quad \lor \quad \land m.type = E2Setup$
$\qquad \land IsValidE2Setup(m)$
$\quad \lor \quad \land m.type = E2SetupResponse$
$\qquad \land IsValidE2SetupResponse(m)$
$\quad \lor \quad \land m.type = E2SetupFailure$
$\qquad \land IsValidE2SetupFailure(m)$
$\quad \lor \quad \land m.type = ResetRequest$
$\qquad \land IsValidResetRequest(m)$
$\quad \lor \quad \land m.type = ResetResponse$
$\qquad \land IsValidResetResponse(m)$
$\quad \lor \quad \land m.type = RICSubscriptionRequest$
$\qquad \land IsValidRICSubscriptionRequest(m)$
$\quad \lor \quad \land m.type = RICSubscriptionResponse$
$\qquad \land IsValidRICSubscriptionResponse(m)$
$\quad \lor \quad \land m.type = RICSubscriptionFailure$

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\begin{array}{ll}
& \land IsValidRICSubscriptionFailure(m) \\
\lor & \land m.type = RICSubscriptionDeleteRequest \\
& \land IsValidRICSubscriptionDeleteRequest(m) \\
\lor & \land m.type = RICSubscriptionDeleteResponse \\
& \land IsValidRICSubscriptionDeleteResponse(m) \\
\lor & \land m.type = RICSubscriptionDeleteFailure \\
& \land IsValidRICSubscriptionDeleteFailure(m) \\
\lor & \land m.type = RICControlRequest \\
& \land IsValidRICControlRequest(m) \\
\lor & \land m.type = RICControlResponse \\
& \land IsValidRICControlResponse(m) \\
\lor & \land m.type = RICControlFailure \\
& \land IsValidRICControlFailure(m) \\
\lor & \land m.type = RICServiceUpdate \\
& \land IsValidRICServiceUpdate(m) \\
\lor & \land m.type = E2ConnectionUpdate \\
& \land IsValidE2ConnectionUpdate(m) \\
\lor & \land m.type = E2ConnectionUpdateAcknowledge \\
& \land IsValidE2ConnectionUpdateAcknowledge(m) \\
\lor & \land m.type = E2ConnectionUpdateFailure \\
& \land IsValidE2ConnectionUpdateFailure(m) \\
\lor & \land m.type = E2NodeConfigurationUpdate \\
& \land IsValidE2NodeConfigurationUpdate(m) \\
\lor & \land m.type = E2NodeConfigurationUpdateAcknowledge \\
& \land IsValidE2NodeConfigurationUpdateAcknowledge(m) \\
\lor & \land m.type = E2NodeConfigurationUpdateFailure \\
& \land IsValidE2NodeConfigurationUpdateFailure(m)
\end{array}
$$

VARIABLE $servers$, $conns$

INSTANCE $Messaging$ WITH $Nil \leftarrow$ "<nil>", $IsValid \leftarrow IsValidMessage$

VARIABLE $e2apServers$, $e2apConns$

$E2AP \triangleq$ INSTANCE $E2AP$ WITH
$\quad servers \leftarrow e2apServers,$
$\quad conns \leftarrow e2apConns,$
$\quad E2Setup \leftarrow$ "E2Setup",
$\quad E2SetupResponse \leftarrow$ "E2SetupResponse",
$\quad E2SetupFailure \leftarrow$ "E2SetupFailure",
$\quad ResetRequest \leftarrow$ "ResetRequest",
$\quad ResetResponse \leftarrow$ "ResetResponse",
$\quad RICSubscriptionRequest \leftarrow$ "RICSubscriptionRequest",
$\quad RICSubscriptionResponse \leftarrow$ "RICSubscriptionResponse",

$RICSubscriptionFailure \leftarrow$ "RICSubscriptionFailure",
$RICSubscriptionDeleteRequest \leftarrow$ "RICSubscriptionDeleteRequest",
$RICSubscriptionDeleteResponse \leftarrow$ "RICSubscriptionDeleteResponse",
$RICSubscriptionDeleteFailure \leftarrow$ "RICSubscriptionDeleteFailure",
$RICControlRequest \leftarrow$ "RICControlRequest",
$RICControlResponse \leftarrow$ "RICControlResponse",
$RICControlFailure \leftarrow$ "RICControlFailure",
$RICServiceUpdate \leftarrow$ "RICServiceUpdate",
$E2ConnectionUpdate \leftarrow$ "E2ConnectionUpdate",
$E2ConnectionUpdateAcknowledge \leftarrow$ "E2ConnectionUpdateAcknowledge",
$E2ConnectionUpdateFailure \leftarrow$ "E2ConnectionUpdateFailure",
$E2NodeConfigurationUpdate \leftarrow$ "E2NodeConfigurationUpdate",
$E2NodeConfigurationUpdateAcknowledge \leftarrow$ "E2NodeConfigurationUpdateAcknowledge",
$E2NodeConfigurationUpdateFailure \leftarrow$ "E2NodeConfigurationUpdateFailure",
$MiscFailureUnspecified \leftarrow$ "MiscFailureUnspecified",
$MiscFailureControlProcessingOverload \leftarrow$ "MiscFailureControlProcessingOverload",
$MiscFailureHardwareFailure \leftarrow$ "MiscFailureHardwareFailure",
$MiscFailureOMIntervention \leftarrow$ "MiscFailureOMIntervention",
$ProtocolFailureUnspecified \leftarrow$ "ProtocolFailureUnspecified",
$ProtocolFailureTransferSyntaxError \leftarrow$ "ProtocolFailureTransferSyntaxError",
$ProtocolFailureAbstractSyntaxErrorReject \leftarrow$ "ProtocolFailureAbstractSyntaxErrorReject",
$ProtocolFailureAbstractSyntaxErrorIgnoreAndNotify \leftarrow$ "ProtocolFailureAbstractSyntaxErrorIgnoreAndNotify",
$ProtocolFailureMessageNotCompatibleWithReceiverState \leftarrow$ "ProtocolFailureMessageNotCompatibleWithRece
$ProtocolFailureSemanticError \leftarrow$ "ProtocolFailureSemanticError",
$ProtocolFailureAbstractSyntaxErrorFalselyConstructedMessage \leftarrow$ "ProtocolFailureAbstractSyntaxErrorFalsely
$RICFailureUnspecified \leftarrow$ "RICFailureUnspecified",
$RICFailureRANFunctionIDInvalid \leftarrow$ "RICFailureRANFunctionIDInvalid",
$RICFailureActionNotSupported \leftarrow$ "RICFailureActionNotSupported",
$RICFailureExcessiveActions \leftarrow$ "RICFailureExcessiveActions",
$RICFailureDuplicateAction \leftarrow$ "RICFailureDuplicateAction",
$RICFailureDuplicateEvent \leftarrow$ "RICFailureDuplicateEvent",
$RICFailureFunctionResourceLimit \leftarrow$ "RICFailureFunctionResourceLimit",
$RICFailureRequestIDUnknown \leftarrow$ "RICFailureRequestIDUnknown",
$RICFailureInconsistentActionSubsequentActionSequence \leftarrow$ "RICFailureInconsistentActionSubsequentActionSe
$RICFailureControlMessageInvalid \leftarrow$ "RICFailureControlMessageInvalid",
$RICFailureCallProcessIDInvalid \leftarrow$ "RICFailureCallProcessIDInvalid",
$RICServiceFailureUnspecified \leftarrow$ "RICServiceFailureUnspecified",
$RICServiceFailureFunctionNotRequired \leftarrow$ "RICServiceFailureFunctionNotRequired",
$RICServiceFailureExcessiveFunctions \leftarrow$ "RICServiceFailureExcessiveFunctions",
$RICServiceFailureRICResourceLimit \leftarrow$ "RICServiceFailureRICResourceLimit",
$TransportFailureUnspecified \leftarrow$ "TransportFailureUnspecified",
$TransportFailureTransportResourceUnavailable \leftarrow$ "TransportFailureTransportResourceUnavailable"

—— MODULE $E2T$ ——

CONSTANT
 $SubscribeRequest,$
 $SubscribeResponse$
CONSTANTS
 $UnsubscribeRequest,$
 $UnsubscribeResponse$
CONSTANTS
 $ControlRequest,$
 $ControlResponse$

LOCAL $messageTypes \triangleq$
 $\{SubscribeRequest,$
  $SubscribeResponse,$
  $UnsubscribeRequest,$
  $UnsubscribeResponse,$
  $ControlRequest,$
  $ControlResponse\}$

$Protocol \triangleq [t \in messageTypes \mapsto t]$

LOCAL $IsValidSubscribeRequest(m) \triangleq$ TRUE

LOCAL $IsValidSubscribeResponse(m) \triangleq$ TRUE

LOCAL $IsValidUnsubscribeRequest(m) \triangleq$ TRUE

LOCAL $IsValidUnsubscribeResponse(m) \triangleq$ TRUE

LOCAL $IsValidMessage(m) \triangleq$
 $\vee$ $\wedge\, m.type = SubscribeRequest$
   $\wedge\, IsValidSubscribeRequest(m)$
 $\vee$ $\wedge\, m.type = SubscribeResponse$
   $\wedge\, IsValidSubscribeResponse(m)$
 $\vee$ $\wedge\, m.type = UnsubscribeRequest$
   $\wedge\, IsValidUnsubscribeRequest(m)$
 $\vee$ $\wedge\, m.type = UnsubscribeResponse$
   $\wedge\, IsValidUnsubscribeResponse(m)$

VARIABLE $servers,\ conns$

INSTANCE $Messaging$ WITH $Nil \leftarrow$ "<nil>"$,\ IsValid \leftarrow IsValidMessage$

VARIABLES $e2tServers$, $e2tConns$

$E2T \triangleq$ INSTANCE $E2T$ WITH
    $servers \leftarrow e2tServers$,
    $conns \leftarrow e2tConns$,
    $SubscribeRequest \leftarrow$ "SubscribeRequest",
    $SubscribeResponse \leftarrow$ "SubscribeResponse",
    $UnsubscribeRequest \leftarrow$ "UnsubscribeRequest",
    $UnsubscribeResponse \leftarrow$ "UnsubscribeResponse",
    $ControlRequest \leftarrow$ "ControlRequest",
    $ControlResponse \leftarrow$ "ControlResponse"

$Init \triangleq$
    $\land E2AP!Init$
    $\land E2T!Init$

$Next \triangleq$
    $\lor E2AP!Next$
    $\lor E2T!Next$

\ * Modification History
\ * Last modified $Fri\ Aug$ 13 04:37:45 PDT 2021 by $jordanhalterman$
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