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# EHealth Communications at the Network Edge

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# Outline

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# Introduction

Ehealth:

- associated with virtualization and digitalization of healthcare;
- aimed at extending the healthcare from hospital-based model to more flexible distributed care model centered around the patients;
- enables transferring of health resources and healthcare to electronic means;
- delivery of health information for health consumers and health professionals through telecommunications.

# Introduction

5G mobile networks:

- increased efficiency, ubiquitous access, low latency, high bandwidth, reliability and strong security;
- assets tracking and management, remote surgery, cloud services for assisted living, ageing well, lifestyle and prevention, applying medication to the patient on a remote basis etc.

Multi-access Edge Computing (MEC) can add value to many eHealth applications.

# Introduction

- MEC capabilities for third party control on multimedia communications in the context of eHealth.
- A new mobile edge service makes possible edge applications to be notified about media interaction events within a multimedia session initiated in the network.

# Edge Based eHealth Communications

Third party initiated multimedia communications may be useful in the cure, mitigation, treatment, or prevention of diseases:

- Campaign type of applications that provide information periodically aiming to help in actions about anti-smoking or other type of addictions.
- Location-based applications that alert user about high-risk area e.g. air quality-based risk increment.
- Motivational type of applications for home therapy of patients using game or video components.
- Informational type of applications that can summarize the reported drug interactions so far and can provide the user with this information after she inputs the prescribed list of medications.

# Edge Based eHealth Communications

Multi-access Edge Computing:

- enables third party applications to play, capture and record media within an existing session;
- provides applications with notifications regarding media interaction and recording.

Benefits:

- better facilities for real-time communications;
- the media traffic is routed only within edge network and does not traverse the core network.

# Service Resources, Data Model and Interfaces

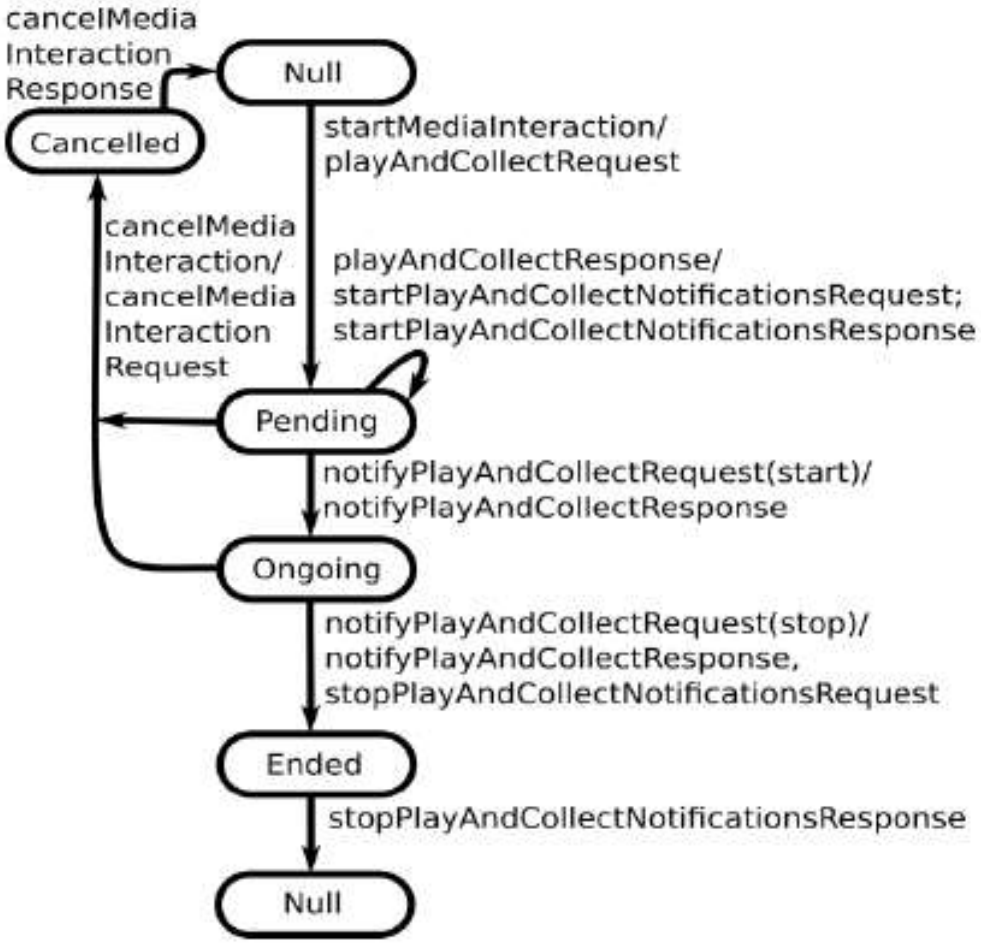

Structure of resources related to media interaction notifications

# Service Resources, Data Model and Interfaces

## Resources of Media Interaction Notification Service and Supported Methods

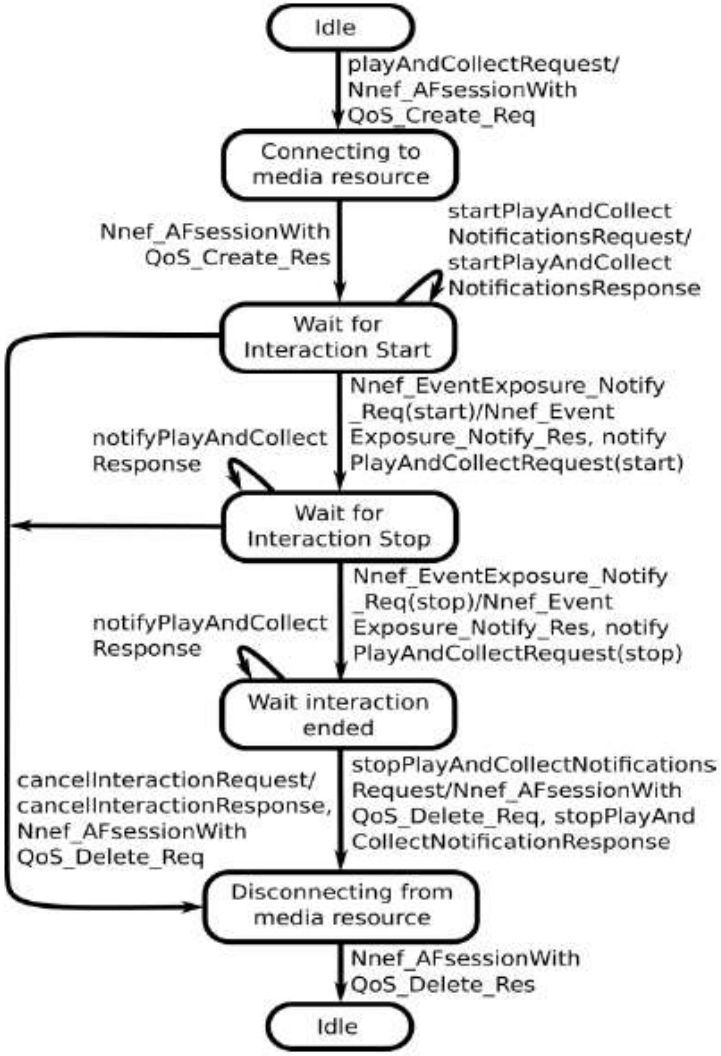
| Resource | Resource URI | HTTP method | Meaning |
|---|---|---|---|
| All subscriptions for notifycations | /subscriptions | GET | Retrieves the list of all subscription types |
| All subscriptions for play and collect media | /subscriptions/playAndCollectSubscriptions | GET<br><br><br>POST | Retrieves the list of all subscriptions for play & collect media<br>Creates a new subscription |
| Existing subscr-iption for play and collect media | /subscriptions/playAndCollectSubscriptions /{playAndCollectSubscriptionID} | GET<br><br>PUT<br><br>DELETE | Retrieves information about a subscription<br>Updates the subscription<br>Terminates the subscription |
| All subscriptions for play & record media | /subscriptions/playAndRecordSubscriptions | GET<br><br><br>POST | Retrieves the list of all subscriptions for play & record media<br>Creates a new subscription |
| Existing subscri-ption for play and record media | /subscriptions/playAndRecordSubscriptions /{playAndRecordSubscriptionID} | GET<br><br>PUT<br><br>DELETE | Retrieves information about a subscription<br>Updates the subscription<br>Terminates the subscription |

# Feasibility Study




Media interaction state as seen by the application

# Feasibility Study




Media interaction state as seen by the network

# Feasibility Study

$T_{App} = (S_{App}, Act_{App}, \rightarrow_{App}, s_0^{App})$ where:

- $S_{App}$ = {Null [$s^A_1$], Pending [$s^A_2$], Ongoing [$s^A_3$], Ended [$s^A_4$], Cancelled [$s^A_5$]};
- $Act_{App}$ = { startMediaInteraction [$t^A_1$], playAndCollectResponse [$t^A_2$], startPlayAndCollectNotificationsResponse [$t^A_3$], notifyPlayAndCollectRequest(start) [$t^A_4$], notifyPlayAndCollectRequest(stop) [ $t^A_5$], stopPlayAndCollectNotificationsResponse [$t^A_6$], cancelMediaInteraction [$t^A_7$], cancelMediaInteractionResponse [$t^A_8$]};
- $\rightarrow_{App}$ = {($s^A_1$ $t^A_1$ $s^A_2$), ($s^A_2$ $t^A_2$ $s^A_2$), ($s^A_2$ $t^A_3$ $s^A_2$), ($s^A_2$ $t^A_4$ $s^A_3$), ($s^A_3$ $t^A_5$ $s^A_4$), ($s^A_4$ $t^A_6$ $s^A_1$), ($s^A_2$ $t^A_7$ $s^A_5$), ($s^A_3$ $t^A_7$ $s^A_5$), ($s^A_2$ $t^A_8$ $s^A_1$), };
- $s_0^{App}$ = {$s^A_1$}.

$T_{Mec} = (S_{Mec}, Act_{Mec}, \rightarrow_{Mec}, s_0^{Mec})$ where:

- $S_{Mec}$ = {Idle [$s^M_1$], ConnectingToMediaResource [$s^M_2$], WaitForInteractionStart [$s^M_3$], WaitForInteractionStop [$s^M_4$], WaitInteractionEnded [$s^M_5$], DisconnectingFromMediaResource [$s^M_6$]};
- $Act_{Mec}$ = { playAndCollectRequest [$t^M_1$], Nnef_AFsessionWithQoS_Create_Res [$t^M_2$], startPlayAndCollectNotificationRequest [$t^M_3$], Nnef_EventExposure_Notify_Req(start) [$t^M_4$], notifyPlayAndCollectResponse [$t^M_5$], Nnef_EventExposure_Notify_Req(stop) [ $t^M_6$], stopPlayAndCollectNotificationRequest [$t^M_7$], cancelMessageRequest [$t^M_8$], Nnef_AFsessionWithQoS _Delete_Res [$t^M_9$]};
- $\rightarrow_{Mec}$ = { ($s^M_1$ $t^M_1$ $s^M_2$), ($s^M_2$ $t^M_2$ $s^M_3$), ($s^M_3$ $t^M_3$ $s^M_3$), ($s^M_3$ $t^M_4$ $s^M_4$), ($s^M_4$ $t^M_5$ $s^M_4$), ($s^M_4$ $t^M_6$ $s^M_5$), ($s^M_5$ $t^M_5$ $s^M_5$), ($s^M_5$ $t^M_7$ $s^M_6$), ($s^M_6$ $t^M_9$ $s^M_1$), ($s^M_3$ $t^M_8$ $s^M_6$), ($s^M_4$ $t^M_8$ $s^M_6$)}
- $s_0^{Mec}$ = {$s^M_1$}.

**Proposition**: $T_{app}$ and $T_{Mec}$ are weakly bi-similar.

**Proof**: By $R_S$, it is denoted a relationship between corresponding states of $T_{app}$ and $T_{Mec}$, such as $R_S$ = {($s^A_1$, $s^M_1$), ($s^A_2$, $s^M_3$), ($s^A_3$, $s^M_4$), ($s^A_4$, $s^M_5$)}.

# Conclusion

- An approach to enhance eHealth communications with media interaction capabilities;
- RESTful interfaces for open access to media interaction notifications are defined, which can be used to add value to multimedia sessions with elderly and patients aimed at improving their health recovery;
- Benefits: low latency and high bandwidth.