4.3. ASN-GW

ASN-GW, which is placed at the edge of the ASN, is the entity that connects the ASN to the CSN. The ASN-GW assists mobility and security in the control plane and handles IP forwarding. In our architecture, the ASN-GW also connects the WiMAX entities with the MBS service entities. It translates the protocol messages from the R6 protocol to the SIP protocol.

The testbed design includes a custom-built C++ software module, the WiMAX Access Network Emulator (WANE), that emulates the functions of the WiMAX access network entities (including the SUs, the BSs and ASN-GW) which are significant for our use case. In more detail, our WANE is in charge of (i) capturing IGMP reports coming from the client by using a raw socket, (ii) encapsulating them into R6 messages, and (iii) encapsulating the latter messages together with some additional information within SIP message requests, which are then sent to the MBSC-SS. Conversely, the WANE generates IGMP queries and send them to clients. Upon receiving MBS Context Request messages from the MBSC-SS, it replies with MBS Context Response messages emulating the overall ASN. Finally, it is in charge of handling and generating 200 OK SIP messages as specified in [25]. Fig. 7 shows the role of the WANE in the WiMAX access network.

![Fig. 7. WANE: emulated network entities and supported protocols.](image)

The MSLEE server providing the MBSC-SS is then in charge of parsing and interpreting encapsulated data. Thus, the service running in the MSLEE is always aware of the protocol being used within the WiMAX network [27].

Given our focus on the IP part of the MBS signaling architecture, we treat the WiMAX network as a black box. Thus, mobility effects, modulation parameters and wireless loss rates and retransmissions are not emulated by our WANE module and are not included in our performance evaluation results.

Finally, it is worth citing that we also executed functional tests of the overall system in the laboratories of a WiMAX manufacturer, running our software on a real ASN-GW, able to dialogite with real WiMAX base stations and our MBSC.

4.4. MBS Software Client

The MBS software client handles the signaling messages at the client side and provides a graphical user interface (GUI) of the implemented IPTV service. The system architecture that we have designed is modular and allows developers to implement a MBS client as both a standalone application and a Web 2.0 client.