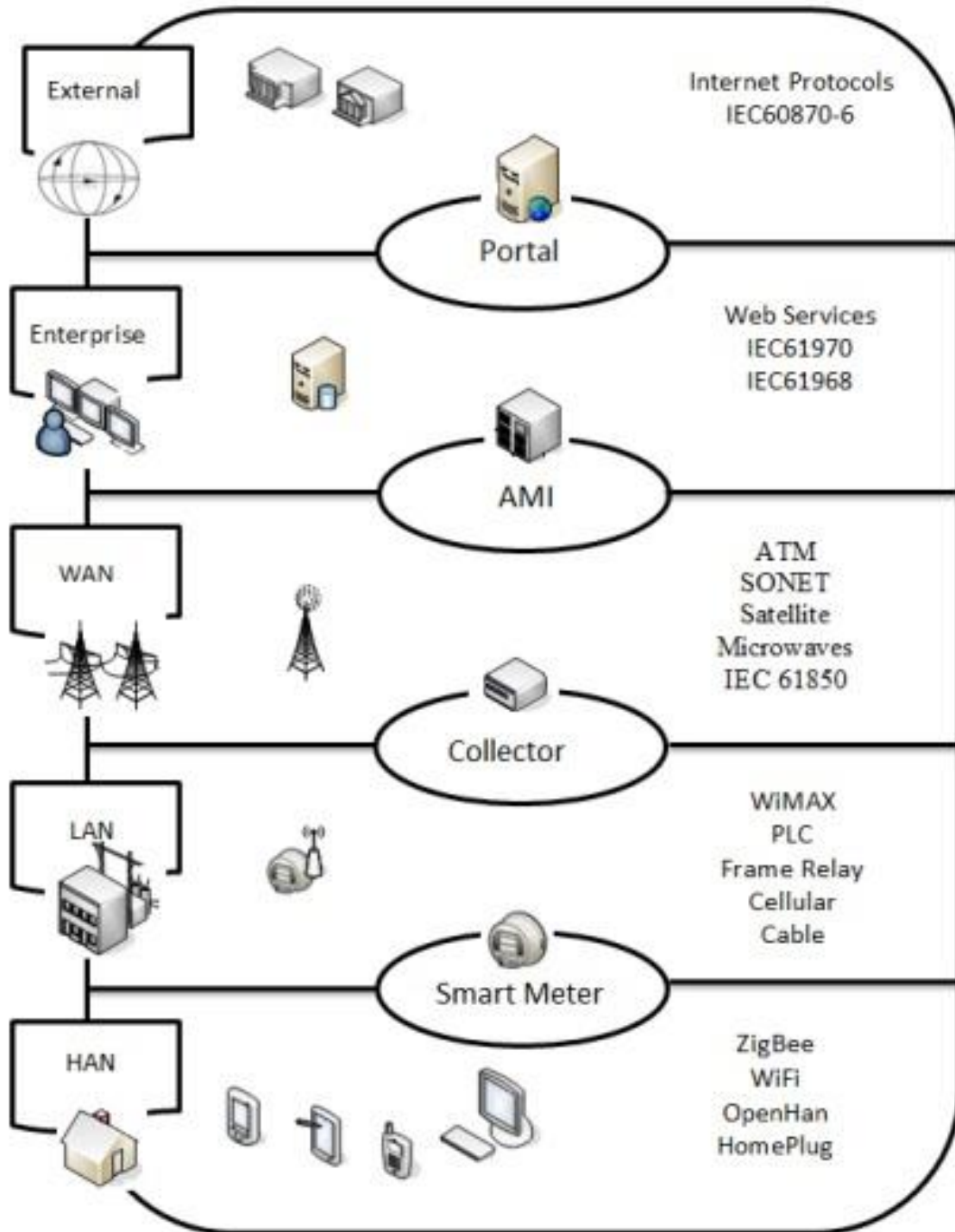


## Summary of Information and Communication Technologies for the Smart Grid



Smart grid communication infrastructure and examples of technologies

## Main Communication Technologies for the Smart Grid

<b>Technology</b>	<b>Specifications</b>	<b>Suitability for Smart Grid</b>
<b>GSM</b>	900-1800 MHz; 14.4 Kbps; 10 km.	Suitable for AMI; demand response (DR), and home area network (HAN)
<b>3G</b>	1.92-1.98 GHz, 2.11-2.17 GHz; 10 km.	Licensed; suitable for AMI; DR, and HAN; costly fee!
<b>WiMax</b>	2.5 GHz, 3.5 GHz, 5.8 GHz; 5 km (NLOS), 50 km (LOS).	DR; Wireless automatic meter reading (WMAR) as part of utility AMI.
<b>ZigBee</b>	868-915 MHz, 2.5 GHz; 250 Kbps; 50 m; 1 mW.	Unlicensed; most suitable communication standards for smart grid low- power residential network domain: HAN [12].
<b>GPRS</b>	900-1800 MHz; 170 Mbps; 10 km.	AMI; HAN; DR.
<b>PLC</b>	1-30 MHz; 3 Mbps.	AMI and HAN; promising technology for smart grid applications due to the fact that the existing infrastructure decreases the installation cost of the communications infrastructure; implemented in China and France [13].

GSM: Global system for mobile communication; 3G: Third generation; WiMax: Worldwide inter-operability for microwave access; GPRS: General packet radio service.

## Smart Grid Standards

Standards	Application	Details
<b>IEEE P2030</b>	Customer applications	A guide for smart-grid interoperability of energy technology with end-use applications and load.
<b>IEEE P1901</b>	Utility and smart grid applications	High speed power line communications.
<b>IEEE 929-2000</b>	Distributed generation (DG)	Utility interface of photovoltaic (PV) systems.
<b>IEEE Std. 1547-2003</b>	DG	Interconnecting distributed energy resources and storage information.
<b>IEC61970</b>	Energy management systems	Transmission domain and enterprise application integration.
<b>IEC 61969</b>	Energy management system	Distribution domain.
<b>IEC 61968</b>	Electrical distribution system	Inter-application integration of a utility enterprise.
<b>IEC 61850</b>	Substation automation	Communications between devices in transmission, distribution, and substation systems.
<b>IEC 60870-6/TASE.2</b>	Inter-control center communications	Data exchange between utility control centers.
<b>ITU-T G.9955 and G.9956</b>	Distribution automation; AMI	Physical layer specifications and data link layer specification.
<b>IEC 62351</b>	Power system management	Security for IEC 61850.
<b>ISO/IEC 15408</b>	Security functions of IT products and systems.	Can be implemented in any sector confronted by the need to test the security of IT including the smart grid.
<b>HomePlug</b>	HAN	Power line technology to connect smart appliances with in HAN.
<b>ISA100.11a</b>	Industrial automation	Wireless systems.
<b>SAE J2293</b>	Electric vehicle (EV) supply equipment	Energy transfer from utility to EVs.
<b>ANSI C12.22</b>	AMI	Data network communications.
<b>ANSI 12.18</b>	AMI	Data transportation via infrared optical port.
<b>ANSI C12.19</b>	AMI	Meter data communications.
<b>Z-Wave</b>	HAN	Alternative solution to ZigBee
<b>ZigBee</b>	Wireless communications	Based on IEEE 802.15.
<b>M-Bus</b>	AMI	European standard for reading all kinds of utility meters.
<b>PRIME</b>	AMI	Multi-vender interoperability.
<b>G3-PLC</b>	AMI	Interoperability and cyber security.
<b>SAE J2836</b>	EVs	Plug-in EV communications.
<b>SAE J2847</b>	EVs	Communication between EVs and grid components.
<b>OpenADR</b>	DR	Communications using Web Services to send demand response signals to end-use customer systems.