

The Use of IPv6 in IoT

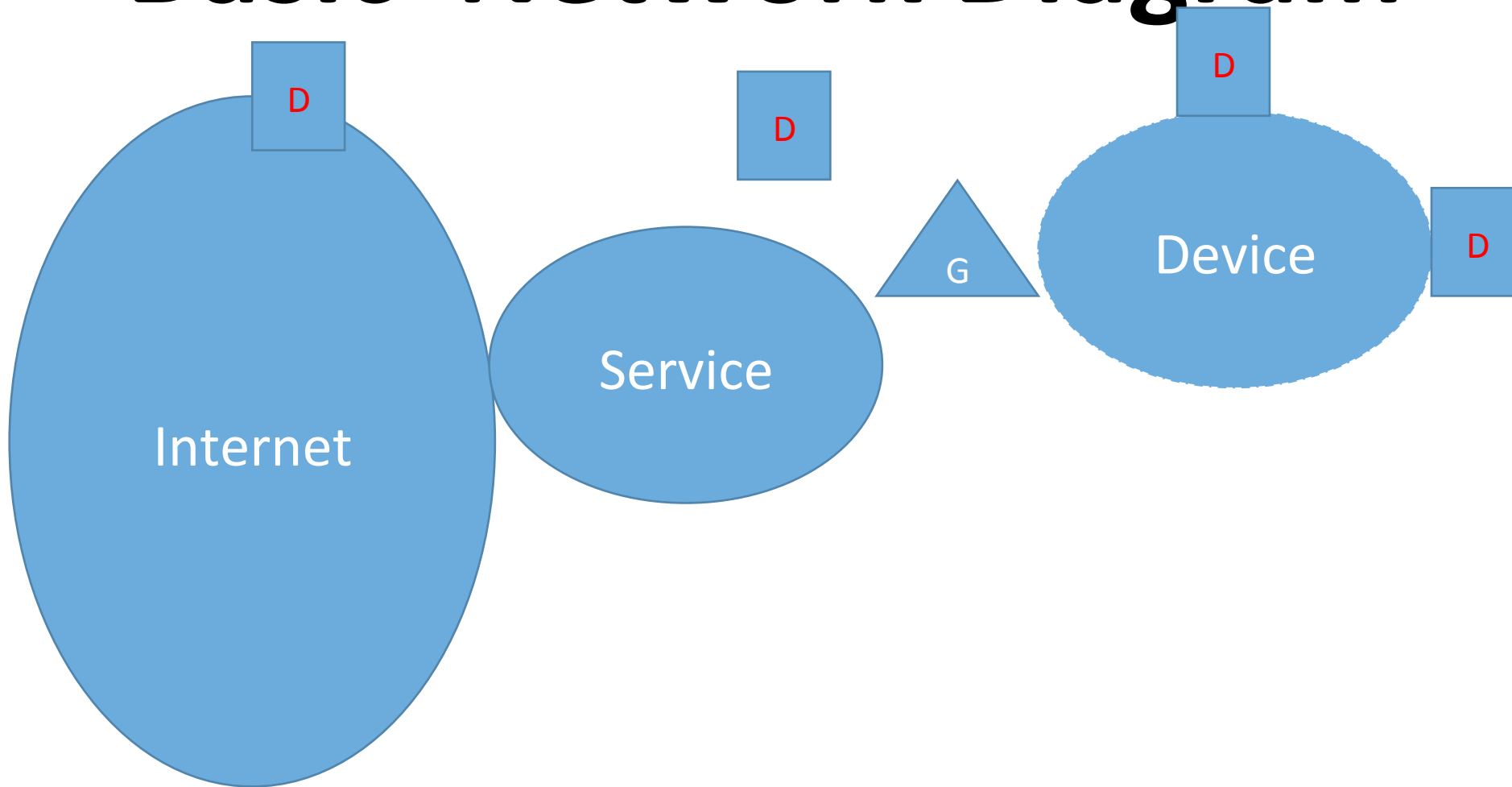
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IoT Objects and Network Characteristics

- Large number of devices
- Wide diversity of network technologies
 - IP but also others
- Wide range of access needs – Global and fairly local
- Multi-application, multi-stakeholder

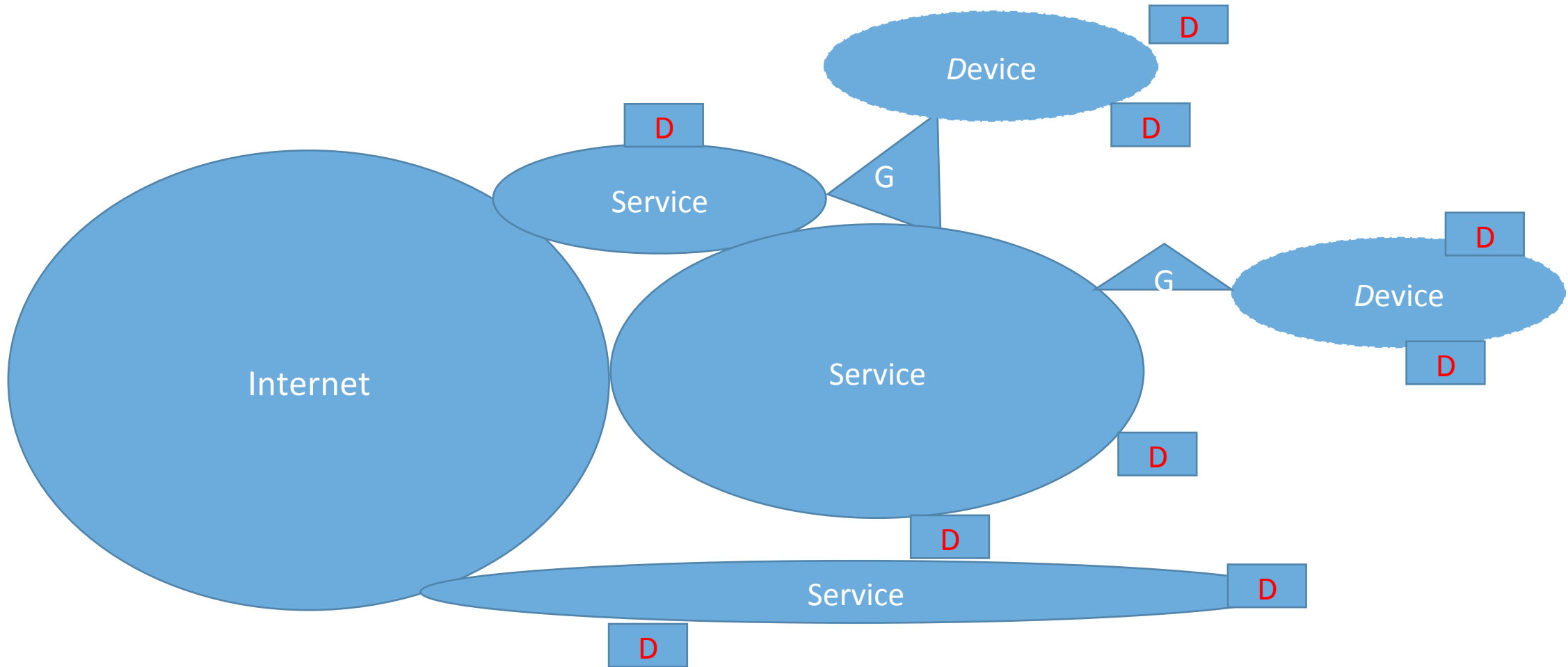
Basic Network Diagram



Basic Three Level Network Structure

- Internet, Service, Device
- ServiceNet Specific to devices used in Application
- DeviceNet often, but not always, IP
- Considerable advantage if ServiceNet is IPv6
 - Allows large number of globally addressable devices
 - IPv6 features like Multicast, MIP6, 6LoWPAN, DTLS
 - Eases multiple addresses for same globally addressable I/F

Multiple Stakeholder Nets



Multiple Applications and Stakeholders

- Physical deployment may be as previous diagram
 - Could have multiple networks on same interfaces
- Applications may use different subsets of deployment and networks in different ways
- Easiest if multiple addresses on same I/F
- Physical picture may be very confusing
 - Easiest in Cyber Space

Physical and Cyber Space Descriptors

- DNS provides Name/address mapping
 - Assume edge devices obey IPv4 or IPv6 Protocol
- In IoT, Edge devices may need attributes of mechanism of access, network used, data desired, security aspects
- Can be achieved by defining Digital Objects (DOs)
- DOs represent devices, processes, data in Cyber Space
- A system like HANDLE represents them in uniform way

Identifiers and Attributes in IoT

- **Can associate each Device + App with a unique Identifier**
 - **Identifiers structured as Names in DNS**
- **A DO ID can be associated with multiple attributes**
 - **Structured as Type/Value with security and ownership metadata**
 - **One attribute can be ServiceNet IP address**
 - **Links Cyber and physical worlds**
 - **IPv4 possible work, but IPv6 is much more powerful for some situations**

Advantages of IPv6 in this Approach to IoT

- Normally deployments will be related to models that are very much application-domain oriented
- Different applications will operate on these deployments in different ways of access and with varied data requirements
- There will often be group operations of limited scope
 - IPv6 will allow direct mappings to physical addresses
- Different Stakeholders may use same I/F in different ways
 - With IPv6, can use address space of Stakeholder

Other IPv6 Advantages for IoT

- One can use the IPv6 features such as Multicast, Scope, MIP6, 6LoWPAN and DTLS
- Different access, security and data procedures can be associated directly with the IPv6 address
- The devices often have limited capability, that must be assisted by procedures elsewhere
 - **DTLS is an excellent mechanism for achieving this**

Conclusions

- While many believe that IPv6 is important for IoT, few realise the advantages beyond address size for its adoption
- When combined with Identifier and a Cyber Space infrastructure, IPv6 is particularly valuable
 - Deployments can populate an ID Attribute Database, Applications can then use this database to construct new virtual networks, and often can mirror IoT operations directly in the physical world
- These advantages will become more apparent with the large multi-stakeholder and multi-application deployments on same infrastructure that are still rare