Positon Paper

Software Defined Adaptive Networking - IoT and Beyond

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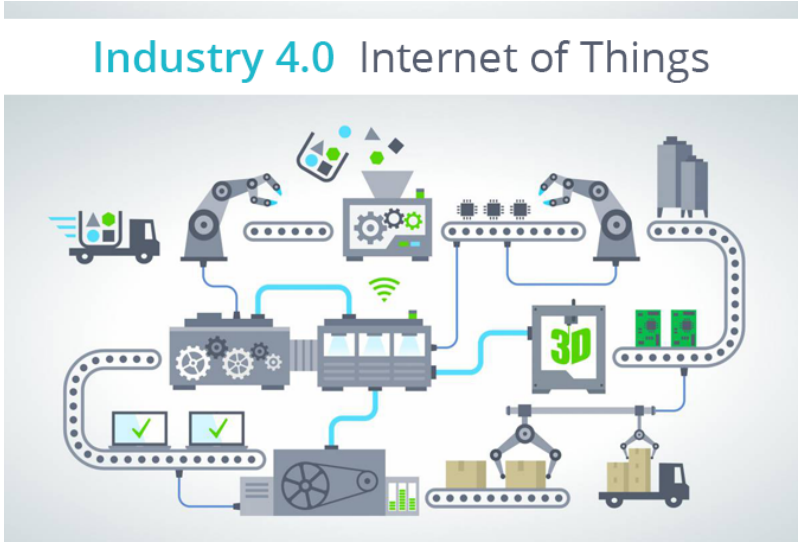
This publication has emanated from research conducted with the financial support of Science Foundation Ireland under Grant 13/IA/1892, and is co-funded under the European Regional Development Fund under Grant 13/RC/2077

Variety of IoT Platforms



www.sd3d.com/

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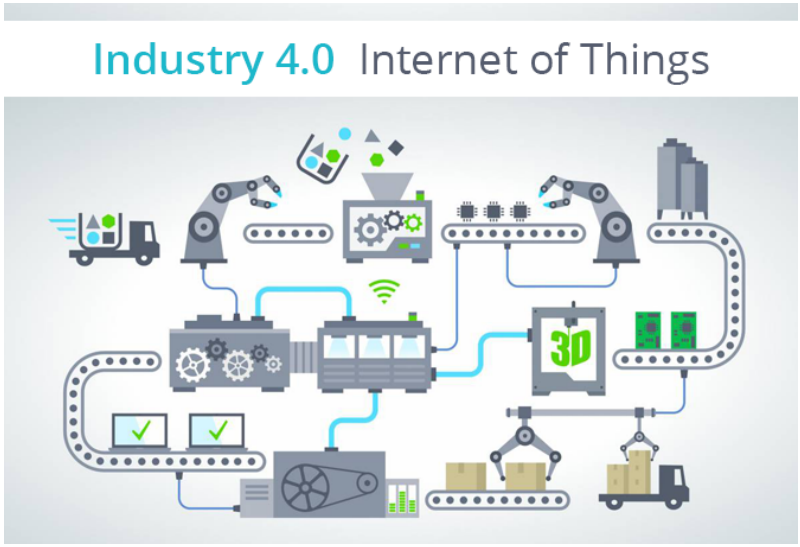

www.sd3d.com/

Connected Car

community.arm.com/

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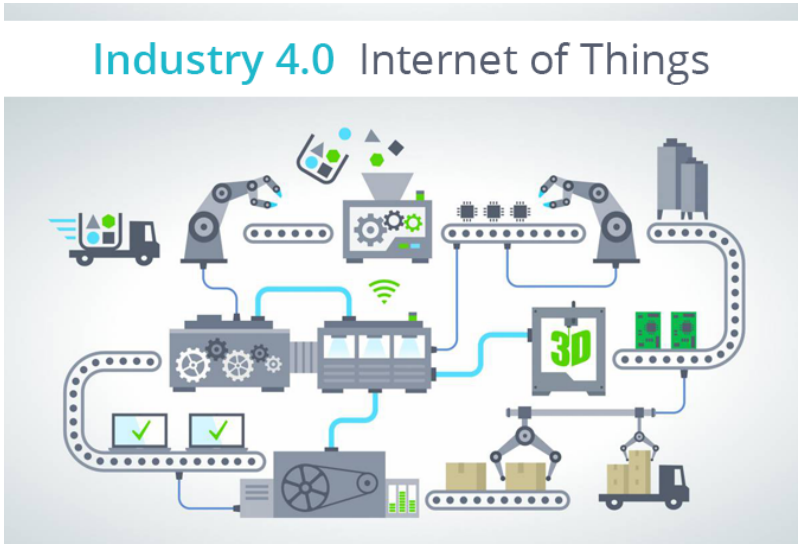

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Smart Metering

http://iot-billing.com

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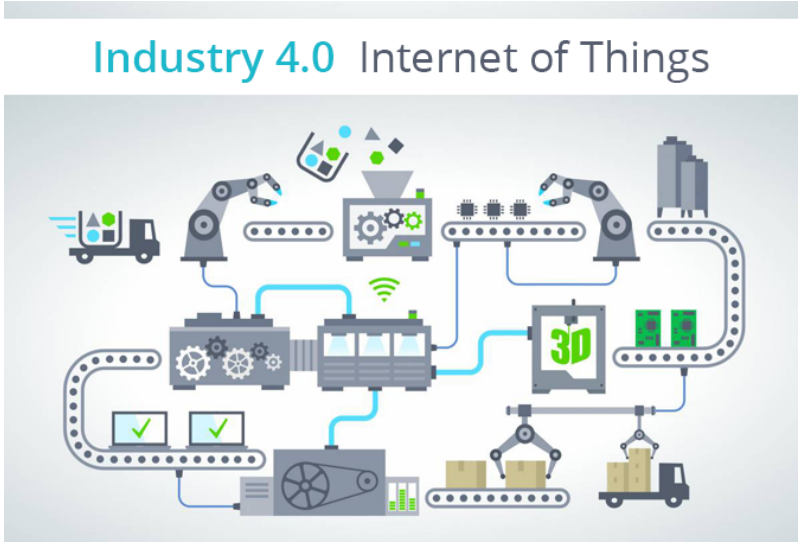

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Connected Car

community.arm.com/

Smart Metering

http://iot-billing.com

Wearable Tech

www.ariasystems.com

Motivation

- explosion in quantity of IoT devices (from 30 billion in 2020 to 75 billion by 2025 – statista.com)
- vast variety of underlying protocols
- range of tasks – from single to chained to multi-hop
- generally loosely coupled
- typically with limited impact on system architecture
- different delay demands
- resource-constrained with bursty traffic
- network integration is challenging but with great opportunities

https://www.statista.com/statistics/471264/iot-number-of-connected-devices-worldwide/

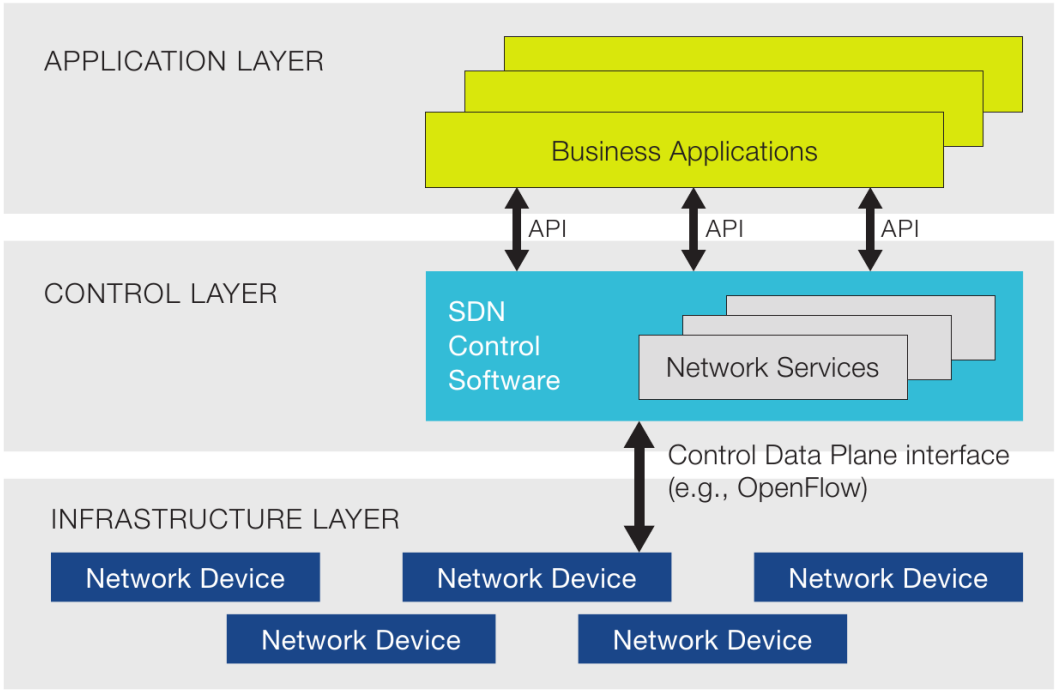
Control and Management

Software Defined Networking (SDN)

- greater control of the device workflows
- traffic management in the network

north

south



Control and Management

Software Defined Networking (SDN)

Examples of separation of control and data planes:

- Allocating rates to different IoT task [1]
- data-plane in-sensor packet forwarding [2]
- defined scheduling over static routes [3]
- mass data analytics [4]

Issues:

- static routes, static controllers, inadequate global view, simple packet forwarding
- this is management of routing rather than efficient control

Vision

Software Defined adaptive Networking (SDaN)

- higher level holistic abstraction on the north and south SDN interfaces
- distributed approach with improved global view
- platform(s)/network(s)/device(s) viewed as a single abstraction
- adaptive *"inter-operative function calls", such as:*
  - energy analysis in device
  - adaptive timing for task instruction execution
  - network slicing and prioritisation

Use Case

IoT Edge Computing – extending wireless networks

- 5G: increased physical data rates, low-latency, resiliency and reliability
- small cell adaptive networking – devices adapt not only in physical location but also connection(s) to the network
- SDaN utilises *"inter-operative function calls"* to:
  - extract workflow knowledge from devices
  - predict network demands
  - provide fairness between wireless devices

Use Case

IoT Edge Computing – extending wireless networks

- SDN permits routing of traffic to local Edge Computing Servers, with:
  - improved location awareness
  - dynamic computation resource allocation
  - local data analysis (transparent to the device)
  - reduced delay for geo-local content (producer and consumer geographically close together)
  - access to radio network information from device(s) and network(s)
  - IoT-centric service provisioning, such as slicing and prediction
  - improved mediation between end devices

Conclusion/Summary

- SDaN, proposed to finally brings system control to SDN
- workflow knowledge rather than workflow routing
- predict rather than react to network demands
- fairness between devices, irrespective of platform
- harmonised resource management, such as:
  - energy consumption
  - triggering of work tasks
  - synchronisation of network interactions
- for IoT and beyond

Questions?

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An Internet Infrastructure for Video Stream Optimisation (iVID) Project

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Check out the iVID Datasets and Software

mCast:	Prototyping SDN-based Multicast Architectures
miniNAM:	A network animator for Mininet
D-LiTE:	A platform for evaluating DASH in a simulated LTE network
D-LiTE-ful:	An platform for DASH SDN offloading in LTE
DASH: Datasets	AVC (H.264) and HEVC (H.265) - trace and stream-based - QoE metrics: PSNR and VQM
SAP:	Stall-Aware Pacing for DASH in Cellular Networks

http://www.cs.ucc.ie/misl/research/current/ivid/

sfi Science Foundation Ireland

Open Questions

- security
  - from interactions to function call deployment
  - end-2-end and device-2-device
- controller sychronisation issues
- can network function virtualization (NFV) be used for dynamic instantiation of *inter-operative function calls* on devices
- adaptive energy usage management in WSNs due to increased interactions
- scalability concerns