Next Generation IoT: Accelerate de-carbonization with AI/ML based data strategy

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Herbert Mittermayr
“We know the past but cannot control it. We control the future but cannot know it.”
Climate change is the planet’s biggest challenge
We must create sustainable societies, economies and environments

1.09°C
Earth’s average temperature rise 1880-2020
Source NASA

2020
Joint warmest year on record

19
of warmest years recorded since 2000

250x
CO2 from human activity is increasing 250x times faster than from natural sources after last Ice Age
Source NASA

90%
of GHG absorbed by oceans
Source National Geographic

Global Land-Ocean Temperature Index
Climate change will impact industries, consumers and regulations

Eye opener ➢ Following the 2016 Paris Climate Agreement, governments & businesses agreed to reduce their dependence on fossil fuels to limit the rise in global temperatures to 2 degrees above pre-industrial temperatures (and aim for 1.5 degrees). The intent is to reach net zero carbon emissions by 2050.

Loss ➢ Governments are developing green policies and considering carbon taxes to curb emissions. Companies generating high levels of carbon emissions will see their costs increase and brands suffer.

Impact ➢ Continued global warming is expected to reduce the places where we can safely live & work. This would impact industrial production and cause shortages and disruption.

New way ➢ It’s not enough to switch to renewable energy. We must continually reduce energy consumption, and therefore emissions, by automating operational processes and using enhanced connectivity and digital services.

Nokia position ➢ “There is no green without digital” – Pekka Lundmark / CEO

Solution ➢ While communications networks generate carbon emissions, that contribution is mitigated 10x by enabling other industries to reduce their emissions through enhanced connectivity and services. There is an opportunity here for all telecommunications networks and its service providers.

Trust ➢ In early 2021, Nokia announced it aims to reduce emissions by 50% across its own operations, its value chain & products in use by 2030. This is Nokia’s recalibrated Science Based Target (SBTs) in line with a 1.5°C global warming scenario.
In its **Enablement Effect** report, the GSMA estimated that while mobile networks contribute about 0.4% to global emissions, the level of avoided emissions enabled today is a **10:1 positive impact**, and this is set to double by 2025.
Bell Labs Consulting aligns three strategies to ensure future networks and operational capabilities dynamically align to changes in strategy and objectives.

- Network capabilities to support a complex technological and service landscape
- Organisational & leader capabilities & future structure to foster innovation & collaboration
- System of activities required enable rapid feedback and insight
- Orchestration and data to automate tasks and augment human decisions
- Strategic planning, governance and insight to facilitate good decision making

- Market opportunities
- De-carbonization goals
- Business objectives
- Customer commitments
- Types and size of business

- Value chain capabilities
- Commercial conditions to model the desired value chain behavior
- Mechanisms to promote co-innovation
The historical value shift in **electrical energy** technology since the 1930’s gives a solid indication of where the future value lies

<table>
<thead>
<tr>
<th>1930s</th>
<th>1950s</th>
<th>1970s</th>
<th>2010s</th>
<th>2030s</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Production:</strong></td>
<td>Small powerplant typ. 10MW</td>
<td>medium powerplant typ. 200MW</td>
<td>More and bigger &gt; 1GW</td>
<td>Many more &amp; much smaller typ. 5kWp solar typ. 5MWp wind</td>
</tr>
<tr>
<td><strong>Distribution:</strong></td>
<td>Local distribution</td>
<td>Local distribution and further</td>
<td>UHV lines &gt;380kV HV lines, 110kV Medium 10..30kV</td>
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</tr>
<tr>
<td><strong>Consumption:</strong></td>
<td>Machinery in manufacturing Lighting in Cities Households' (lamps)</td>
<td>For machinery in big manufacturing</td>
<td>Ubiquitous consumption</td>
<td>Higher variable loads e.g. BEV (10..100kW)</td>
</tr>
</tbody>
</table>

**Virtual Power Plants**
Manageable production

**Microgrids**
Smart intelligent grid with massive IoT

**High loads, plus storage, e.g. BEV**
Manageable consumption

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Balance electric power supply and consumption with AI/ML platform
Avoid carbon intensity and optimize demand-supply

3 green power challenges

- The move to renewables increases the installed (peak) power capacity
- However, energy production dynamics increases as well, and
- Variation in consumption increases, with bigger loads (BEV)

With increasing volatility

Variabilities over 1 day (a snapshot):
- Carbon intensity 1:6:1
- Electricity production 1:75:1
- Electricity prices 1:7:1

Enabling technologies

Control layer
- Massive IoT allows control both at production power as well as on energy consumption loads

Data layer
- Intelligent forecasting predict renewable productions, depending on weather
- Intelligent load control with IoT connected e.g., via telcos IoT-network
- Network-as-a-sensor for predictive power production estimation

Intelligence layer
- AI/ML based optimization between demand, supply and external factors
- Operation with monetizing data and algorithms in an aaS knowledge base model
AI/ML platform need to balance electric power supply and consumption

Green energy optimization platform in an aaS-model

Telecommunications network
Leverage network assets and IoT for optimizing on electricity costs and even generate revenue

Data lake Operator
Create a telco-grade AI/ML solution offering aaS model for electric power supply-demand balancing

Grid Operator
Extend virtual power plants and grid control with IoT control, based on ML algorithms

Green energy optimization
• Metaverse trading platform
• Ubiquitous data lake
• Massive IIoT, incl network-aaSensor
• AI/ML based optimization
• Balancing demand-supply
• Planning predictive maintenance

→ Green energy aaS model
Bell Labs future architecture for green energy optimization
End-to-end networking for green energy digital transformation journey

Value creation

Agility
Intelligence
Efficiency
Security
Low-latency
Robustness
Capacity
Coverage

Connectivity

Business applications
AI/ML based optimization applications
Energy efficiency and safety
Asset optimization & automation

Data lake platform
Horizontal integration in Ind4.0
Cognitive analytics
Digital twins congruence

Multi-cloud
Local edge
Distributed edge
Hybrid cloud

High performance networking
Deep wireless connectivity
Massive IoT
Network as a Sensor

Dynamic Security
Industrial Metaverse

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Utility of the future – a Bell Labs perspective

To envision the electric grid of the future, it is helpful to look at the forces that have shaped the electric grid to date and envision how changes in the underlying economics and capabilities of grid technologies will shape its future.

Executive summary

Pervasive, wide-scale deployment of distributed generation and storage is a major disruptive force that will shape the electric power utility of the future. Significant amounts of power will be generated at consumer premises and at stand-alone distributed generation locations leading to the emergence of neighborhood and community energy exchanges. We
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