Watt

From Simple English Wikipedia, the free encyclopedia :https://simple.wikipedia.org/wiki/Watt

*The **watt** (symbol: W) is the SI unit of power.*

Definition

The watt is a method of measuring the rate of energy transfer of an appliance. A one watt lightbulb, for example, will change one joule of electrical energy into light energy (and some heat/sound) every second, thus "consuming" it. It is a measure of an appliance's power (appetite for joules).

*The **watt** is the rate a source of energy uses or produces one joule during one second, so the same quantity may be referred to as a **joule per second**, with the symbol **J/s**. It can also be written as $kg{\cdot}m^2{\cdot}s^{-3}$. The more watts, the more energy used per second. That is why a higher-watt electrical appliance works faster than a lower-watt appliance.*

It is equivalent to one volt ampere (1 V·A) or 1/746 of a horsepower. The power of a light bulb is measured in watts. LEDs have much smaller consumption of power. Example small led can be used by 0.015 watts (2.0×10^{-5} horsepower) what can be also written 15 milliwatts.

*Watt is a unit of power, joule is a unit of work and energy, and time is a unit of time. An equation for solving Power, Work and Time is **Power = Work ÷ Time, Work = Power** × **Time,** or **Time = Work** ÷ **Power**.*

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Greening of Streaming View

By the Lexicon Working Group (WG1)

WATTs, Streaming Services and Measurement.

Greening of Streaming has an objective to improve the energy efficiency of streaming ecosystems. It adopts a WATTs first target, in the belief that by focusing on reducing the power used by the complete system there will be benefits both in a reduced TCO and in a raised ESG position, ultimately benefiting stakeholders, shareholders, subscribers and consumers.

On reviewing the supply chain for common frames of reference around which to orient systemic change with the goal of improved energy efficiency, WATTs have proven to be the one consistent measure that ALL streaming service providers *can* potentially measure. From energy supply through the telecoms and internet switching and routing, right up into the service provisioning and out to the consumers, every participating digital system can potentially provide WATT measurement.

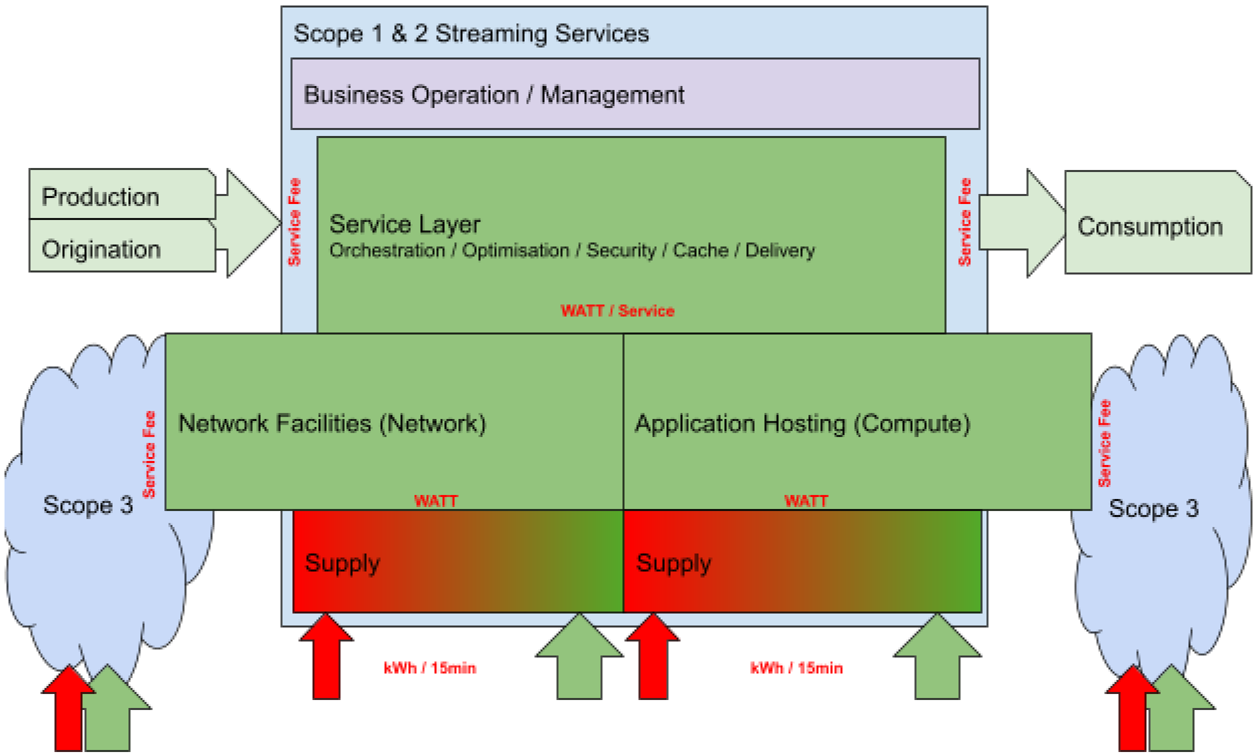
Some, we have found, will only provide Ampere and Voltage, but WATTage can be derived from these KPIs. Other infrastructures have enterprise management systems that can monitor power demand from individual processes, chipsets, PSUs, PDUs and top-of-rack systems.

It is complex to measure streaming services that span multiple systems. In many cases these are 'nested' systems such as a process on a CPU on a server with PSUs, in racks with PDUs which in turn are monitored at a 'room' or 'availability zone'. The wrong measurement will count the same WATT multiple times, or miss evaluating the demand for energy-hungry 'parent systems'. It is therefore critical that a complete systemic view be taken before any claims about the power requirement are made by individual contributors to the ecosystem, and particularly before any claims of reduction in power are made. Not least, it may be that the measurement is focussed on the wrong power load and a reduction in one area may cause unintended increases, and even significant increases in power consumption elsewhere in the complete system view. Without establishing a consistent way of measuring, we can't hope to 'actually' reduce energy consumption.

Despite the challenges of measuring and relating streaming services to power demand, Watts do at least provide a single constant reference throughout all disciplines.

Energy providers bill in kWh at the point of consumption by the infrastructure providers. kWh are volumetric counts that are metered. For larger enterprises this billing can be resolved to 15-min increments. There is also typically a 'peak' supply load measured in Watts. All systems must run within that peak loading. Actual load is not often monitored or reported outside of the energy providers' own facilities.

A high-level schema of a streaming service and its relationships to measuring WATTs throughout the system:



In the diagram above a demarcation of 'scopes' is laid out (in blue) as per the GHG protocol: https://ghgprotocol.org/scope-3-technical-calculation-guidance Scope 1 and 2 ('those we can directly influence') are in the centre box. The balance of supply (billed in kWh from energy providers) can be directly controlled.

The kWh is in turn consumed by a combination of Network Facilities and Application Hosting facilities. These are also under our control, and a strong engineering focus should be, and is being fostered by Greening of Streaming, to focus on measuring this power load, and on reducing that demand - from 'any' energy supplier.

The supply to these systems is measured in kWh.. The Network Facilities and Application Hosting systems do not by default measure kWh consumption, but can typically readily provide current power consumption levels in Watts directly (or indirectly via a calculation of Voltage and Current draw).

The balance between network facilities and application hosting energy demand will vary depending on the role the streaming service provider plays in the ecosystem.

This means that at the supply stage we have to be able to measure the power demand for the provisioned infrastructure required to make the streaming service available. While the energy consumption will most closely correlate to the kWh billing from the energy providers, rather than with the traffic, the infrastructure will scale up as the service models scale up, and increase the energy demand. Planning for energy as that infrastructure scales is of essential importance.

Some model conversion metrics have been included below to help create some idea of the relationship between these measures of Watts from the infrastructure and kWh from the supply in some model scenarios.

Readings			Consumption calculation		Streaming Metrics			KPI	
Total Wh	Total Ah	Voltage	Interval (mins)	Equals to kWh	Traffic GB / Hour	Bitrate Mbps (w/overhead)	Viewers	Viewers/kWh /Interval	Wh/Viewer /Interval
250.00			15.00	1.00	140,000.00	5.00	62,222	62,222.22	0.02
	1.50	230.00	15.00	1.38	180,000.00	5.00	80,000	57,971.01	0.02
26,400.00			60.00	26.40	2,970,000.00	5.00	1,320,000	50,000.00	0.02
50.00			15.00	0.20	22,500.00	5.00	10,000	50,000.00	0.02

Data attribution models then have a role in helping to translate actual energy consumption and power demand to make the infrastructure correlate to an identifiable ‘Watts per service’ model, so we can understand how power demand will evolve with the scaling of the business.

WG4 Activities:

In Greening of Streaming, Working group 4 is currently working hard to instrument the interface between the supply and the Network Facilities and the Application Hosting facilities in a way that we can consistently measure wattage, and further, looking up to the Service Layer, we can isolate which systems are involved in delivering which service, and we can hope to begin to look at where infrastructure power is being demanded before, during and after the Service Layers service life cycles.

The intended outcome is to be able to communicate how the source supply in kWh is influenced by the Watts / Service as services are provisioned and scaled.

For now our key strategy is to focus initially on collectively generating a consistent model of Watt load across identifiable workflows - a target of Watt average over 15 mins ‘fits’ with the supply resolution. Through this we hope to generate enough granularity for comparison to (for example) live-event traffic spikes. The hope is that we can correlate energy variations with infrastructure deployments and then more closely deploy infrastructure to services as they are actually commissioned, used and released.

The aim is for service models to be ‘energy mapped’ in Average Watts per 15 min across their end-to-end workflows. This introspection will then allow us to properly evaluate innovations across the systems and collectively make the most energy-efficient decisions as an engineering community.