

CSA Group

Computer Real-World

Energy Use Test Procedure

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Global Footprint For Market Expertise & Access

+2,000 employees

39 offices in
14 countries,
(Including Irvine, CA)

assists in entering
+140 countries



Standards & Codes Drive Trust and Safety

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and Gas



Healthcare



Power
Generation
and Delivery

Construction
and
Infrastructure

Over **3,000** standards,
codes & related products
in **50+** technology areas

Public and
Workplace
Safety

Petroleum
and
Natural Gas

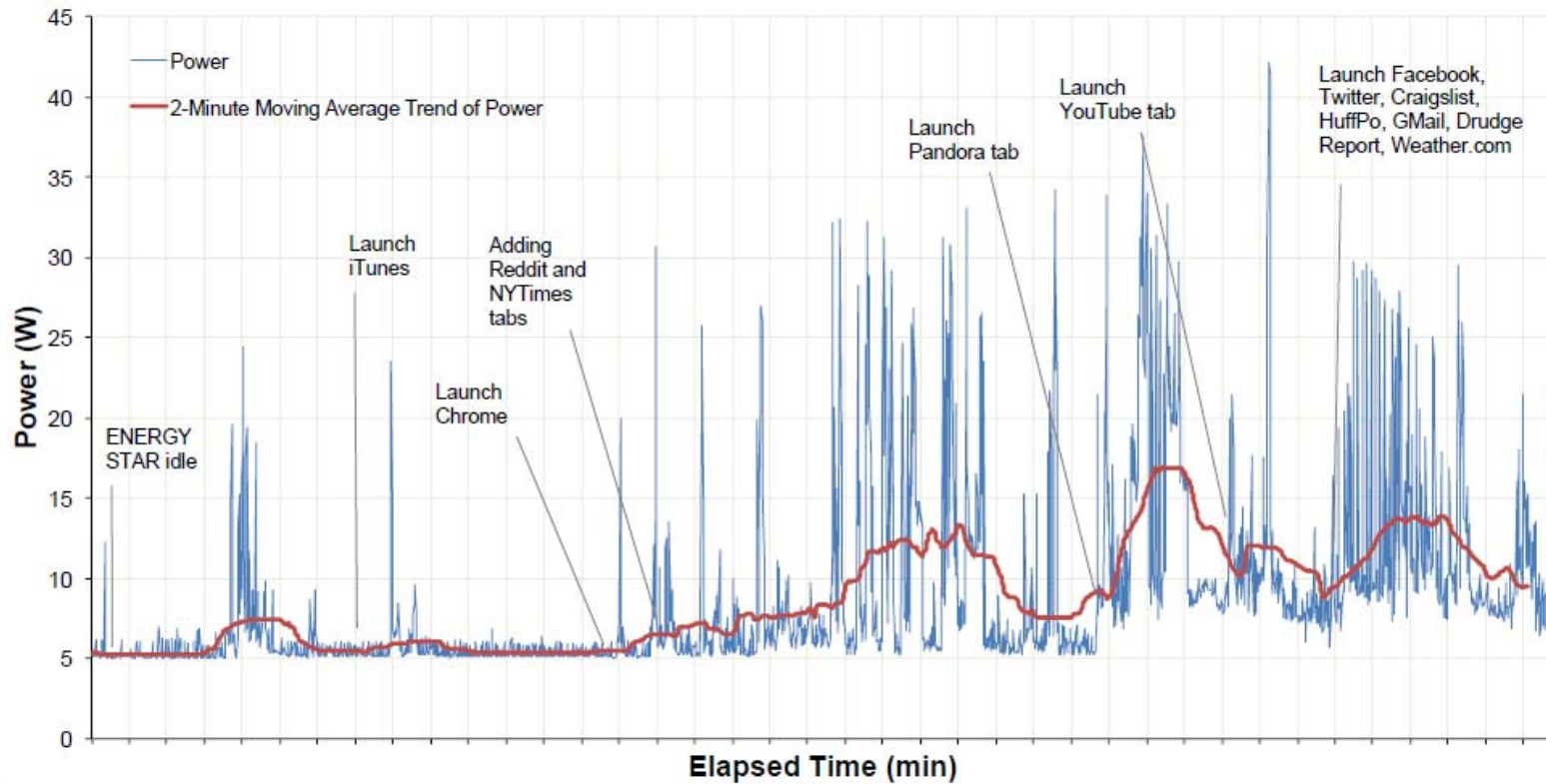


Environment



Business
Excellence

Motivating Example: Laptop idles at 5 watts (ENERGY STAR short idle), but consumes significantly more in real-world use



Source: CA IOUs Comments on CEC docket: Computers - Real World Adjustment Factor Report www.csagroup.org

Computer Real-World Energy Use Test Procedure

Computer Energy Test and Measurement

- In mobile phones and tablets, power consumption in real-life active mode is 10-100x higher than in idle
- Modern computers also heading that way, with increased power scalability and modern standby
- Issue isn't just an active mode vs. Idle issue, also a real-world vs. ENERGY STAR mode issue
- Diminishing policy returns on ENERGY STAR idle. Next frontier for computer energy policy is real-world use, including “browser idle” and “browser active”:
 1. Will help more appropriately report computer real-world energy use
 2. Will enable future policy action on computer energy use



Computer Real-World Energy Use Test Procedure

Scope

- **What?** Evolve the test and measurement procedure for computers to better reflect their real-world energy use, and ensure continued effectiveness of ENERGY STAR and other energy efficiency policies
- **How?** Use established practices for energy testing of mobile devices to define test and measurement procedures for real-world idle and light active mode
- **When?** Start now with computers, leverage for other computing appliances (web & video-enabled) in the future



Approach

- In scope:

- Web browsing
- Video + audio streaming
- Real-world idle (browser windows open, programs loaded...)



Large share of typical computer duty cycle

- Out of scope (at least initially):

- High-intensity active (gaming, video editing, etc.):

Higher complexity, smaller share of computer energy use



Research Phases

	Duration (Weeks)	
Phase 1a - Proof of Concept		
Detailed Specification Dev	8	Q2'2018
Execution Environment Dev	12	
Proof of Concept Content Definition	6	
Proof of Concept Testing	2	
Project Management Phase 1a	8	
Phase 1b - Production Environment		
Content Definition	10	Q3'2018 (est.)
Validation Test Development	8	
Alpha Testing	4	
Beta 1 Updates and Testing	6	
Beta 2 Updates and Testing	8	
Public Release Updates and Testing	6	
Documentation Development	16	
Project Management Phase 1b	18	
Phase 2- Remote Streaming		
Detailed Specification Dev	4	Q4'2018 (est.)
Execution Environment Dev	8	
Validation Test Development	6	
Alpha Testing	4	
Beta Updates and Testing	4	



Inception/Timeline

- 2013 Submission by Aggios Inc. during CEC Computer Rulemaking process
 - Discussions unfold with BC Ministry of Energy and Mines, BC Hydro through Pacific Coast Collaborative (PCC)
 - Submission of a project proposal form (PPF) to CSA in 2013; approved in November 2013
 - Goal: Develop horizontal real-world idle and light active state test and measurement procedures for computing appliances based on established energy testing practices for mobile devices
- Technical Sub-Committee (TSC) formed in 2014
 - Some hesitation on industry's part to participate citing concerns around reproducibility, imminent regulation
 - 2015 - 2016: TSC generally in agreement that discussions would re-start after research was complete
 - 2017 (December): Computing Appliances R&D project initiated. Aggios Inc retained as the contractor



Project Governance

Sponsors:



CA investor-owned utilities



Advisory Committee

- Voytek Gretka, *Chair* (Morrison Hershfield)
- Jovan Cheema (CSA Group)
- Gary Hamer (BC Hydro)
- Pierre Delforge (NRDC)
- Vojin Zivojnovic (Aggios Inc)
- Pat Saxton (CEC)

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Phase 1a – Executive Summary

- 1) Active Mode Test and Measurement (T&M) Specification
 - T&M definition and execution environment
 - Benchmark and content definition
 - T&M procedure specification

- 2) Develop prototype execution environment

- 3) Create proof of concept content



Test & Measurement Definition

- Each T&M procedure defines the sequence of content to be loaded, as well as the user interactions with the content
- The T&M procedure shall perform a fixed set of actions over a pre-determined period of time
- T&M Procedure Requirements:
 - Representative
 - Repeatable
 - Platform Independent
 - Reasonable



Existing T&M Procedures and Benchmarks

EnergyStar T&M procedure

- Single measurement run, sensitive to settling time (maintenance tasks after prolonged off-periods)
- Measurements are often difficult to reproduce, results can vary significantly

Various performance-oriented browser benchmarks

- Basemark Web 3.0
- browserbench.org (Speedometer, JetStream, Ares6, Motionmark)
- Peacekeeper
- Octane
- Sunspider
- PCMark8

Existing energy benchmark:

- EEcoMark (BAPCO)

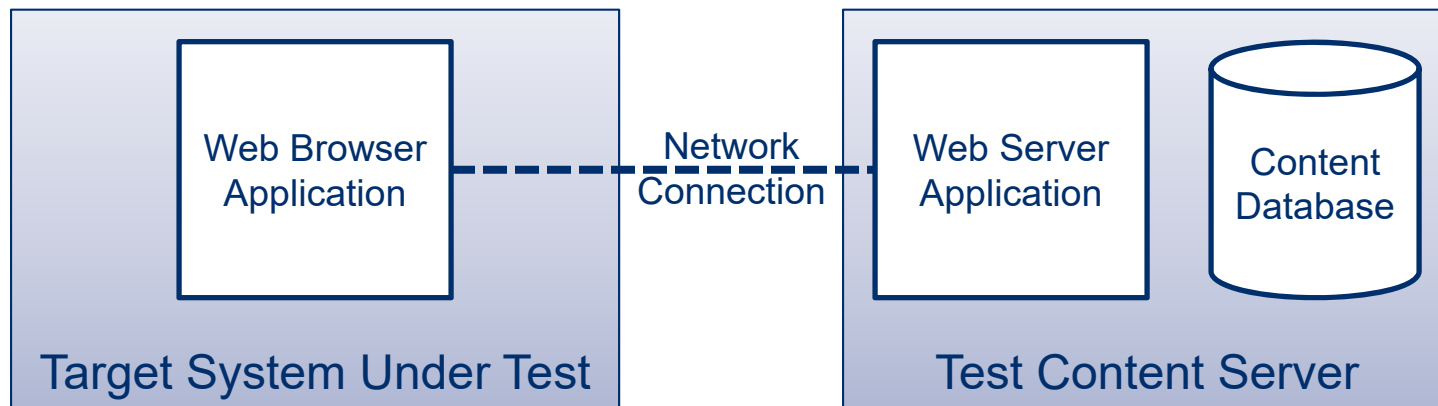
Challenges

- Existing benchmarks either measure the time it takes to perform a fixed task, or they measure how much work can be performed in a fixed amount of time
- Existing benchmarks are performance-oriented, hence browser intensity is much higher than real world usage
- Existing energy benchmarks are not device independent, i.e. they need device-specific code



Execution Environment

- We propose the following setup for active mode and real world idle benchmarking:



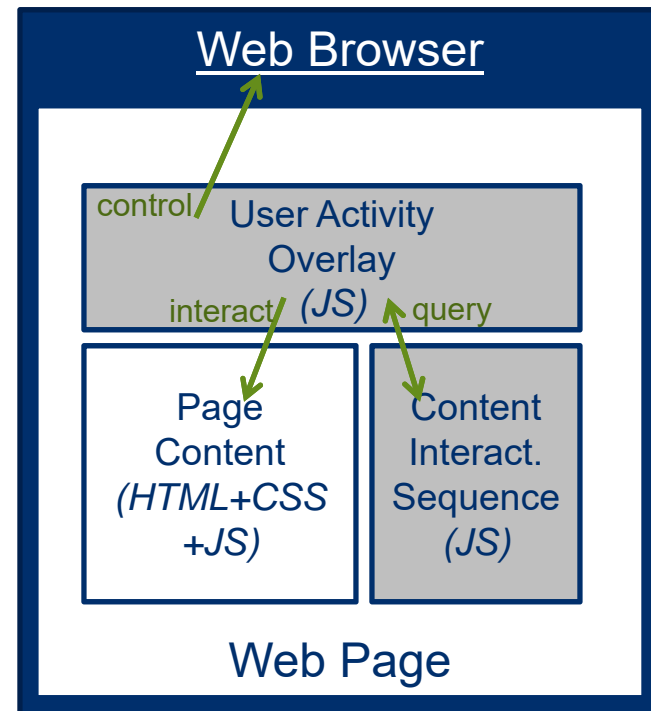
Web Browsing T&M: User Activity

- The following user activities shall be covered by the T&M procedure
 - sequentially visiting multiple different websites
 - scrolling up and down the page
 - moving the mouse over page items triggering dynamic content
 - downloading files
 - clicking on hyperlinks
 - entering data in forms and submitting the data
 - opening new browser tabs and browser windows

Proposed Solution: User Activity Emulation

JavaScript Overlays:

- Emulate user activity in a platform independent manner
- Each web page generated by the test content server shall consist of
 - The content itself (HTML, CSS, JS)
 - Content interaction sequence (JS)
 - Benchmark overlay (generic JS)
- The benchmark overlay JavaScript code will query the content interaction sequence and then emulate user activity by controlling the web browser (e.g. scrolling) and interacting with the web page (e.g. trigger dynamic content).



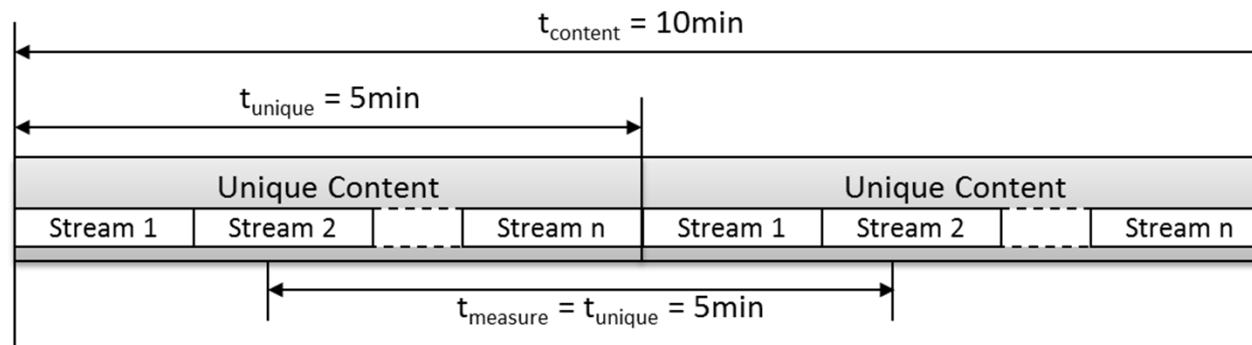
Content Definition

- Content must be defined for each activity type
 - Web browsing
 - Audio/video streaming
 - Real world idle
- Content must be representative
 - Must include all relevant technologies
 - Reflect content of popular US consumer and business websites
 - Must reflect similar level of complexity and hierarchy
 - Must include HTML5 and CSS3 features
 - Restricted to standardized features supported by all browsers



Video Stream T&M

- To ensure timing independent results the content must be repeated



- To avoid unintended caching effects each repetition should have its own unique URL
- Two repetitions should be sufficient as we want each unique content to be covered once
- Unique Content duration is TBD, proposed time is 5 minutes

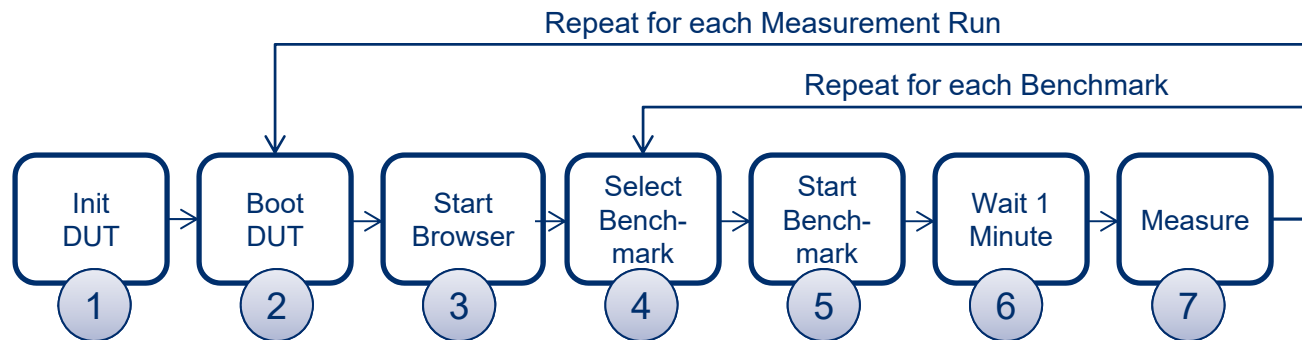
Power Measurements

- Power Measurement Requirements
 - Relevant
 - Content shall be representative of typical consumer and business websites
 - Reliable
 - Execution environment shall ensure reliability
 - Repeatable
 - Controlled, locally hosted content
 - Well-defined power measurement procedure
 - Reproducible
 - Local hosting of content
 - Well-defined power measurement procedure
 - Reasonable
 - A 5-minute cycle should be sufficient to produce representative results



Power Measurement Procedure

- We propose the following procedure for measuring power during active mode benchmarking:





Questions?



**CSA
Group**