

NTIA IoT WG4

INCENTIVES AND BARRIERS

For new comers - Who are we?

WG4 - Incentives and Barriers

How do we foster greater adoption of good patching and updating practices?

What influences the decision making process around adoption?

Definitions

- Finalize our taxonomy concept, focus on ‘environmental’, ‘interactive’, and ‘scale’ factors
 - **Environmental:** surrounding, externalized factors with material impact to IoT upgradability and patchability
 - **Interactive:** machine-machine or human-machine interaction with IoT and its relation to upgradability and patchability
 - **Scale:** connected device is beyond any localized infrastructure; the factor of scale concerns how far-reach (i.e. penetration) and exhaustive (i.e. new and legacy devices) an upgrade or patch could go
- Major stakeholder groups identified as ‘producer’, ‘user’, ‘regulator’
 - **Producer:** An individual organization that designs and/or manufactures hardware or software components of IoT products in whole or in part, or a provider whose service(s) is essential to the expected functioning of the product. Influenced by: cost, market pressure, mitigation of risk; reputation; profit
 - **User:** An individual, organization or machine that procures and/or implements and interacts with one or more IoT products in any given context. Influenced by: features; ease of use; cost; safety; privacy
 - **Regulator:** A government or private sector organization that requires or recommends, via enforcement or voluntary adoption, one more standards pertaining to the expected features and functionality of an IoT product, either specifically or categorically. Influenced by: safety; privacy;

Stakeholder	Category	Factors
Producer	Software	Environmental
		Interactive
		Scale
	Hardware	Environmental
		Interactive
		Scale
	Service	Environmental
		Interactive
		Scale
User	Human	Environmental
		Interactive
		Scale
	Machine	Environmental
		Interactive
		Scale
Regulator	Enforcement	Environmental
		Interactive
		Scale
	Voluntary	Environmental
		Interactive
		Scale

Use-Case Development

- Focus on multistakeholder relations to IoT scenarios. For example:
 - **Connected dishwasher in a small- to medium-sized restaurant**
 - Supermarket to perform automated inventory check
 - Trash can to monitor when full and notify collection trucks
- Recognize risk and incentivize desired behavior based on purpose and expected life cycle of device
- Use of personification and design-thinking to consider stakeholders' perspective
 - Effectively identify corresponding barriers and incentives

Example: Producer Dishwasher Software

Factor	Barrier	Incentive
Environmental	<ul style="list-style-type: none">• Ability to track device ownership is difficult• Unreliability of Internet connectivity• Attack vector for malicious code insertion<ul style="list-style-type: none">• Unintended operation• Impact to connected environment	<ul style="list-style-type: none">• Improve operation/new features• Bug fixes• Integration with smart home
Interactive	<ul style="list-style-type: none">• Consumer “jail-break” and “factory reset”• Consumer perception of control and privacy	<ul style="list-style-type: none">• Improve user experience/features
Scale	<ul style="list-style-type: none">• Support of legacy devices	

Example: User Human

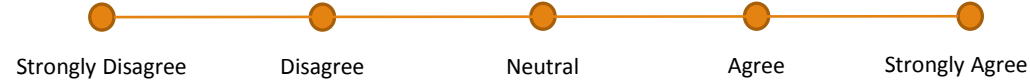
Factor	Barrier	Incentive
Environmental	<ul style="list-style-type: none">• Possibly more expensive than “dumb” dishwasher	<ul style="list-style-type: none">• Improve operation/new features• Bug fixes• Integration with smart home
Interactive	<ul style="list-style-type: none">• Perceived loss of control• “Hackable”	<ul style="list-style-type: none">• Perceived increase in control• “Hackable”
Scale	<ul style="list-style-type: none">• NA?	<ul style="list-style-type: none">• NA?

Extend use-case beyond qualitative description

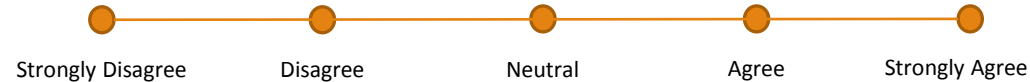
- Use-case is effective to describe barriers and incentives via a content-rich, qualitative manner.
- Conversion of qualitative data to quantitative is useful for further analysis (or to inspire efforts to find solutions)
- Tools similar to Likert Scale could be used to quantify relative strength of barriers and incentives identified

Example Questions for Dishwasher Stakeholders

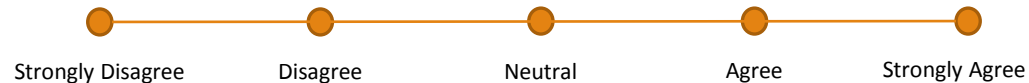
Producer: I expect to support this device for several years (Incentive/Scale)



User: New features are important to me (Incentive/Interactive)

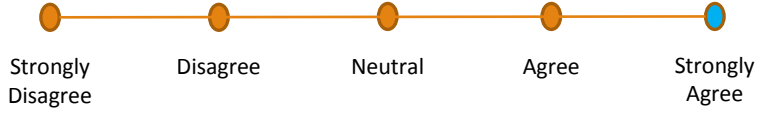


Regulator: This device impacts users physical safety (Incentive/Environmental)

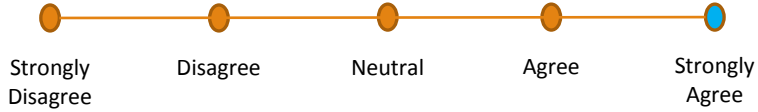


Strength of Incentives (Strong) vs. Barriers (Strong)

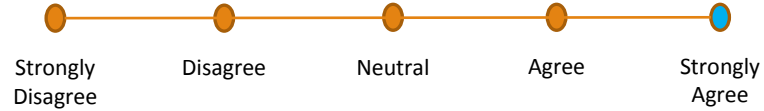
Producer: I expect to support this device for several years (Incentive/Scale)



Producer: Providing new features to users is Important (Incentive/Interactive)

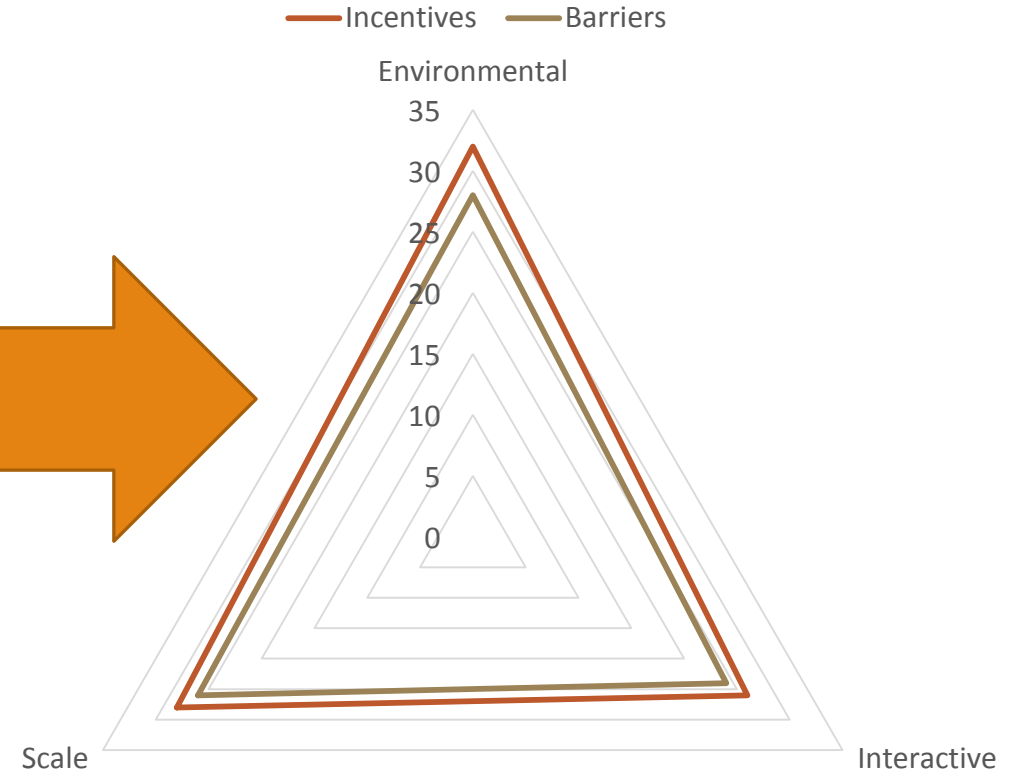


Producer: Patching could introduce new Vulnerabilities (Barrier/Environmental)



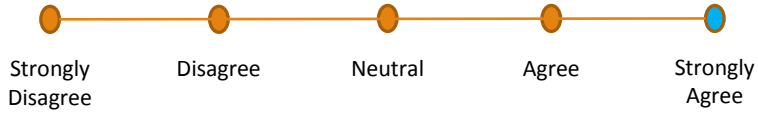
Same stakeholder

Relatively strong incentives and strong barriers == may be difficult to change status-quo.

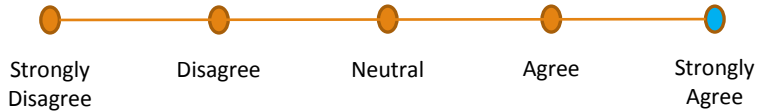


Strength of Incentives (Strong) vs. Barriers (Weak)

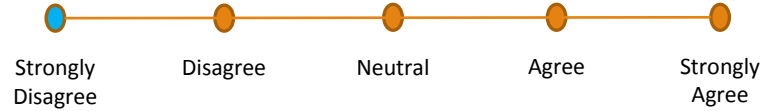
Producer: I expect to support this device for several years (Incentive/Scale)



Producer: Providing new features to users is Important (Incentive/Interactive)

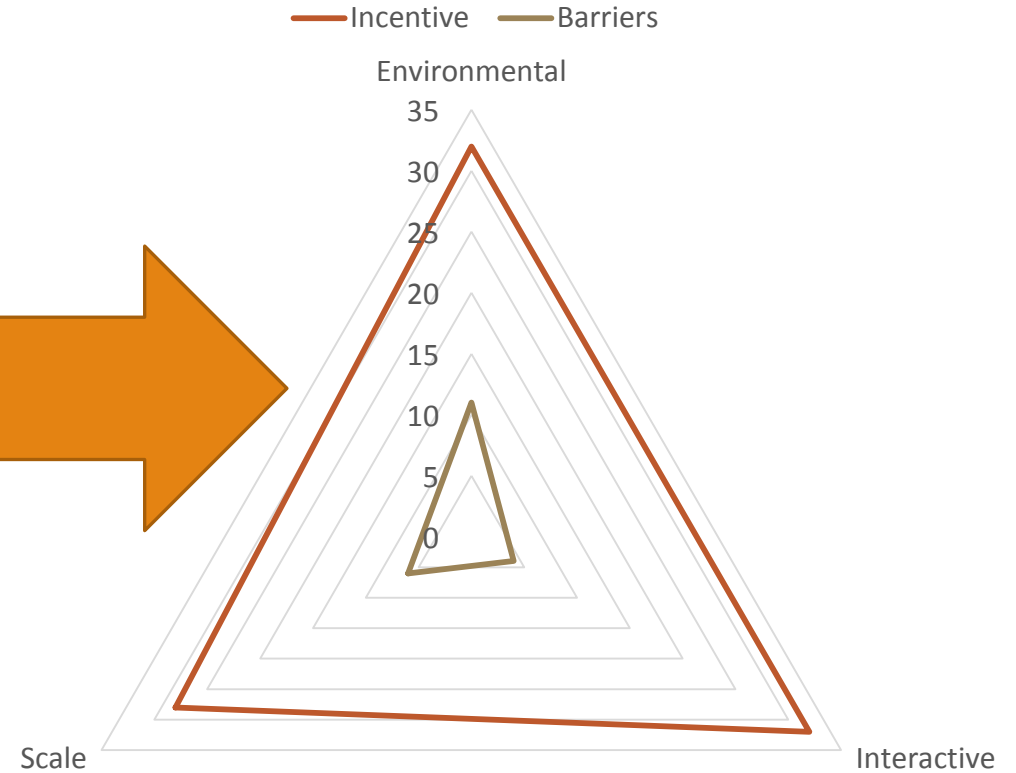


Producer: Patching could introduce new Vulnerabilities (Barrier/Environmental)



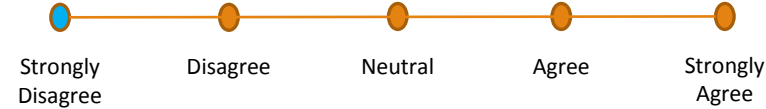
Same stakeholder

Relatively strong incentives but weak barriers == Can advocate change internally.

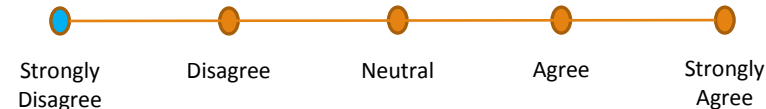


Strength of Incentives (Weak) vs. Barriers (Strong)

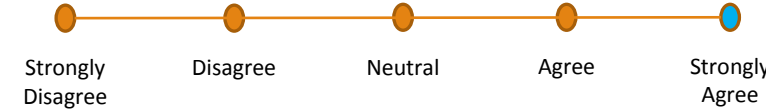
Producer: I expect to support this device for several years (Incentive/Scale)



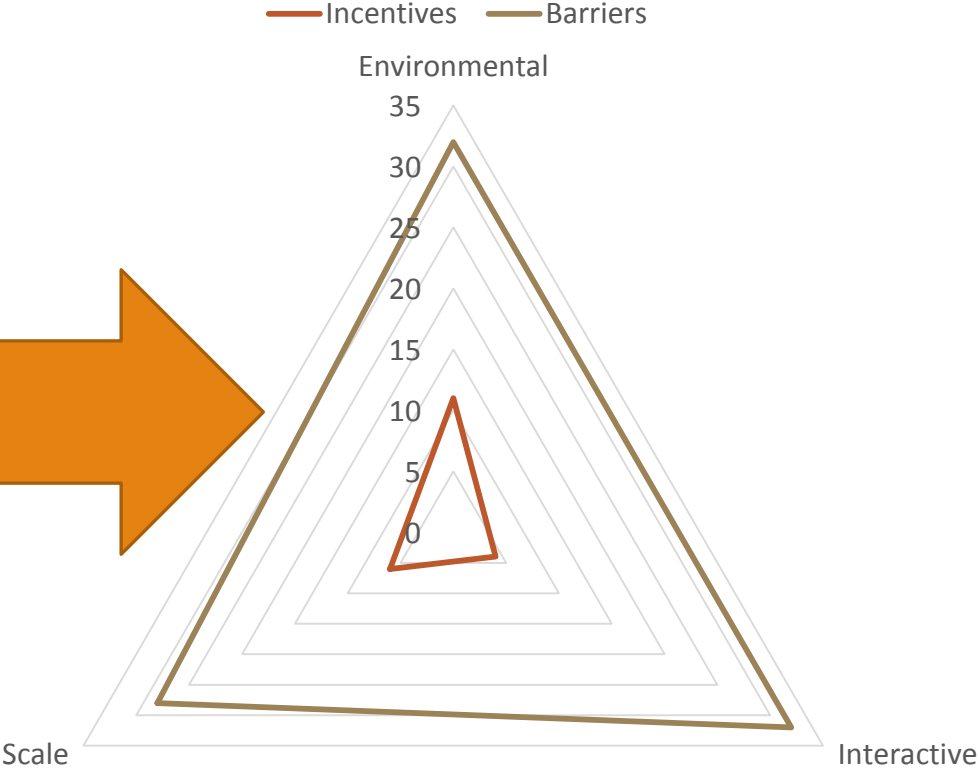
Producer: Providing new features to users is Important (Incentive/Interactive)



Producer: Patching could introduce new Vulnerabilities (Barrier/Environmental)

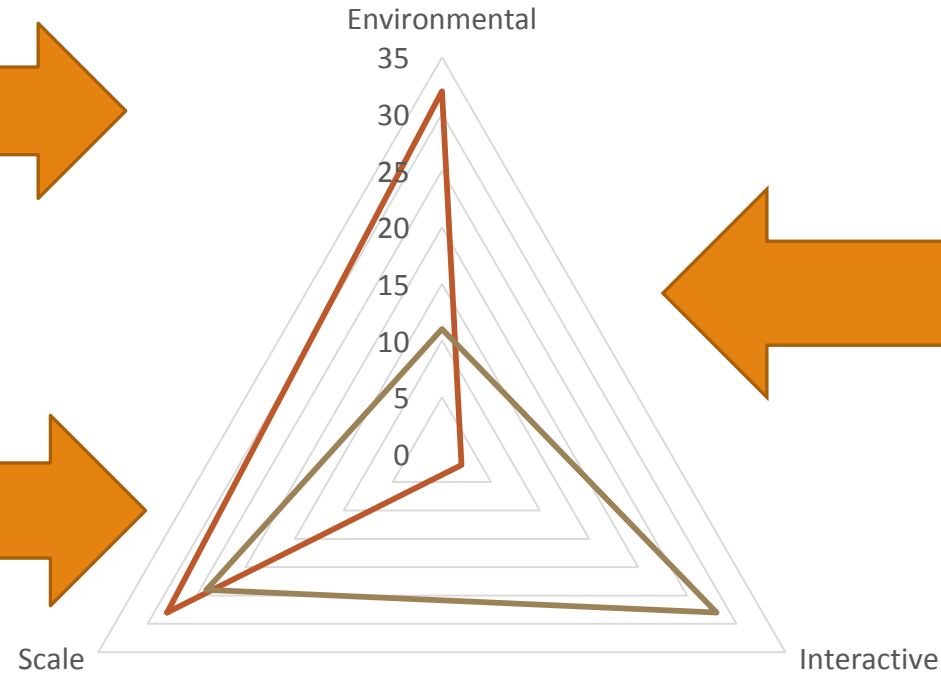


Same stakeholder
 Relatively weak incentives
 and strong barriers ==
 Hesitant to
 institute/advocate change
 internally.



Cross-stakeholder analysis Producer (Barrier - Strength) vs. Regulator (Incentive - Strength)

— Producer (Barrier) — Regulator (Incentive)



Strong Regulator Incentive with weak producer barrier on *Interactive* factors == 'easy win' to institute change.

Strong Producer Barrier with weak Regulator Incentive on *Environmental* factors == identify alternative stakeholder to address change

Strong Regulator Incentive with strong Producer barrier on *Scale* factors == driving combination to tackle 'hard' issues.

Future Directions

- Perceived and actual strength of incentives and barriers can be subjective.
 - What are the influences?
- The meaning of **change** may cover many possibilities- policies, regulations, laws, technical implementations, architectural designs
 - Further work/exploration to investigate how cross-disciplines and stakeholders can consider alternative perspectives and influence each other