IBIS-AMI and Co-Optimization

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Purpose of This Presentation

- IBIS-ATM group is working on a BIRD to extend IBIS-AMI for TX/RX Co-optimization
- We have defined
  - Target user scenarios
  - Solution requirements
  - High-level analysis flow
- We are looking for industry input on this presentation to help guide our efforts

Optimization

http://en.wikipedia.org/wiki/Mathematical_optimization

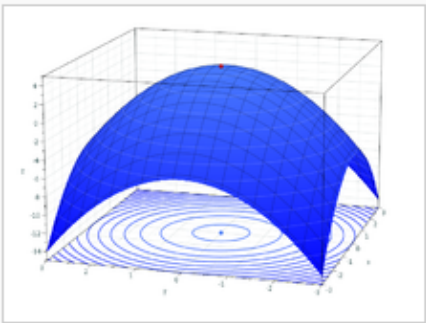
Mathematical optimization

From Wikipedia, the free encyclopedia
(Redirected from Optimization)

"Optimization" and "Optimum" redirect here. For other uses, see Optimization (disambiguation) and Optimum (disambiguation).

In mathematics, computer science, economics, or management science, **mathematical optimization** (alternatively, **optimization** or **mathematical programming**) is the selection of a best element (with regard to some criteria) from some set of available alternatives.[1]

In the simplest case, an optimization problem consists of maximizing or minimizing a real function by systematically choosing input values from within an allowed set and computing the value of the function. The generalization of optimization theory and techniques to other formulations comprises a large area of applied mathematics. More generally, optimization includes finding "best available" values of some objective function given a defined domain (or a set of constraints), including a variety of different types of objective functions and different types of domains.



Graph of a paraboloid given by $f(x, y) = -(x^2 + y^2) + 4$. The global maximum at (0, 0, 4) is indicated by a red dot.

Other Terms …

WIKIPEDIA
The Free Encyclopedia

The page "Co-Optimization" does not exist.
see whether the topic is already covered.
For search help, please visit Help:Searching.

Co-Optimization

Link Trainer

From Wikipedia, the free encyclopedia
(Redirected from Link Training)

The term **Link Trainer,** also known as the "Blue box" and "Pilot Trainer"[1] is commonly used to refer to a series of flight simulators produced between the early 1930s and early 1950s by the **Link Aviation Devices, Inc**, founded and headed by Ed Link, based on technology he pioneered in 1929 at his family's business in Binghamton, New York. These simulators became famous during World War II, when they were used as a key pilot training aid by almost every combatant nation.


Link trainer in use at a British Fleet Air Arm station in 1943

The original Link Trainer was created in 1929 out of the need for a safe way to teach new pilots how to fly by instruments. A former organ and nickelodeon builder, Link used his knowledge of pumps, valves and bellows to create a flight simulator that responded to the pilot's controls and gave an accurate reading on the included instruments. More than 500,000 US pilots were trained on Link simulators,[2] as were pilots of nations as diverse as Australia, Canada, Germany, United Kingdom, Israel, Japan, Pakistan and the USSR.

The Link Flight Trainer has been designated as a *Historic Mechanical Engineering Landmark* by the American Society of Mechanical Engineers.[2] The Link Company, now the Link Simulation & Training division of L-3 Communications, continues to make aerospace simulators.[3]

Link Training

Backchannel (disambiguation)

From Wikipedia, the free encyclopedia

A **backchannel** is a real-time online conversation using networked computers that takes place alongside live spoken remarks.

Backchannel may also refer to:

- Return channel, a low-speed, or less-than-optimal, telecommunications transmission channel in the opposite direction to the main channel
- Backchanneling, the method a malicious malware program uses to secretly communicate to command and control servers from a compromised computer
- Track II diplomacy, an unofficial channel of communication between states or other political entities
- Backchannel (linguistics), listener responses that can be both verbal and non-verbal in nature
- Backchanneling, an organizational practice in business that involves bypassing recognized or official chains of command in order to create vulnerability[*clarification needed*] at the level(s) skipped

Back Channel

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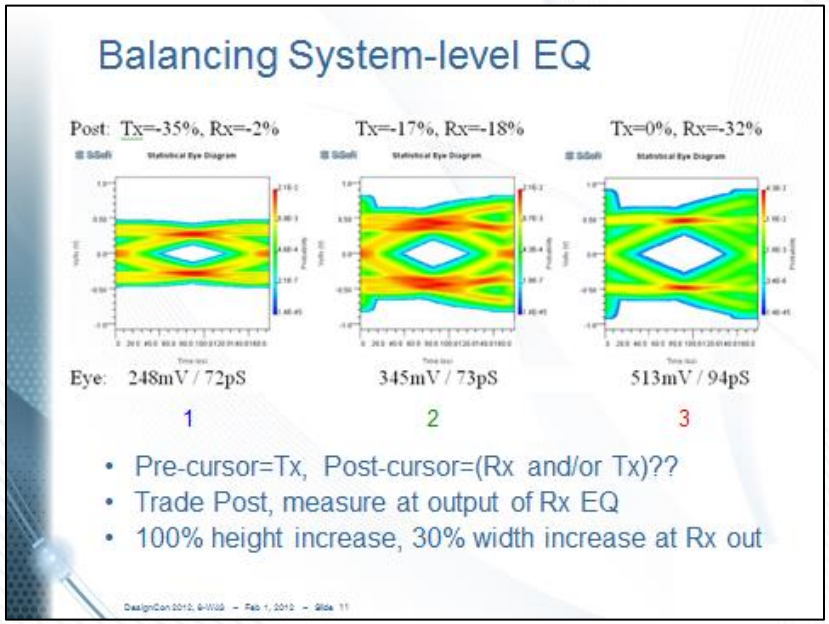
Observation …

- Optimizing TX/RX settings together provides more margin than optimizing settings individually



"Simulating Large Systems with Thousands of Serial Links"
DesignCon 2012 Session 8-WA3

Target User Scenarios

1. Hardware Back Channel Emulation
   - AMI models predict the final settings and system operating margin achieved thru hardware run-time training
2. Model-based Co-optimization
   - AMI models Co-optimize and report settings to maximize system operating margin
3. Simulator-based Co-optimization
   - Simulator optimizes settings for one (or both) AMI models to maximize system operating margin

User Scenario #1:
Hardware Backchannel Emulation

- SerDes hardware uses run-time back channel communication to co-optimize TX & RX settings
  - AMI models implement hardware optimization protocol as closely as possible to predict how hardware will converge
  - User programs hardware to self-optimize and expects that the system will converge to settings predicted by simulation
- Designer's Questions:
  - Will this link converge?
  - Do we need specific presets to ensure convergence?
  - What will the trained margins be?

User Scenario #1 Requirements

1. TX & RX models emulate hardware protocol
2. Report optimized margins (eye height, width, etc.)
3. Cross-vendor support
4. Report optimized IP settings (taps, etc.)
5. Constrain solution based on IP capabilities
6. Support hardware starting point (presets)
7. Support industry protocols
8. Support multiple protocols with one model
9. Support private protocols
10. Probes work correctly (TX EQ from TX)

User Scenario #2: Model-based Co-Optimization

- SerDes hardware **is not assumed to** support hardware run-time optimization
  - AMI models can perform co-optimization **beyond** what hardware can do at run-time
  - User programs hardware based on simulation results and expects that the system will exhibit predicted margins
- Designer's Questions:
  - Can this link work with this IP?
  - How should IP be configured?
  - What will the margins be?

User Scenario #2 Requirements

1. Report optimized IP settings and margins
2. Cross-vendor support
3. Ability to validate results independently
4. High performance optimization
   - Optimize 4,000 links overnight
5. Constrain solution based on IP capabilities
6. Support private protocols
7. Probes work correctly
8. User-selectable optimization criteria
   - Defined objectives and constraints

User Scenario #3: Simulator-based Co-Optimization

- Simulator optimizes settings for AMI models that cannot participate in a Co-Optimization flow (e.g. legacy IBIS-AMI models)
  - No additions to DLL functionality beyond IBIS 6.0
  - Optimization executed by EDA tool
  - Meta-data supplied to characterize AMI model controls and their effects

- Designer's Questions:
  - Can this link work with this IP?
  - How should IP be configured?
  - What will the margins be?

User Scenario #3 Requirements

1. Support IBIS 6.0 AMI models
   - NOTE: Requires TX models that can be configured to use exactly the settings passed in, no self-optimization changes
   - NOTE: Legacy Tx models need to supply ASCII meta-data to map tap coefficients to AMI equalization settings.
2. Report optimized IP settings and margins
3. Cross-vendor support
4. Ability to validate results independently
5. High performance optimization
   - Optimize 4,000 links overnight
6. Constrain solution based on IP capabilities
7. Probes work correctly
8. User-selectable optimization criteria
   - Defined objectives and constraints

IBIS-AMI Optimization Terminology

- **Adaptation** – When AMI models change their behavior (EQ, clock recovery) on a bit by bit basis in time-domain simulation
- **Eye Quality Metric (EQM)** – Computed measure of eye quality at the RX decision point, such that different scenarios can be evaluated and the best case identified
- **Self-Optimization** – When an RX adjusts it internal behavior based on an internal EQM to optimize its settings
- **Co-Optimization** – Simultaneous adjustment of TX / RX settings to optimize EQM, usually at the RX decision point

- **Co-Optimization by proxy** – Where one device provides the EQ that would normally be provided by another. In AMI this normally occurs with TX EQ disabled and the RX providing the TX (LTI) equalization in the TX's place

How Should AMI Co-Optimization Work?

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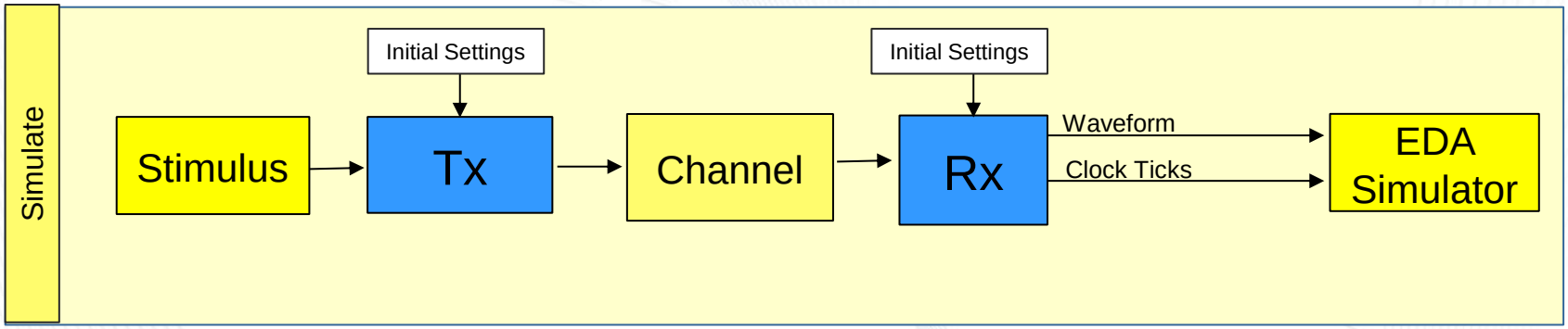
Key Questions

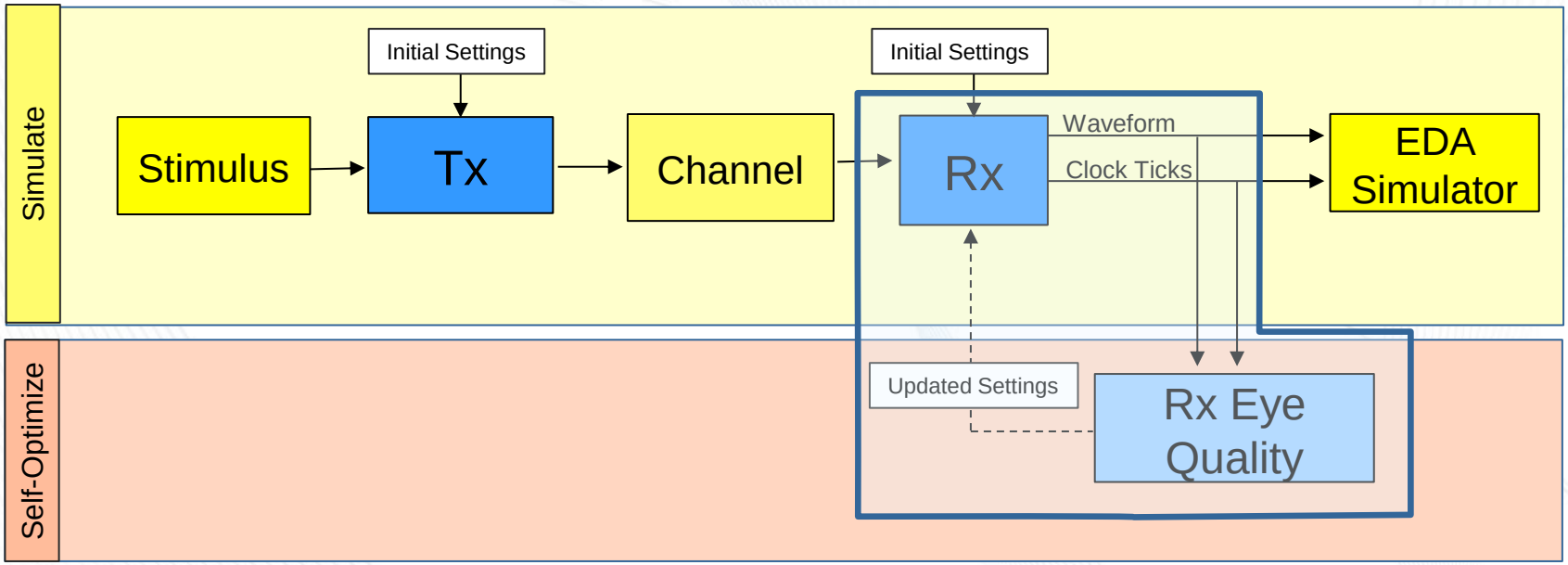
- What is being optimized?
- What does the optimizing?
- What optimization algorithm is used?

No Optimization



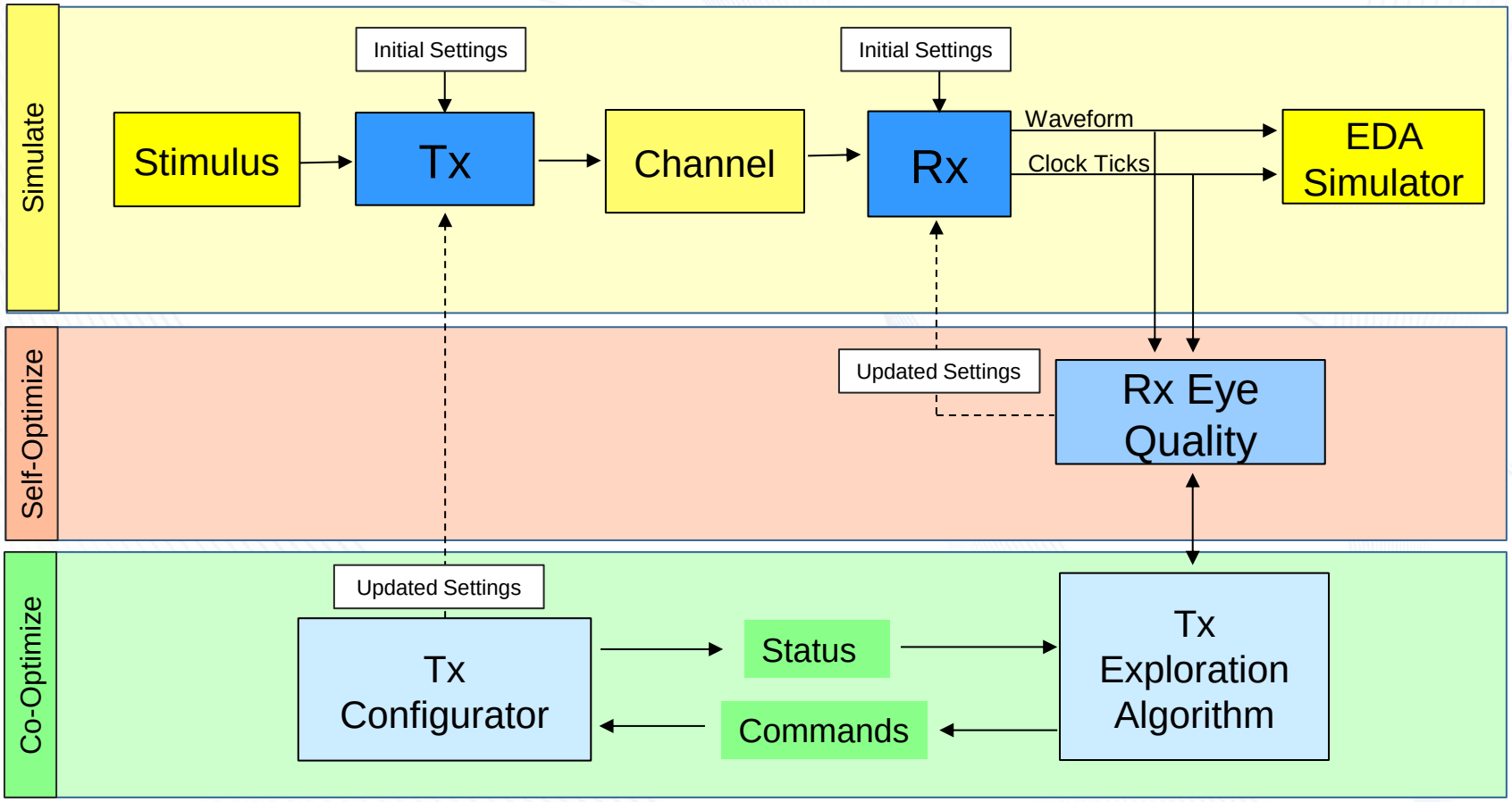
Legend: EDA AMI

Self-Optimization



Legend: EDA AMI

Co-Optimization Functions



Legend: EDA AMI Messages

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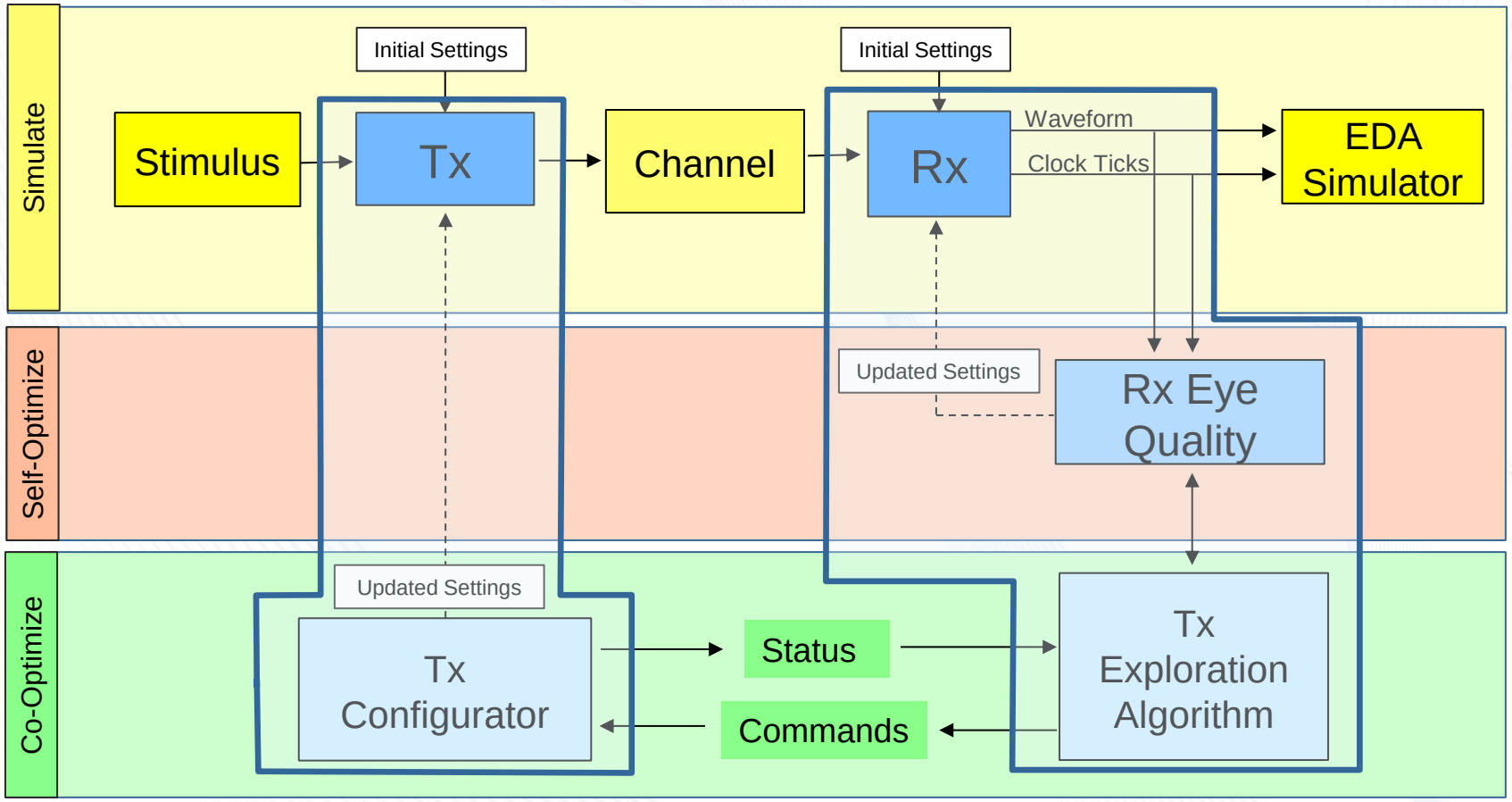
Co-Optimization – Scenarios 1 & 2



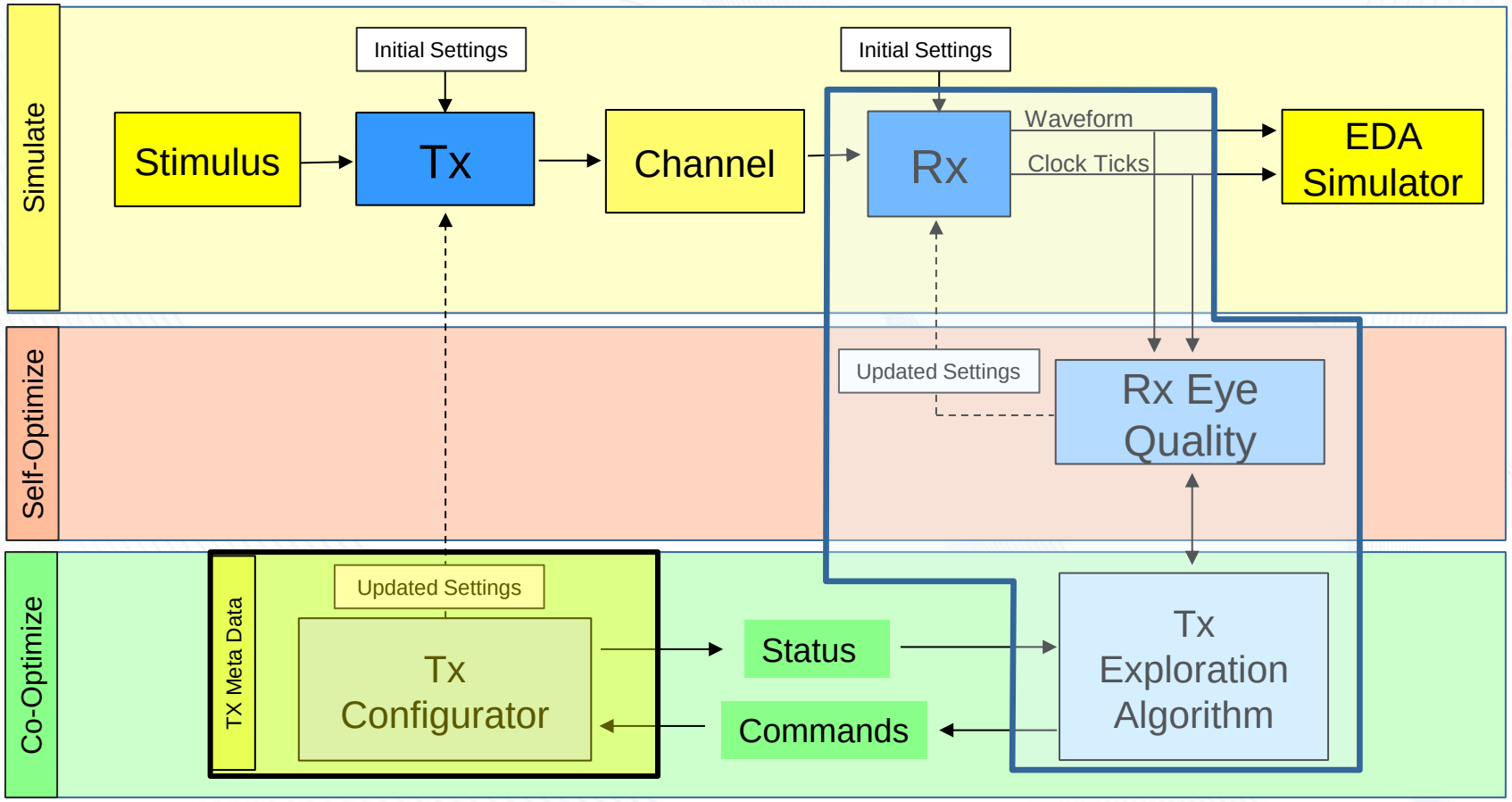
Legend: EDA AMI Messages

Scenario 3 Co-Optimization

- There are three cases for scenario 3:
  - 3a: The TX model does not participate in Co-Optimization; the simulator must perform the TX Configurator function
  - 3b: The RX model does not participate in Co-Optimization; the simulator must perform the TX Exploration function
  - 3c: Neither the TX nor RX model participates in Co-Optimization; the simulator must perform both the TX Configurator and TX Exploration functions

Co-Optimization – Scenario 3a

Simulator >> TX Configurator



Legend: EDA AMI Messages

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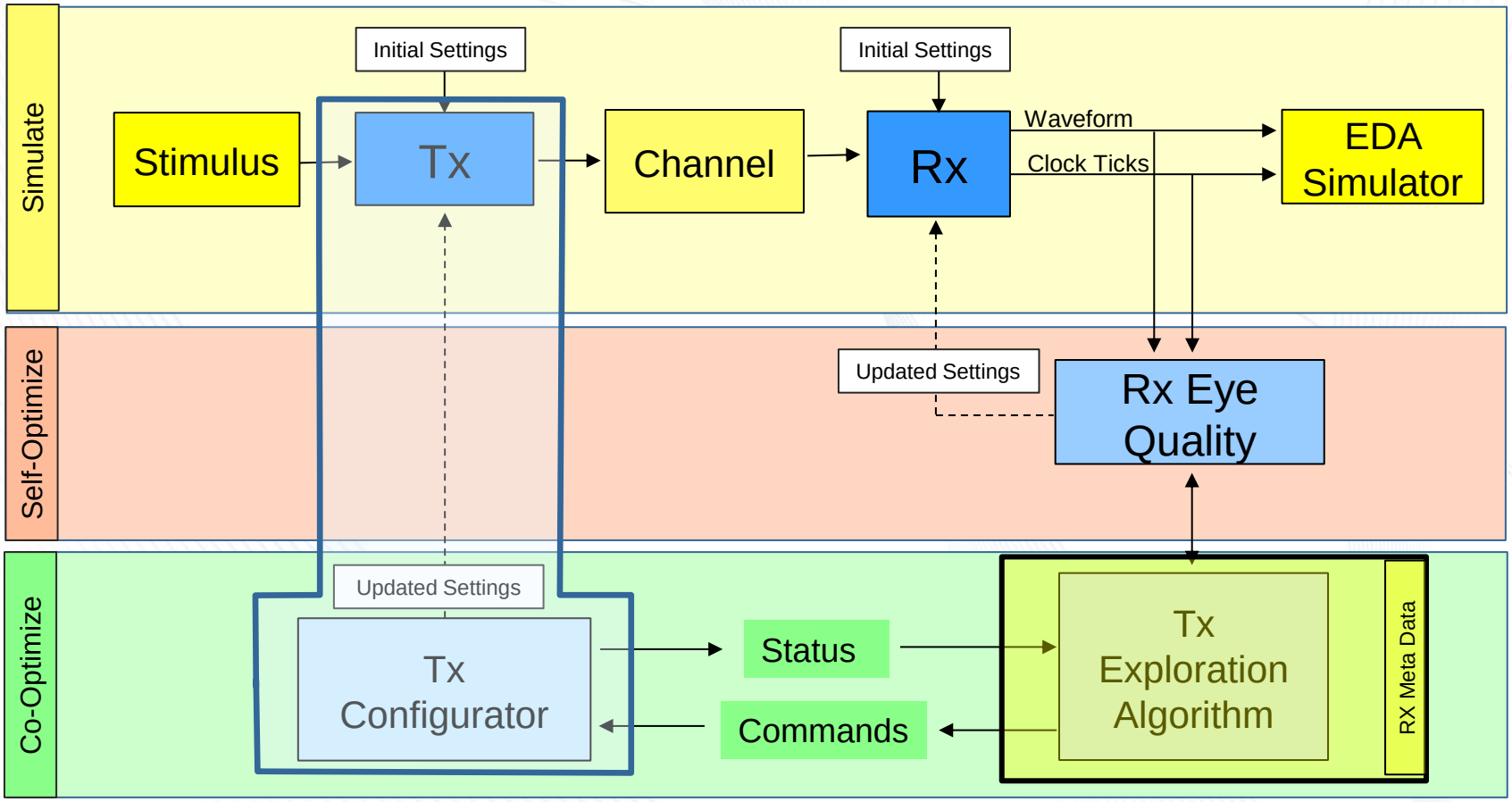
Co-Optimization – Scenario 3b

Simulator >> TX Exploration



Legend: EDA AMI Messages

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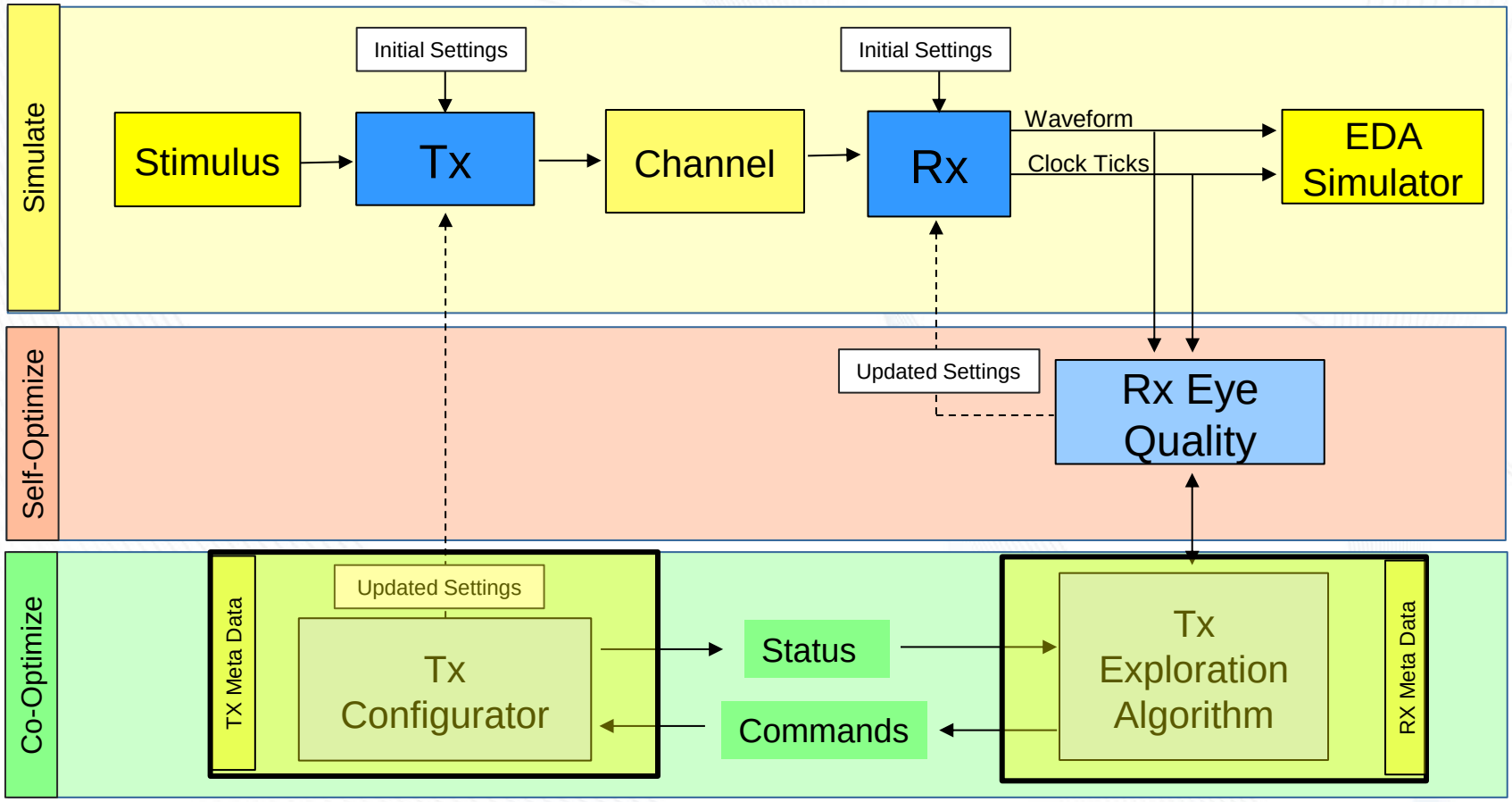
Co-Optimization – Scenario 3c

Simulator >> TX Configurator and TX Exploration



Legend: EDA AMI Messages

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Key Points

- What is being optimized?
  - Eye Quality – a quantitative metric determined either by the RX model or the simulator. Does not have to be rigorously defined or even reported
- What does the optimizing?
  - The RX model (Scenarios 1, 2, 3a)
  - The simulator (Scenarios 3b, 3c)
- What optimization algorithm is used?
  - Scenario #1 – an algorithm internal to the TX and RX models that emulates the hardware protocol
  - Scenarios #2, 3a – an algorithm internal to the RX model
  - Scenarios #3b, 3c – an algorithm internal to the simulator

Your Feedback is Appreciated!

- Do you agree with the defined user scenarios?
- Are any requirements missing?
- Do you agree with the requirement priorities as defined?
- Is the presentation clear?
- Other suggestions for improvement?


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