A Catalog of Self-replicating Cellular Automatons

for

von Neumann Cellular Automata

(29 States)

and

Nobili Cellular Automata

(32 States)

by

William R. Buckley

The configurations given within the pages of this catalog were developed in association with two tasks; (i) examination of the necessity of signal crossing mechanisms to the construction of self-replicators within the cellular automata of von Neumann, and (ii) evaluation of satisfaction of von Neumann's self-replication problem by the configuration published by Umberto Pesavento. Consequently, the four configurations presented herein constitute an analysis of two closely related systems of cellular automata; (i) the 29-state system of John von Neumann, and (ii) the 32-state alteration of von Neumann's system, developed by Renato Nobili. The configurations demonstrate, among other things, the interconvertability of configurations between the two systems of cellular automata.

The behavioral and operational details for these four configuration is given in the paper *Signal Crossing Solutions in von Neumann Self-replicating Cellular Automata*, as presented in the proceedings volume for Automata 2008.

The printing of the pages of this document is prohibited. The configurations are available in electronic form, from the author, for scholarly use only, such as the demonstration of configuration behavior (including self-replication).

The pulse corpus von Neumann cellular automaton has been demonstrated unto self-replication. The details of this event are available from the author. Demonstration of self-replication for the packet corpus von Neumann cellular automaton is an active effort, as is demonstration of self-replication by means of partial construction.

These configurations were all developed and tested using the simulation software provided by Renato Nobili, at the URL

http://www.pd.infn.it/~rnobili/

All commercial use of these configurations is strictly prohibited.

The work is dedicated to James Robert Hauser and Bruce Howard Weber, teachers, mentors, colleagues and friends.

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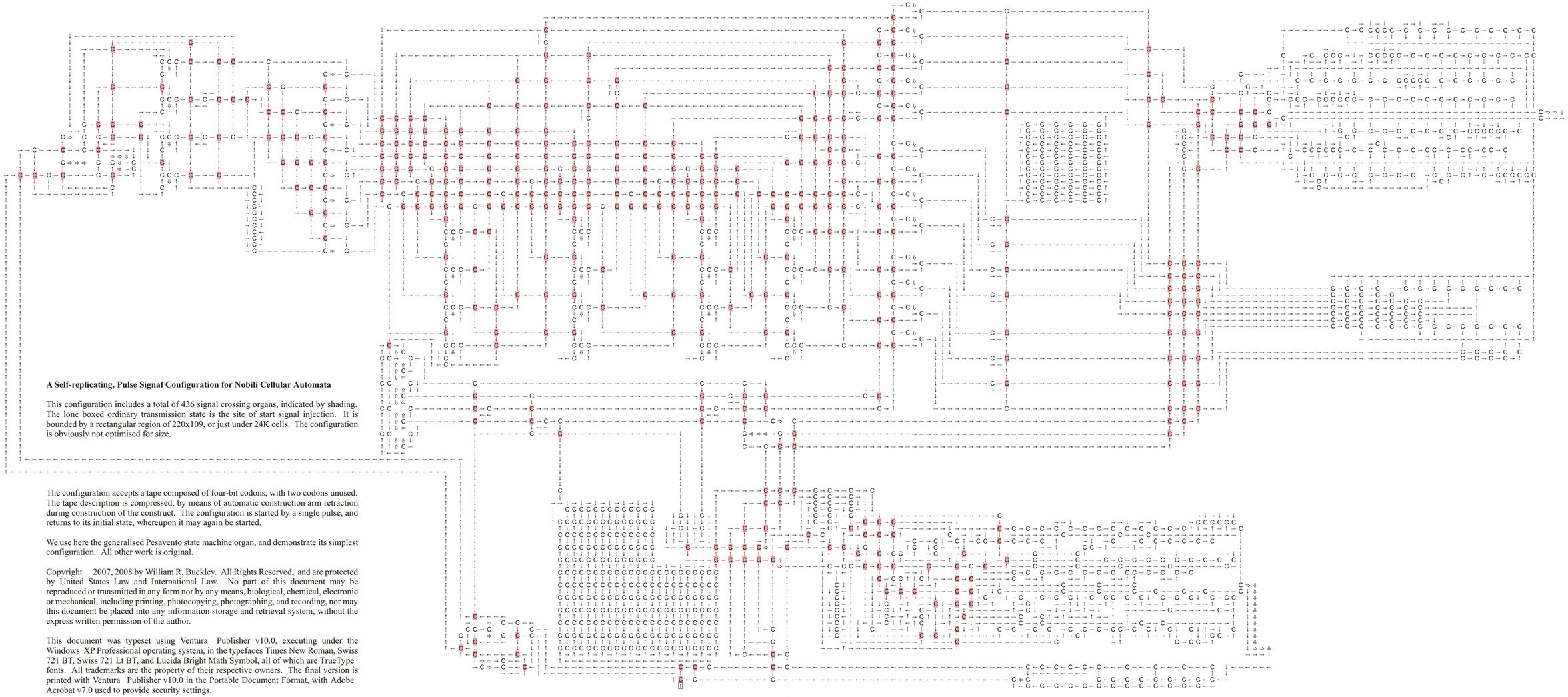

A Self-replicating, Pulse Signal Configuration for Nobili Cellular Automata

This configuration includes a total of 436 signal crossing organs, indicated by shading. The lone boxed ordinary transmission state is the site of start signal injection. It is bounded by a rectangular region of 220x109, or just under 24K cells. The configuration is obviously not optimised for size.

The configuration accepts a tape composed of four-bit codons, with two codons unused. The tape description is compressed, by means of automatic construction arm retraction during construction of the construct. The configuration is started by a single pulse, and returns to its initial state, whereupon it may again be started.

We use here the generalised Pesavento state machine organ, and demonstrate its simplest configuration. All other work is original.

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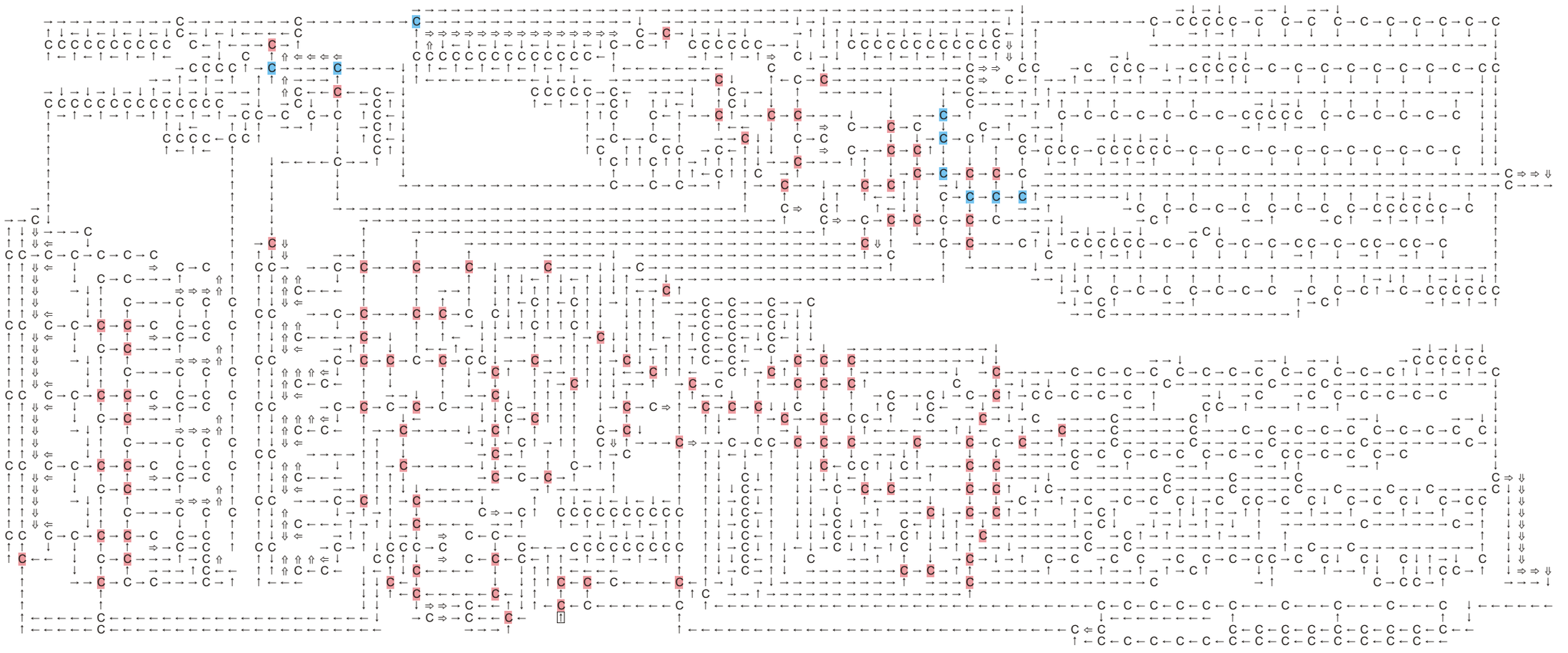

A Self-replicating, Packet Signal Configuration for Nobili Cellular Automata

This configuration includes a total of 137 signal crossing organs, indicated by shading. Salmon shaded cells cross pulse signal (128), while blue shaded cells cross packet signal (9). The lone boxed ordinary transmission state is the site of start signal injection. The configuration is bounded by a rectangular region of 55x118, or just under 6.5K cells. The configuration is obviously not optimised for size.

The configuration accepts a tape composed of five-bit codons. The tape description is compressed, by means of automatic construction arm retraction during construction of the construct. The configuration is started by a single pulse, and returns to its initial state, whereupon it may again be started.

This configuration is a direct response to the inadequacies expressed in the configuration produced by Umberto Pesavento (1995) *An Implementation of von Neumann's Self-Reproducing Machine*, Artificial Life 2: 337-354. The memory and state machine oegans are borrowed form the Pesavento design, and have both been improved and generalised.

The generalised Pesavento state machine organ and the generalised Pesavento memory organs are incorporated in this configuration. All other work presented is original.

The reader may compare in detail the figure above with the Pesavento design, and so observe some of the differences between a general constructor and a self-replicator, which may be summarised as the difference between even a fine estimate, and a full accounting.

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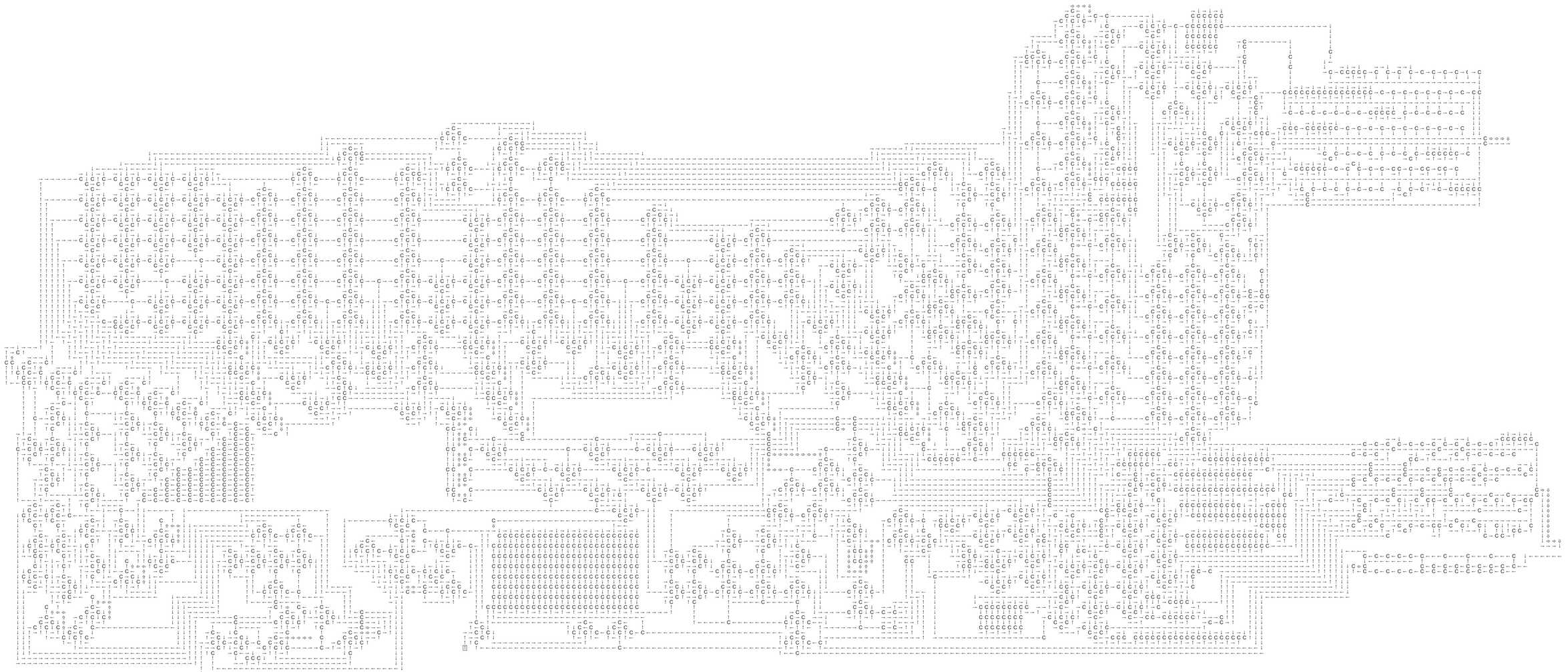

A Self-replicating, Pulse Signal Configuration for von Neumann Cellular Automata

This configuration derives from the *Self-replicating, Pulse Signal Configuration for Nobili Cellular Automata* by the replacement of ideal signal crossers with the vNCA 4x5 coded channel, followed by the rearrangement of component organs, so as to minimise the endo-perimetric cell count. The bounding rectangle is 272 x132. The lone boxed ordinary transmission state is the site of start signal injection. The configuration is obviously not optimised for size. The configuration accepts a tape composed of four-bit codons. The tape description is compressed, by means of automatic construction arm retraction during construction of the construct. The configuration is started by a single pulse, and returns to its initial state, whereupon it may again be started.

The generalised Pesavento state machine organ is employed in this configuration. All other work is original.

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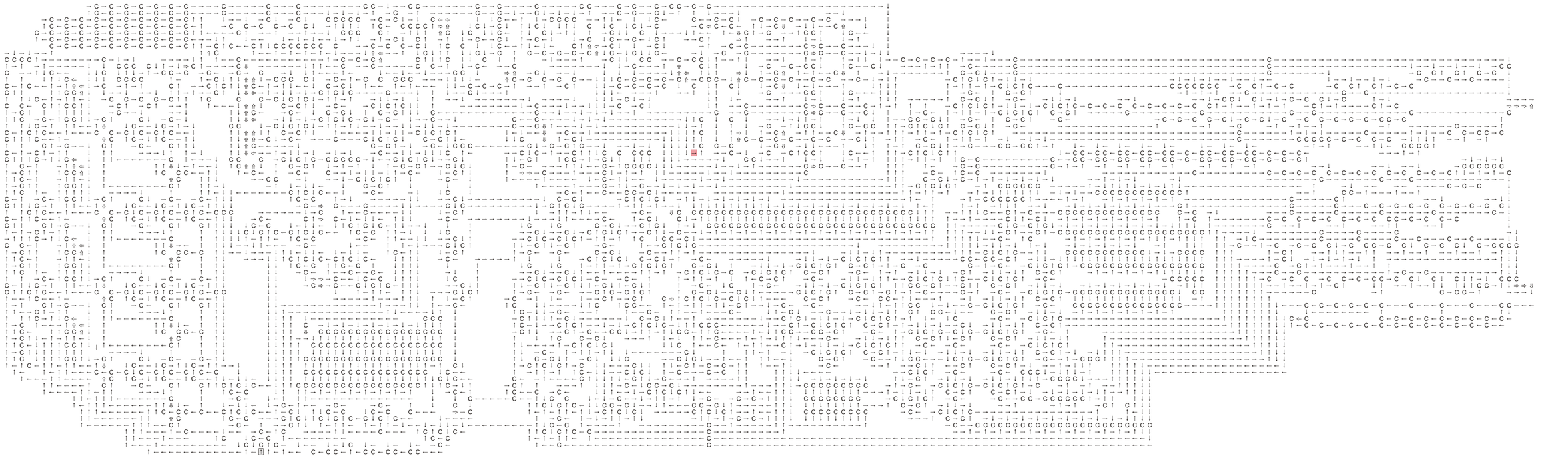

A Self-replicating, Packet Signal Configuration for von Neumann Cellular Automata

The 11,932 endo-perimetric cell configuration is bounded by a rectangular region of 205x68. The lone boxed ordinary transmission state is the site of start signal injection. The configuration is highly optimised for size, though with some effort the endo-perimetric cell count can be reduced. The salmon shaded cell is the site of start signal injection for the component Mukhopadhyay signal inverter, which accepts a single pulse.

The generalised Pesavento state machine organ, and the auto-initialised Mukhopadhyay signal inverter organ, are employed in this configuration. All other work is original.

The configuration accepts a tape composed of four-bit codons. The tape description is compressed, by means of automatic construction arm retraction during construction of the construct. The configuration is started by a single pulse, and returns to its initial state, whereupon it may again be started.

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