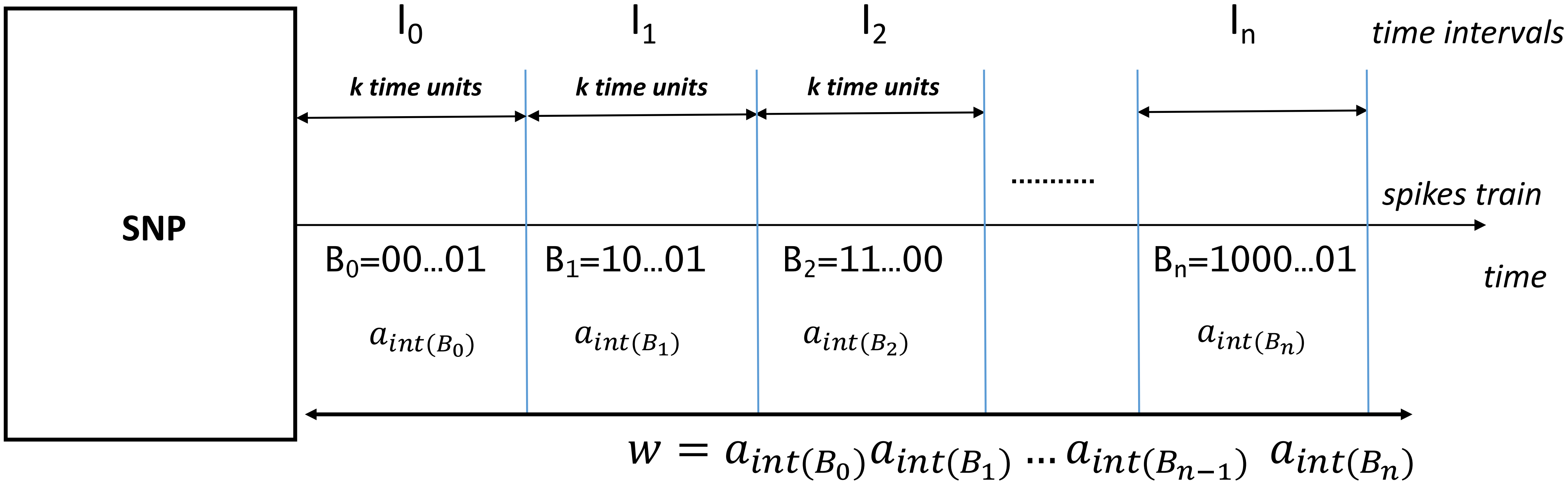
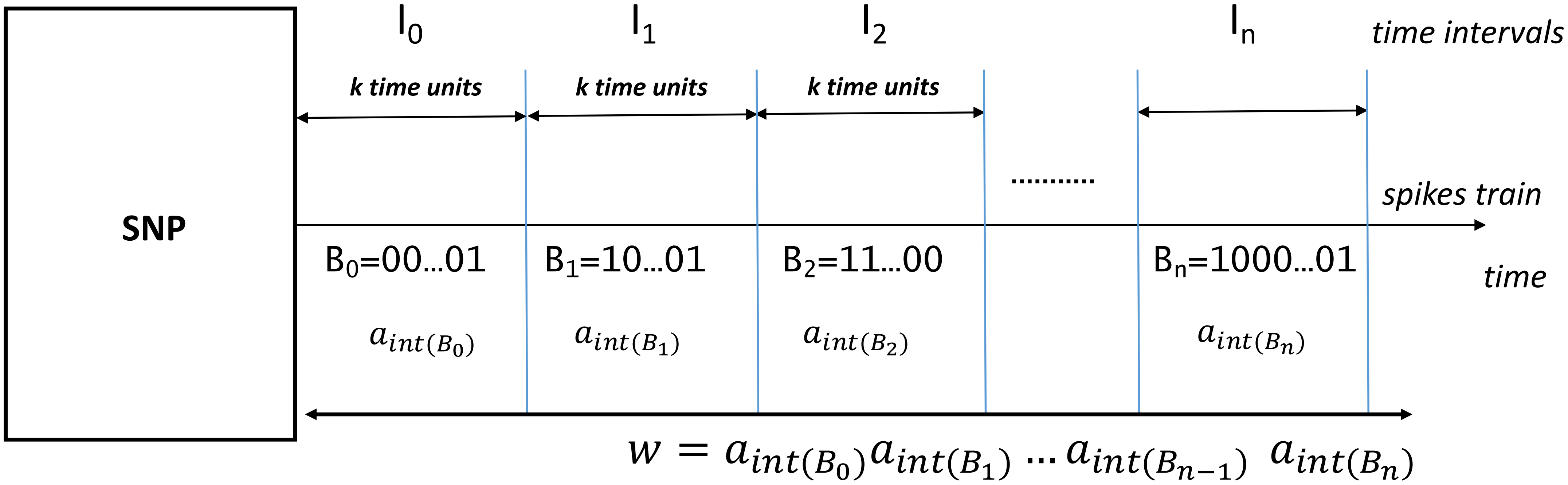
Families of Languages Associated with SN P Systems

Gh. Paun **José M. Sempere**

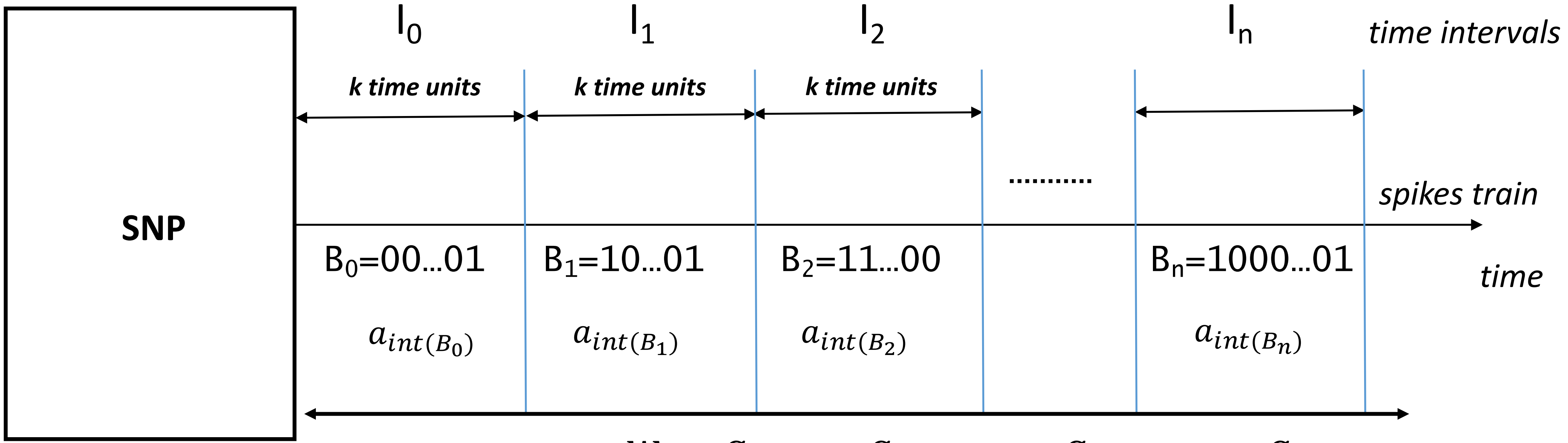


$$\Sigma_k = \{a_0, a_1, \dots, a_{2^k - 1}\}$$



$$\Sigma_k = \{a_0, a_1, \dots, a_{2^k-1}\}$$

$$\boldsymbol{\varphi_k : \{0,1\}^k \to V_k}$$



$$w = a_{int(B_0)} a_{int(B_1)} \dots a_{int(B_{n-1})} \; a_{int(B_n)}$$

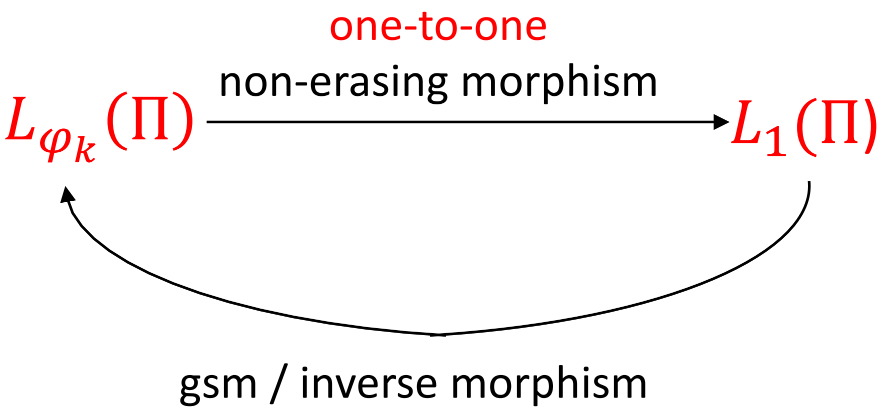
$$\Sigma_k = \{a_0, a_1, \dots, a_{2^k-1}\}$$

$$\boldsymbol{\varphi_k : \{0,1\}^k \rightarrow V_k}$$

$$\boldsymbol{k^{w=w0^t}} \qquad \boldsymbol{t = \min\{n \geq 0 : \; |w0^n| \bmod k = 0\,\}}$$

Let Π be an SN P system and φ_k an enconding. Then

$$L_{\varphi_k}(\Pi) = \{\varphi_k(k^w) : w \in L_1(\Pi)\}$$



Proposition 1: If $L_1(\Pi) \in$ FL, where FL is a family of languages closed under gsm mappings or under inverse morphism, then $L_{\varphi_k}(\Pi) \in$ FL, for all $k \geq 1$. If FL is closed under non-erasing morphism and $L_{\varphi_k}(\Pi) \in$ FL, then also $L_1(\Pi) \in$ FL.

(i.e. FL is REG/LIN/CF)

Let Π be an SN P system and φ_k an enconding. Then

$$F(\Pi) = \{L_{\varphi_k}(\Pi) : k \geq 1\}$$

$F(\Pi)$ contains only languages of the same language class (for the one-to-one case)

If $L_1(\Pi)$ is finite then so is $L_{\varphi_k}(\Pi)$ and $F(\Pi)$ is finite (up to a renaming of symbols of encodings alphabets)

If $L_1(\Pi)$ is infinite then so is $L_{\varphi_k}(\Pi)$ and $F(\Pi)$ can be infinite (no matters the initial language) (CONJECTURE)

Let Π be an SN P system and φ_k an (not one-to-one) enconding.

$$L_{\varphi_k}(\Pi) = \{\varphi_k(k^w) : w \in L_1(\Pi)\}$$

Proposition 1 does not hold

$L_1(\Pi)=\{1^n01^n : n \geq 1\}$ **(NON REGULAR)**

$\varphi_k(w) = a$ if $|w|_0 \leq 1$

$\varphi_k(w) = b$ if $|w|_0 \geq 2$

$L_{\varphi_k}(\Pi) = a^+ \cup a^*b \quad k \geq 4$

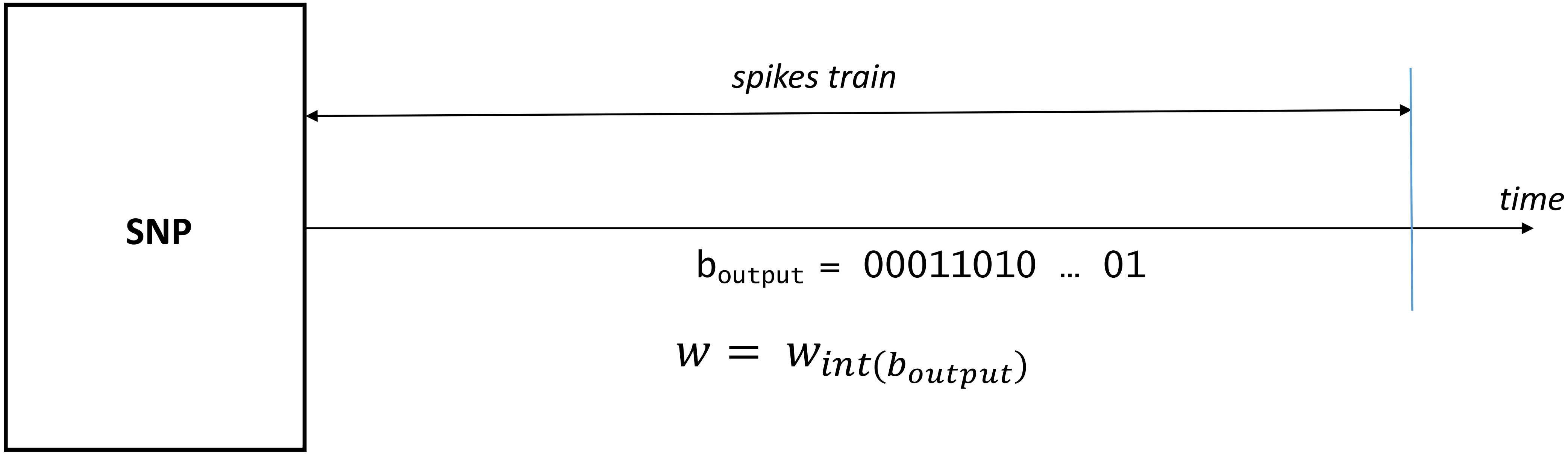
$L_{\varphi_k}(\Pi) = a^+ \cup a^+b \quad k = 2,3$

(REGULAR)

$F(\Pi)$ characterizations ?

The infinite case

Let Π be an SN P system



b_{output} = 00011010 … 01

$$w = w_{int(b_{output})}$$

$$\Sigma^* = \{w_0, w_1, \dots, w_i, \dots\}$$ A pre-defined enumeration

$$\Sigma = \{a_0, a_1, \dots, a_p\}$$

The infinite case

Let Π be an SN P system

$$L_\infty(\Pi) = \{x_{int(w)} : w \in L_1(\Pi)\}$$

The encoding does not preserve the language class:

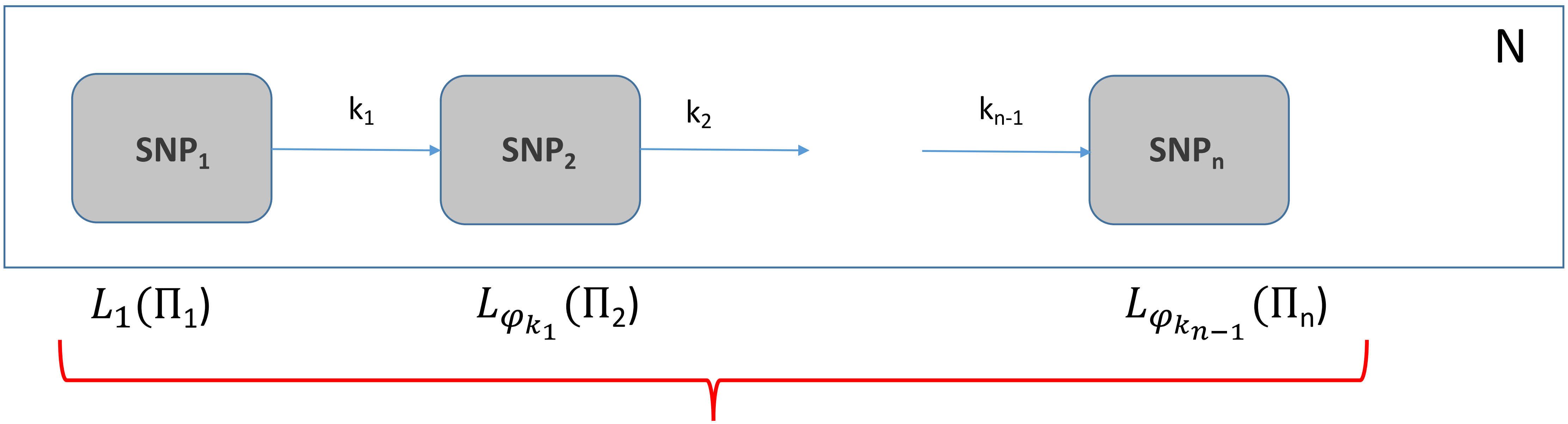
Let $L_1 = \{0^n 1^n : n \geq 0\}$ and $L_2 = \Sigma^* - L_2$ be ordered in lexicographic order.

We can apply the following order for Σ^* : for the odd positions we apply L_2 and for the even positions we apply L_1

We take $L_1(\Pi) = \{(10)^n : n \geq 0\}$ (regular) and $L_\infty(\Pi)$ be an infinite subset of L_1 (hence it is not regular)

$L_\infty(\Pi)$ characterizations ??

The network case



A family of languages F(N)

- What is the characterizations of F(N) ?
- Does the network topology influence the characterizations ?
- $L_{\varphi_{k_{n-1}}}(\Pi_n)$ can be considered as the result of iterated transductions. How many SN P systems are needed to produce every recursively enumerable language ? (A descriptive complexity measure: number of SN P systems, neurons, connections, etc.)