

BioComputing's Network-Graph Tool

Version 0.99

Joachim Niehren
Inria & BioComputing, Lille, France

1 Reaction Network `Networks/b-subtilis.xml`

Reaction Network. See file: `Networks/b-subtilis.xml` See Figure 1.

Analysis `means-native-24h`

Fig. 1. The Networks/b-subtilis.xml.

Name	Function
r ₁	Phosphorylation of G
r ₁ '	degradation of Signal
r ₂	Catalyse the conversion of G6P to F6P
r ₃	Catalyse the conversion of F6P to G6P ?
r ₄	Catalyse the conversion of F6P to F16BP
r ₅	Catalyse the conversion of F16BP to F6P
r ₆	Conversion of F16BP to G3P
r ₇	Conversion of G3P to F16BP
r ₈	Catalyse the conversion of G3P to 13BPG
r ₉	Catalyse the conversion of 13BPG to G3P
r ₁₀	Catalyse the conversion of G3P to DHAP
r ₁₁	Catalyse the conversion of DHAP to G3P
r ₁₂	Catalyse the conversion of 13BPG to 3PG
r ₁₃	Catalyse the conversion of 3PG to 13BPG
r ₁₄	Catalyse the conversion of 3PG to 2PG
r ₁₅	Catalyse the conversion of 2PG to 3PG
r ₁₆	Catalyse the conversion of 2PG to PEP
r ₁₇	Catalyse the conversion of PEP to 2PG
r ₁₈	Catalyse the conversion of PEP to Pyr
r ₃₃	expression of pykA
r ₃₃ '	degradation of pykA
r ₃₄	Express F16BP
r ₃₅	Bind CcgR to gapA for inhibition
r ₃₅ '	degradation of BS _{CcgR}
r ₃₆	Regulation of gapA activity, activation by CcpA and inhibition by CcgR
r ₃₆ '	degradation of gapA
r ₃₇	Bind CcpA to gapA for activation
r ₃₇ '	degradation of BS _{CcpA}
r ₃₈	Express DHAP
r ₃₉	Expression of F16BP
r ₄₀	Express glpX
r ₄₁	Express fbp
r ₄₂	degradation of fbp + glpX
r ₄₃	Express G6P
r ₄₄	Activation of GlcT activity
r ₄₄ '	degradation of ptsGHI
r ₄₅	Inhibition of GlcT activity by pstGHI
r ₄₅ '	degradation of GlcT
r ₄₆	Production of G throw Gluco
r ₄₇	Catalyse the conversion of G1P to G6P
r ₄₈	Catalyse the conversion of G6P to G1P
r ₄₉	Production of Gluco throw Gluco6P
r ₅₀	Production of G6P throw Gluco6P
r ₅₁	Production of Xylu5P throw Gluco6P
r ₅₂	expression of pfkA
r ₅₂ '	degradation of pfkA
r ₅₃	Production of Xylu5P throw F6P
r ₅₄	Production of Xylu5P throw F6P
r ₅₅	Production of G3P throw Xylu5P
r ₅₆	Production of Xylu5P throw G3P
r ₅₇	Expression of gapB
r ₅₇ '	degradation of gapB
r ₅₈	expression of pgk
r ₅₈ '	degradation of pgk
r ₅₉	Bind CcpN to gapB for inhibition
r ₅₉ '	degradation of BS _{CcpN}
r ₆₃	expression of fbp
r ₆₃ '	degradation of fbp
r ₆₄	expression of glpX
r ₆₄ '	degradation of glpX
r ₆₅	degradation of G6 +F16
r ₆₆	degradation of tpi
r ₆₆ '	degradation of tpi
r ₆₇	expression of CcpA
r ₆₇ '	degradation of CcpA
r ₆₈	expression of CcgR
r ₆₈ '	degradation of CcgR
r ₆₉	degradation of G6P + DH + F2
r ₈₆	expression of eno
r ₈₆ '	degradation of eno
r ₈₇	expression of pgm
r ₈₇ '	degradation of pgm
r ₈₈	degradation of yqfL
r ₈₈ '	degradation of yqfL
r ₈₉	expression of CcpN
r ₈₉ '	degradation of CcpN
r ₉₀	degradation of tkt
r ₉₀ '	degradation of tkt
r ₉₁	degradation of enz
r ₉₁ '	degradation of enz
r ₉₂	degradation of gntk
r ₉₂ '	degradation of gntk
r ₉₃	degradation of gdh
r ₉₃ '	degradation of gdh
r ₉₄	expression of pgcA
r ₉₄ '	degradation of pgcA
r ₉₅	degradation of zwf
r ₉₅ '	degradation of zwf
r ₉₆	expression of pgi
r ₉₆ '	degradation of pgi

r97	expression of fbaA
r97'	degradation of fbaA
r20	Production of Atoin throw Pyr
r21	Production of Oxa throw Mal
r22	Production of Pyr throw Mal
r23	Production of TCA throw Oxa
r24	Production of Mal throw TCA
r25	Turn to TCA throw AcCoA
r26	Production of AcCoA from Pyr
r27	Production of Atate from AcCoA
r29	Production of Atoin from Aceto
r30	Production of Alanine from Pyr
r32	Production of Lac from Pyr
r60	Production of Ile from Oxa
r61	Production of AcCoA from Atoin
r62	Production of AcCoA from Atate
r70	expression of ldh
r70'	degradation of ldh
r72	expression of AcDH
r72'	degradation of AcDH
r74	expression of acsA
r74'	degradation of acsA
r75	expression of AlsS
r75'	degradation of AlsS
r76	expression of eno
r76'	degradation of AlsD
r77	expression of ackA
r77'	degradation of ackA
r78	expression of pta
r78'	degradation of pta
r79	expression of pdhABCD
r79'	degradation of pdhABCD
r80	expression of CitA
r80'	degradation of CitA
r81	expression of CitG
r81'	degradation of CitG
r82	expression of mdh
r82'	degradation of mdh
r83	expression of ystJ
r83'	degradation of ystJ
r84	expression of pycA
r84'	degradation of pycA
r85	expression of pckA
r85'	degradation of pckA
r19	feedback reaction to PEP from Oxa
rL1	bind CodY to Pilv–Leu for inhibition
	predition: single knockout, unsafe
	experiment: OK (we have this mutant)
rL1'	degradation of BS _{CodY}
rL2	activate Pilv–Leu promoter
	predition: no
	experiment: not done, because we need the expression of Pilv – Leu
	in order to activate the reaction r23, r24, r39, r37
rL2'	degradation of Pilv–Leu
rL3	bind BkdR to BkL Bcd promoter
	experiment: Ok
rL3'	degradation of OP _{BkL–Bcd}
rL4	constitutive expression of BkL Bcd operon
	experiment: Ok
rL5	express YbgE
rL6	express YwaA
rL7	bind TnrA to Pilv–Leu promoter for inhibition
	predition: safe single knockout
	experiment: OK (we have this mutant)
rL7'	degradation of BS _{TnrA}
rL9	bind CcpA to Pilv–Leu promoter without BS _{TnrA} loop
rL9'	degradation of BS _{Ccpa}
rL10	expression of Bcd, activated by OP _{BkL–Bcd}
	experiment: OK (we have this mutant)
rL10'	degradation of Bcd
rL11	expression of BkL, activated by OP _{BkL–Bcd}
	experiment: OK (we have this mutant)
rL11'	degradation of BkL
rL12	activate BkdR by Ile
	experiment: Francois: I need to check what is the mechanism of this activation.
	If is via the Val-tRNA is not possible because the gene
	encoded for the valyl-tRNA synthetase is essential in B. subtilis
rL13	activate BkdR by Val
	experiment: Francois: I need to check what is the mechanism of this activation
	if it is via the Ile-tRNA is not possible because the gene encoded
	for the isoleucyl-tRNA synthetase is essential in B. subtilis
rL14	expression of CcpA
	predition: single-knockout, unsafe
	experiment: It seems to be possible but we do not see the interest since CcpA is
	an activator of Pilv – Leu and a repressor of CodY
rL14'	degradation of CcpA
rL15	express and accelerate CodY (to be explained acceleration)
	OK (we have this mutant)
rL15'	degradation of CodY
rL16	expression of TnrA
	experiment: OK (we have this mutant)
rL16'	degradation of TnrA
rL17	Gtp degradation
rL18	BkdR degradation
rL19	YwaA+YbgE degradation
rL20	disabeling of IlvA by Ile
rL21	disabeling of IlvA by Val
rL22	expression of IlvA inhibited by binding of CodY

	experiment: Ok but the IlvA expression is r21 ? (we have this mutant but the result were not good)
rL22'	degradation of IlvA
rL23	expression of IlvBH
	experiment: NO, because we need the expression of IlvBH in order to activate the reaction r30 , thereby producing Ket_b , the precursor of Ket_c
rL23'	degradation of IlvBH
rL24	expression of IlvC
	experiment: NO, because we need the expression of IlvC in order to activate the reaction r30 , thereby producing KetB the precursor of Ket_c
rL24'	degradation of IlvC
rL25	expression of IlvD , inhibited by binding of CodY to promotor
	experiment: NO, because we need the expression of IlvD in order to activate the reaction r30 , thereby producing Ket_b , the precursor of Ket_c
rL25'	degradation of IlvD
rL26	metabolic transformation of Keta to Ile activated by ywaA+ybgE , after an amino addition taken from Glu , which becomes OxoGlu .
rL27	metabolic transformation of Akb and Pyr into Keta
r777	
r28	prepare output of Keta activated by BkL
rL29	degradation of Ile into Keta activated by YwaA and Bcd , with an amino transfer from OxoGlu which becomes Glu .
rL30	metabolic transformation from Pyr to Ketb , activated by IlvD
r31	prepare output of Ketb activated by BkL
rL32	degradation of Val into Ketb activated by YwaA and Bcd with an amino transfer from OxoGlu which becomes Glu .
rL33	metabolic transformation of Ketb into Ket_c , activated by LeuBCD and LeuA
rL34	prepare output of Ket_c activated by BkL
rL35	degradation of Leu into Ket_c ctivated by YwaA and Bcd with an amino transfer from OxoGlu which becomes Glu .
rL36	metabolic transformation of Ketb to Val activated by ywaA+ybgE , after an amino addition from Glu which becomes OxoGlu
rL37	expression of LeuA
	experiment: NO, because we need the expression of leuA in order to activate the reaction r33 , thereby producing Ket_c the precursor of Leu
rL37'	degradation of LeuA
rL38	expression of LeuBCD
	experiment: NO, because we need the expression of leuBCD in order to activate the reaction r33 , thereby producing Ket_c the precursor of Leu
rL38'	degradation of LeuBCD
rL39	deactivation of LeuA by Leu
rL40	Leucine attenuation
	experiment: OK (we have this mutant)
rL40'	degradation of Tbox
rL41	metabolic transformation of Thr into Akb using IlvA
rL45	metabolic transformation of Ket_c to Leu activated by ywaA+ybgE after an amino addition from Glu , which becomes OxoGlu
rL46	expression of YbgE , inhibited by binding of CodY to promoter
	experiment: NO, because we need the expression of YbgE in order to activate the reaction r5 , which produce Leu
rL46'	degradation of YbgE
rL47	expression of YwaA
	experiment: Ok
rL47'	degradation of YwaA

Fig. 3. Reactions of Networks/b-subtilis.xml

1.1 What Else

Comments to be treated A small FAQ

Question 1. Are r40 r41 candidates for KO ?

Question 2. Define Signal real name

Question 3. Do we add G1P outflow ? do we remove the inflow ? is pgcA an Accelerator ?

Question 4. Precision for CcpA from Tobish 1999?

Question 5. Repression of CodY by Val-Leu (r71)? (cf Carbon Catabolic Control of the Metabolic Network in B. Subtilis)

Question 6. Repression of production of Malate throw TCA by CcpA (r24)? (cf Positive regulation of B. Subtilis by CodY ...)

Question 7. Ilv actor meaning ?

A small FAQ

A small FAQ

Question 2. Why is reaction **r3** needed, given that **r4** produces **OP_{BkL-Bcd}** anyway? Answer: since more **OP_{BkL-Bcd}** is produced this way.

Question 3. Is **Akb** input from context needed, since **Akb** can also be produced from **Thr** (**r9**)? Answer: yes since external pathways can produce it too.

Role	Short name	Chemical Species
Metabolites	Glc	D-Glucose
	G1P	Glucose-1-Phosphate
	G6P	Glucose-6-Phosphate
	F6P	Fructose-6-Phosphate
	F16BP	Fructose-1,6-Biphosphate
	G3P	Glyceraldehyde-3-Phosphate
	13BPG	1,3-Bisphosphoglycerate
	3PG	3-Phosphoglycerate
	2PG	2-Phosphoglycerate
	PEP	Phosphoenolpyruvate
	Pyr	Pyruvate
	DHAP	Dihydroxyacetonphosphate
	Pp	PyroPhosphate
	Gluco	Gluconate
	Gluc6P	Glucose-6-P
	Xylu5P	Xylulose-5-P
	TCA	Krebs cycle
	Atoin	Acetoin
	Atate	Acetate
	Ala	Alanine
	Lac	Lactate
	AcCoA	Acetyl CoA
	Oxa	Oxaloacetate
	Mal	D-Malate
	Ile	Isoleucine
	Leu	Leucine
	Val	Valine
	Akb	L-2-amino-acetoacetate
	Glu	L-Glutamate
	OxoGlu	Oxogluterate
	Gtp	Guanosine triphosphate
	Ket_a	2-keto-3-methylvalerate
	Acyl-Coa	Acyl Coenzyme A
	Ket_b	2-keto-isovalerate
	Ket_c	2-keto-isocaproate
	Thr	Threonine deshydratase
	Gln	L-Glutamine
	Orn	L-Ornithine
	Cit	Citrate
	Glyx	Glyoxalat
	Pro	L-Proline
	Ser	L-Serine
	Gly	Glycine
	Suc	Succinate
	Fum	Fumarate
	Cys	L-Cysteine
	BAla	Beta-alanine
	Met	L-Methionine
	OxoPro	5-oxoproline
	Asp	Aspartate
	AKet	Alpha ketoglutaric acid
	PenPyr	Penylpyruvate
	Phe	L-Phenylalanine
	Aspg	L-Asparagine
	Fru	Fructose
	Glucu	Glucuronate
	Glyt	Glycerate
	IsoCit	Isocitrate
	His	L-Histidine
	Lys	L-Lysine
	Trp	L-Tryptophane
	MyoI	Myo-inositol
	Tyr	Tyrosine
	Aco	Trans-aconicic acid
Proteines	GlcT	Transcriptional antiterminator.
	pgi	Glu-6-Phosphate isomerase.
	pfkA	Phosphofructokinase.
	fbaA	Fructose-1,6-biphosphate aldolase
	gapB	Glyceraldehyde-phosphatedehydrogenase
	pgk	Phosphoglycerate kinase
	pgm	2,3-Biphosphoglycerate - Independent phosphoglycerate mutase
	eno	Enolase
	pykA	Pyruvate kinase
	tpi	Triose phosphate isomerase
	gapA	Glyceraldehyde-3-phosphate dehydrogenase
	CcgR	Transcriptional repressor
	CcpN	Transcriptional repressor
	yqfL	Positive regulator
	fbp	Fructose-1,6-biphosphatase class III
	glpX	Fructose-1,6-biphosphatase class II
	pgcA	α -phosphoglucomutase
	gdh	Glucose 1-deshydrogenase
	gntk	Gluconokinase
	enz	??
	tkt	Transketolase
	zwf	Glucose-6-phosphate 1-dehydrogenase
	CcpA	Transcriptional activator
	pdhABCD	Pyruvate d \dot{A} fshydrogenase
	ystJ	Enzyme malique
	CitA	Citrate synthase
	CitG	Fumarase
	mdh	Malate deshydrogenase
	pckA	Phosphoenolpyruvate carboxykinase
	pycA	Pyruvate carboxylase
	ackA	Acetate kinase
	pta	Phosphotransacetylase
	AcDH	Acetoin deshydrogenase
	acsA	Acetyl CoA synthetase
	AlsS	α -acetolactate synthetase
	AlsD	α -acetolactate-dehydrogenase
	ldh	Lactate dehydrogenase
	CodY	Transcriptional pleiotropic regulator
	Bcd	Branched chain amino-acid dehydrogenase
	BkL	2-oxoisovalerate dehydrogenase
	BkdR	Transcriptional activator of BkL
	IlvA	Threonine deshydratase
	IlvBH	Acetolactate synthase
	IlvC	Ketol-acid reductoisomerase
	IlvD	Dihydroxy-acid dehydratase
	LeuA	2-isopropylmalate synthase
	LeuBCD	3-isopropylmalate dehydratase
	TnrA	Nitrogen pleiotropic transcrptional regulator
	YbgE	Branched chain amino-acid aminotransferase
	YwaA	branched chain amino-acid aminotransferase
Actors	ptsGHI	Composed by ptsG, ptsH and ptsI
	fbp + glpX	Activity of fbp and glpX
	DHAP+ F1,6BP	Activity of G6P, DHAP, F6P and F16BP
	G6 +F16	Activity of G6P and FOneSixBP
	BS_{CcpA}	Activity of CcpA binding to gapA
	BS_{CcgR}	Activity of CcgR binding to gapA
	BS_{CcpN}	Activity of CcpN binding to gapB
	Signal	Signal generated by the phosphorylation of G to G6P
	Pilv-Leu	Activity of promoter of IlvBH IlvC LeuA LeuBCD operon
	BS_{CodY}	Activity of CodY binding to promoter PilvLeu
	BS_{TnrA}	Activity of TnrA binding to promoter PilvLeu
	BS_{CcpA}	Activity of CcpA binding to promoter PilvLeu without BS_{TnrA} loop
	OP_{BkL-Bcd}	Activity of promoter of BkL Bcd operon
	YwaA+YbgE	Activity of YbgE and YwaA
	Tbox	activity of tryptophan attenuation

Fig. 2. Molecules of Networks/b-subtilis.xml.