

# Smart and modular containers for the Physical Internet – possibilities and obstacles

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# PI container

## Content

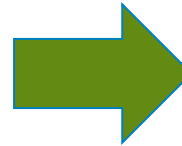
- Background
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*„The Physical Internet is a global logistics system based on the interconnection of logistics networks by a standardized set of collaboration protocols, modular containers and smart interfaces for increased efficiency and sustainability”*

*B. Montreuil, R.D. Meller and E. Ballot (2011)*

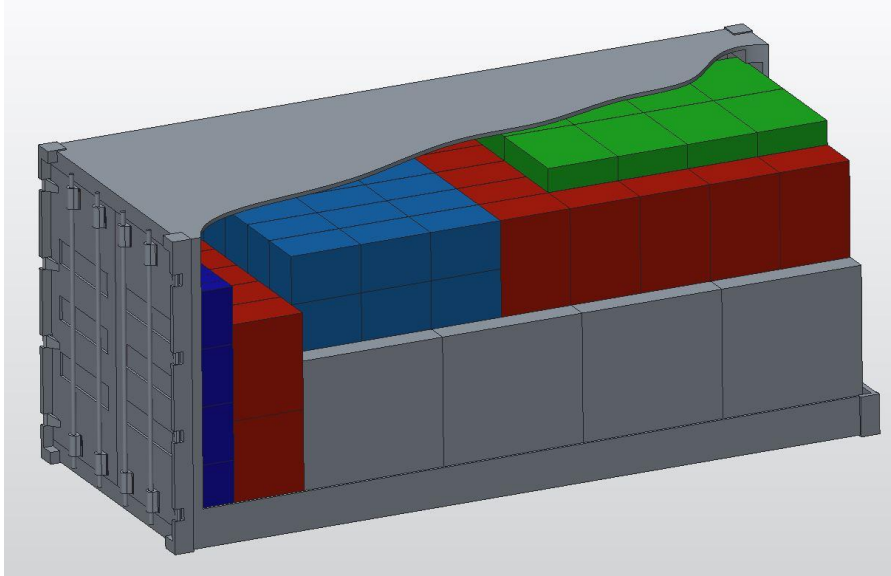


Source: <http://www.autobild.de/artikel/lkw-ladung-viele-laster-sind-ueberfluessig-3879917.html>

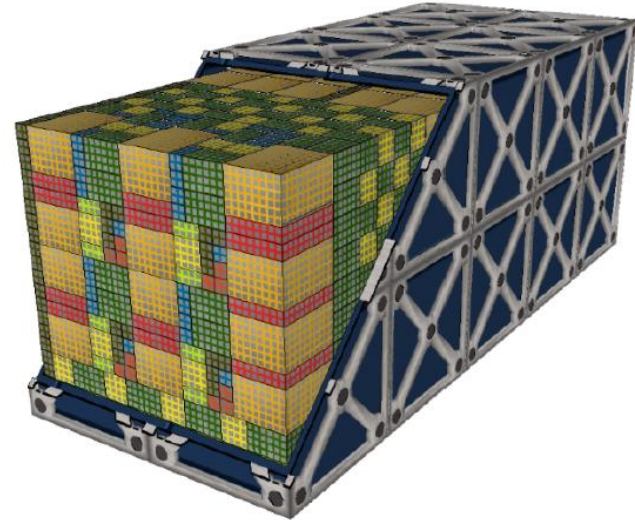


Source: <http://konvoi-nach-odessa.blogspot.com/2010/09/>

# Background/Approach

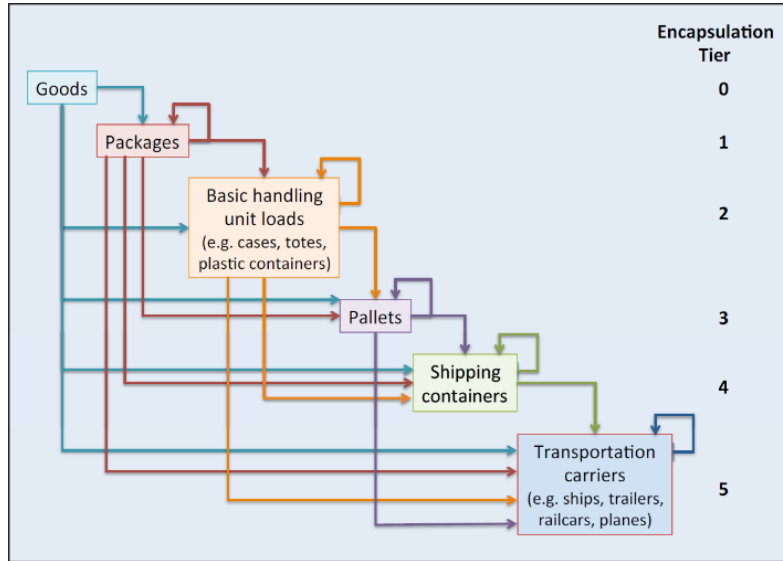


Source: Modulushca D3.1 (2013)

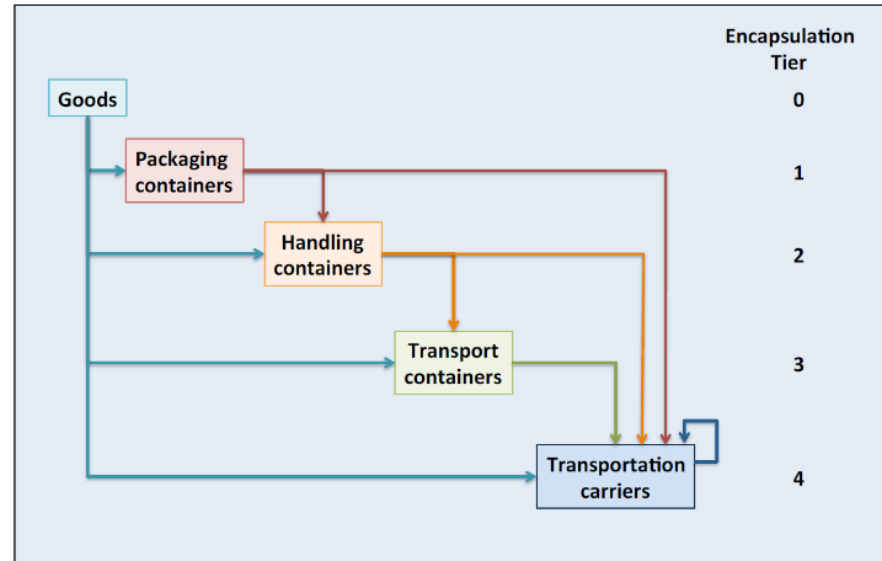


Source: B. Montreuil, E. Ballot, W. Tremblay; (2015)

# Approach



Current encapsulation practice characterization  
Source: [B. Montreuil, E. Ballot, W. Tremblay; 2015]

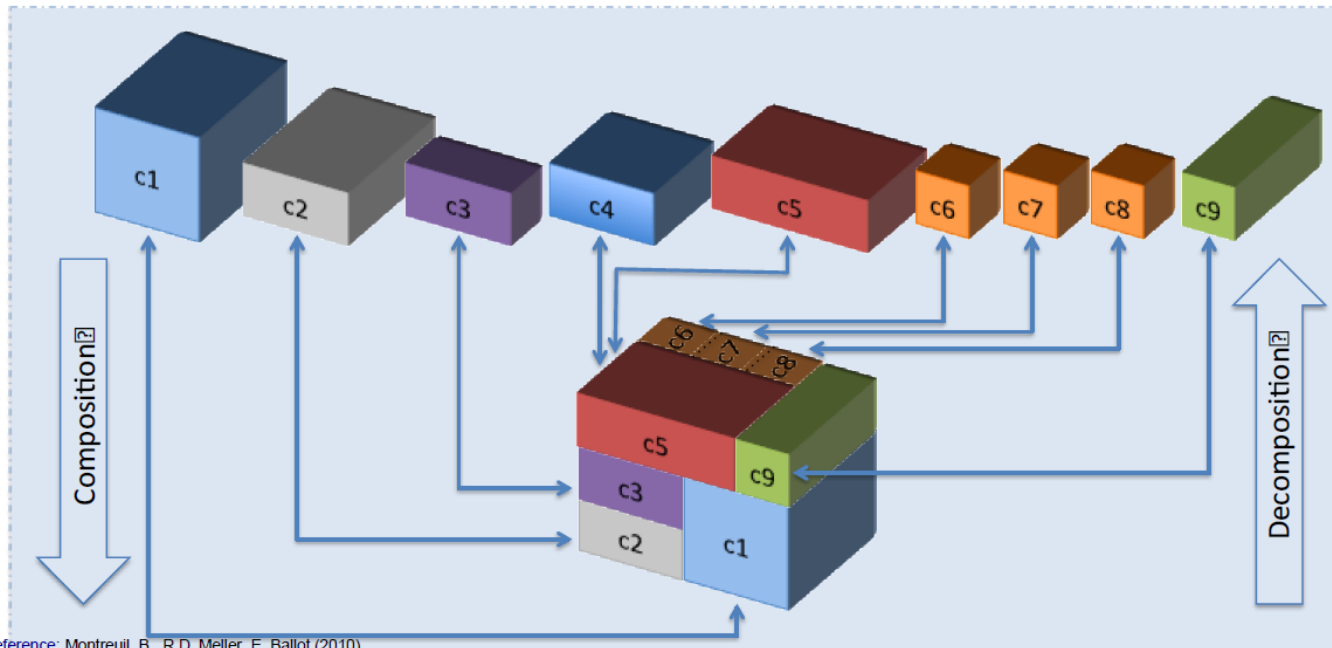


Proposed PI encapsulation characterization  
Source: [B. Montreuil, E. Ballot, W. Tremblay; 2015]

# Approach

## $\pi$ -Containers designed for the Physical Internet

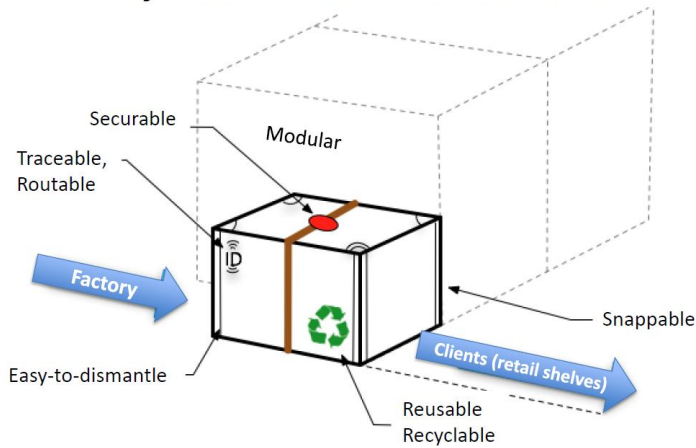
Easy to load, unload, handle, store, transport, seal, snap, interlock, construct, dismantle, panel, compose and decompose



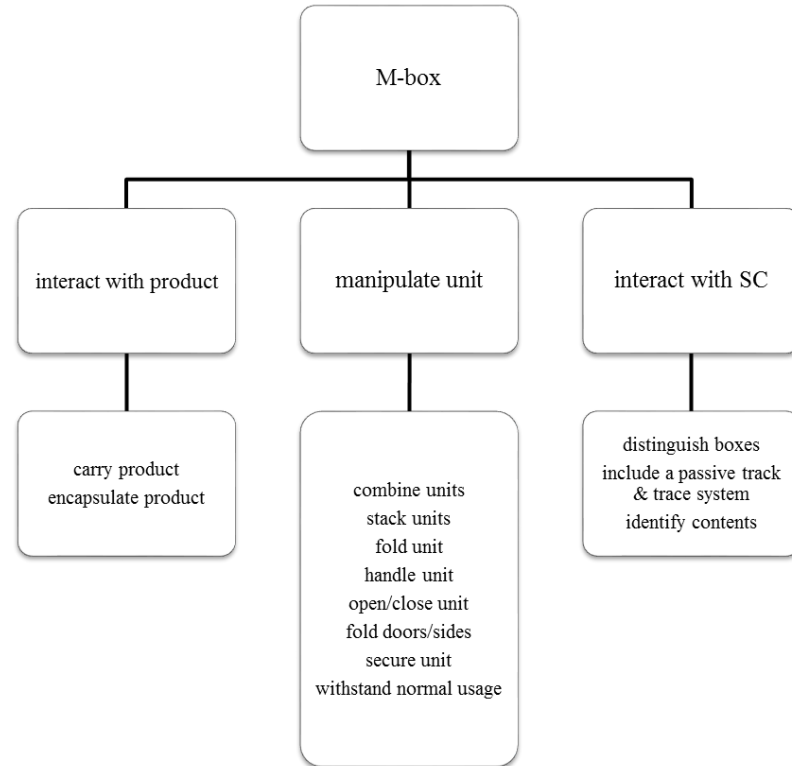
B. Montreuil, R.D. Meller and E. Ballot (2010)

# Approach – key features

## Key features of $\pi$ -containers

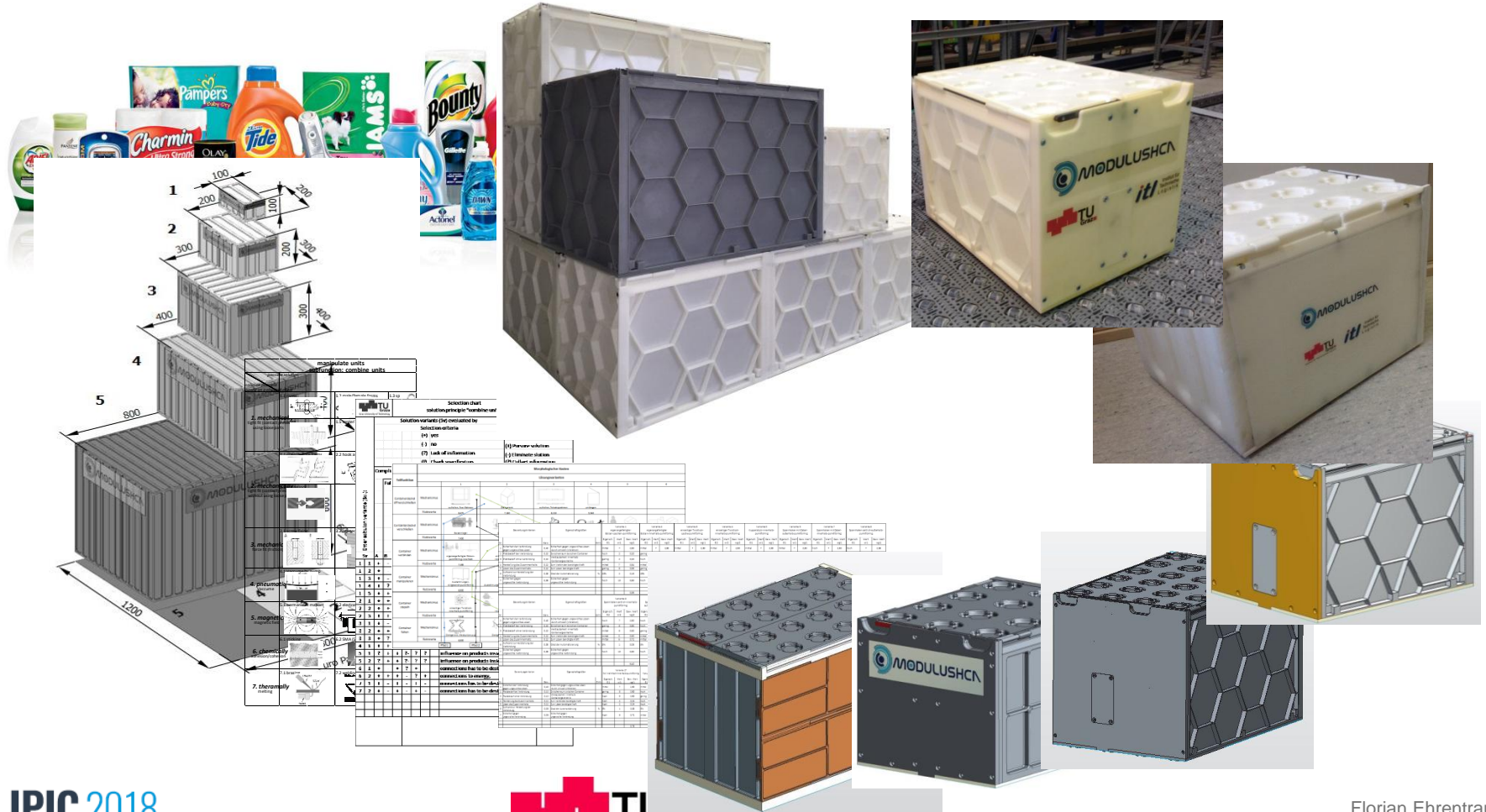


Original drawing by Eric Ballot, Mines ParisTech, 2011-06-27, adapted by Benoit Montreuil

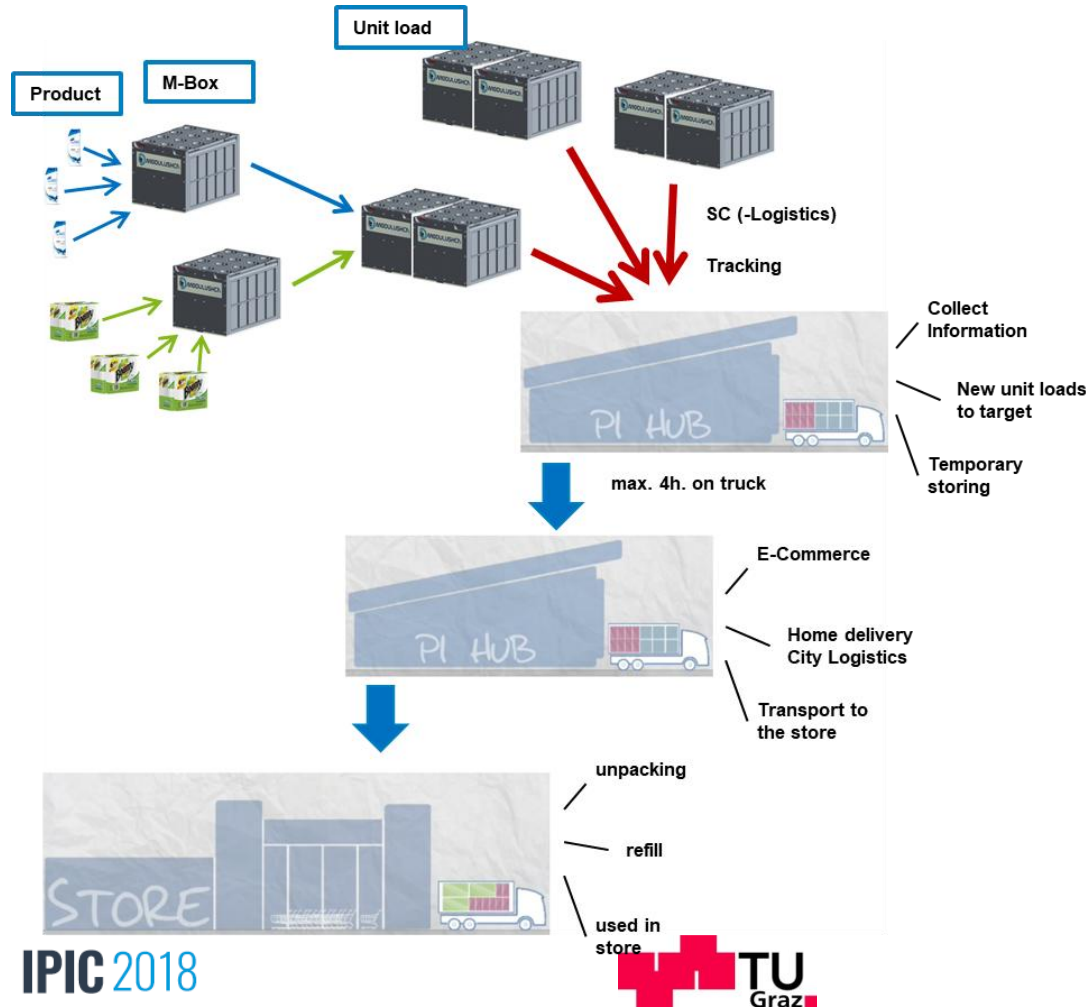




# Approach – Prototype



# Possibilities



- Better volume utilisation of trucks -  
→ around 20% calculated in Modulushca
- Handle boxes and unit loads more efficient (fully automated handling is possible) → better time and cost efficiency
- Use the boxes through the whole supply chain → from production to the store
- Reduce the size of packaging → even better volume utilisation
- Anonymisation of products → cooperation with competitors
- Etc. etc...

# Obstacles – diversity of logistic assets



Source: <https://media.istockphoto.com/>



Source: <https://i.ebayimg.com>



Source: [de.wikipedia.org/wiki/Gitterbox](https://de.wikipedia.org/wiki/Gitterbox)



Source: <https://blog.sbbcargo.com>



Source: <https://www.merford.com>

# Obstacles – diversity of products



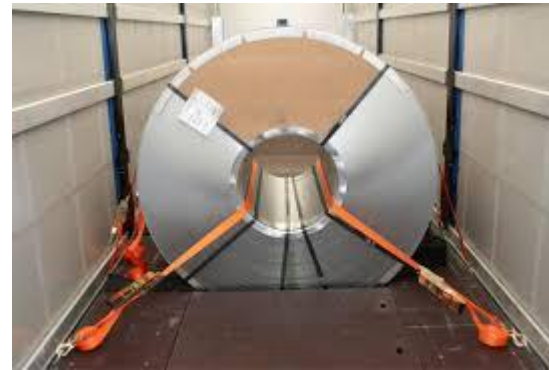
Source: [www.sma-sunny.com](http://www.sma-sunny.com)



Source: P&G

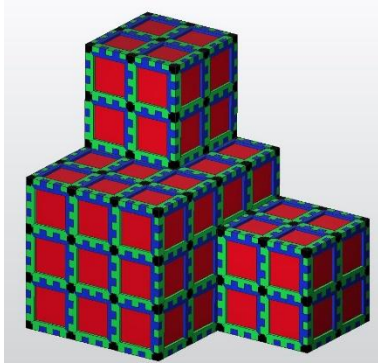


Source: [thumbs.dreamstime.com](http://thumbs.dreamstime.com)

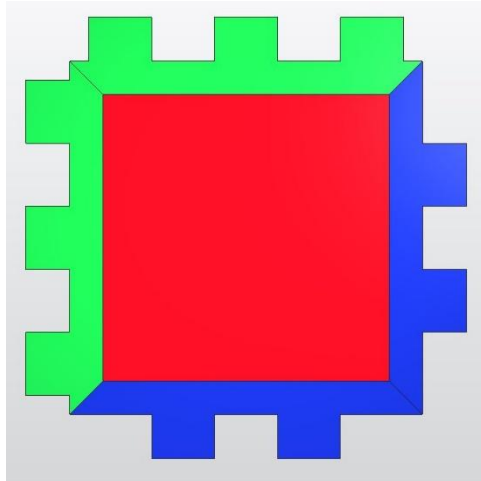
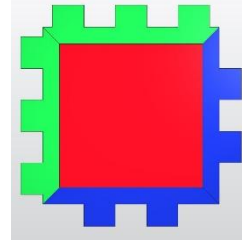
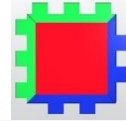


Source: [Schwarzmueller.com](http://Schwarzmueller.com)

# Obstacles – requirements of the market



panel size #	x [mm]	Y [mm]
1	100	100
2	200	200
3	400	400



## Panel #1

Box size	200x100	600x800	1200x800	1200x800
# of	x 100	x 600	x600	x2400
Panels	10	264	432	1152
Pins	40	1056	1728	4608
Connector 1	8	8	8	8
Connector 2	0	190	334	982
Connector 3	4	68	92	164

## Panel #2

Box size	200x100	600x800	1200x800	1200x800
# of	x 100	x 600	x600	x2400
Panels	-	66	108	288
Pins	-	264	432	1152
Connector 1	-	8	8	8
Connector 2	-	32	62	206
Connector 3	-	28	40	76

## Panel #3

Box size	200x100	600x800	1200x800	1200x800
# of	x 100	x 600	x600	x2400
Panels	-	-	-	72
Pins	-	-	-	288
Connector 1	-	-	-	8
Connector 2	-	-	-	34
Connector 3	-	-	-	32

# Solutions!?



Source: [www.clusters20.eu](http://www.clusters20.eu)



Source: [www.ilog.it/images/citilog.png](http://www.ilog.it/images/citilog.png)

# Solutions!?



Maybe the solution is to make the PI-Containers smart!?