

TramLink und CityLink Familien – die neue Generation von Strassenbahnen und Stadtbahnen



43. Tagung – Moderne Schienenfahrzeuge. TU Graz

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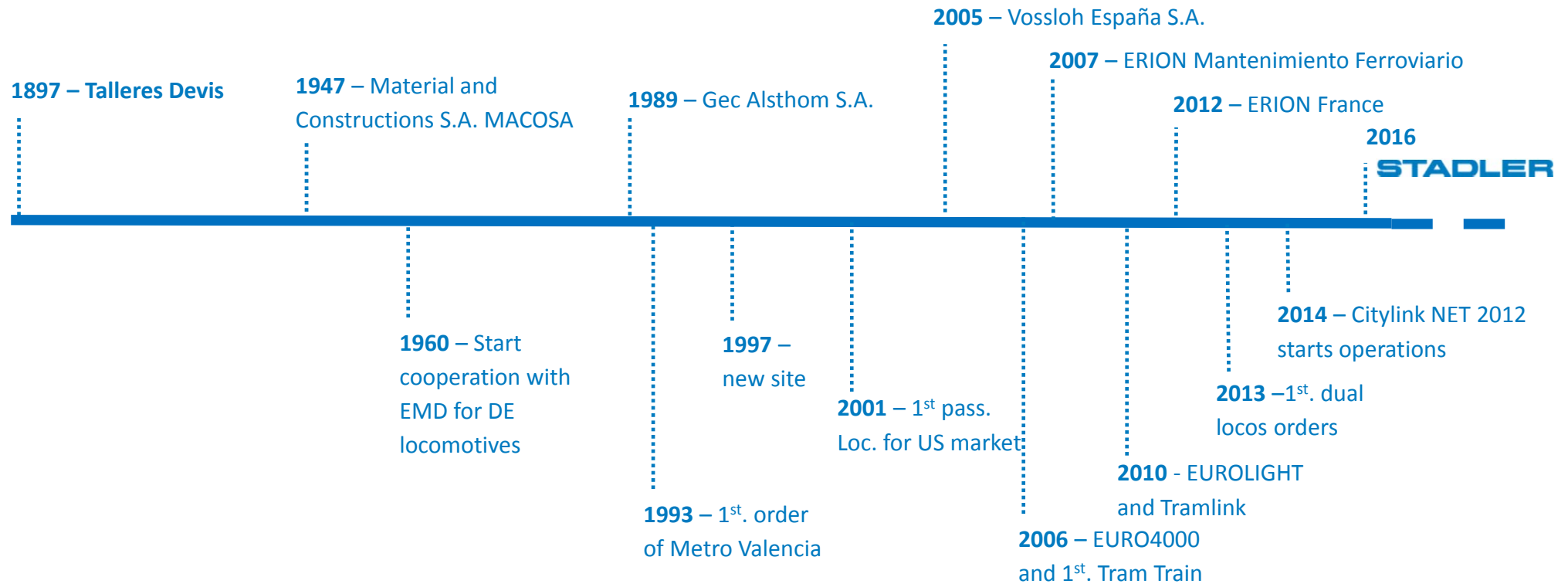
The Stadler Rail Group

Consolidated turnover 2016 (Budget): ca. CHF 2,2 billion
Number of employees (Budget, FTE): ~ 7000



Stadler Rail Valencia - Site History

More than a century of experience putting visionary solutions on track.



Stadler Rail Valencia - Business snapshot

Converging engineering and production capabilities in ONE site.

- Design and manufacturing of **locomotives, LRVs and bogies** and after-sales services of rail vehicles
- **Integral engineering and production facilities for carbodies and bogies on site.**
- 900 multi-skilled employees with more than 150 engineers dedicated to product development.
- Facility completed in 1997 with almost 200,000m² distributed in several product-oriented workshops and installations. Flexible and full integrated plant which configuration allows to design, develop and test all vehicles in house.



Main facility size (m ²)	199,724 Total covered: 46,959
Facility layout	Vehicle workshop, Bogies workshop, Testing installations
Certifications	IRIS2.0, ISO9001, ISO14001, OHSAS 18001, EMAS, EN 15085 (welding), DIN 7601 (bolding)

Stadler Product Portfolio: Urban Transport

STAV



STAV LRVs for urban and suburban transport

Citylink



Stadtbahn family
“One vehicle for two systems”

Tramlink

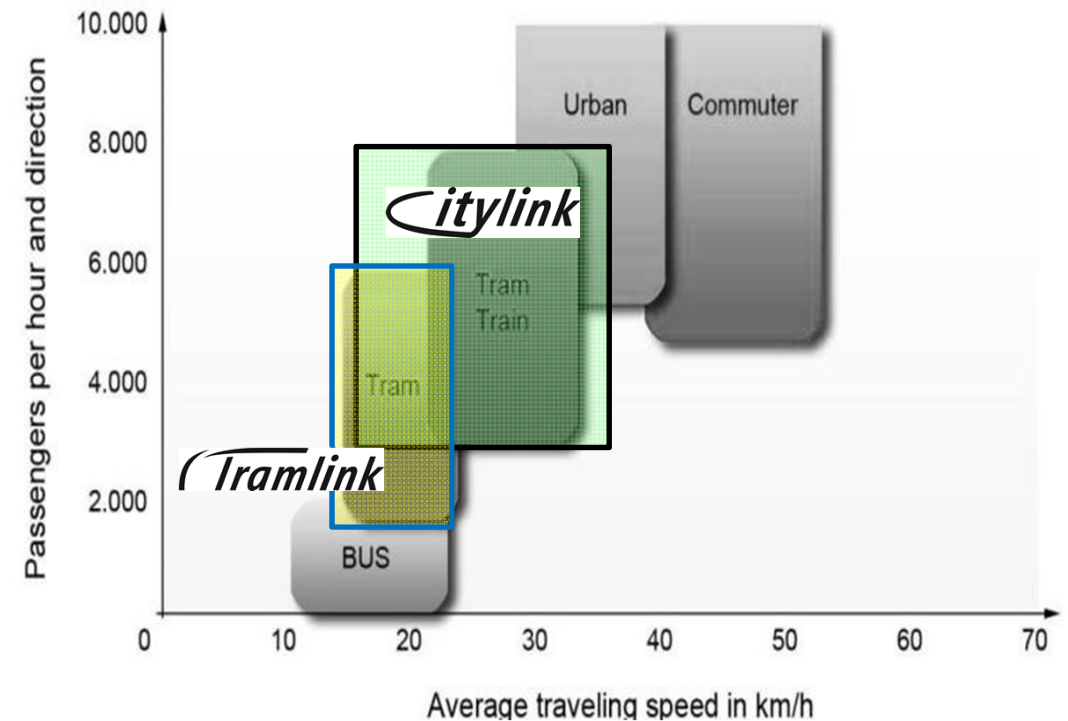


Strassenbahn family
100% LF multi-articulated tramway

TramLink and CityLink crosscheck

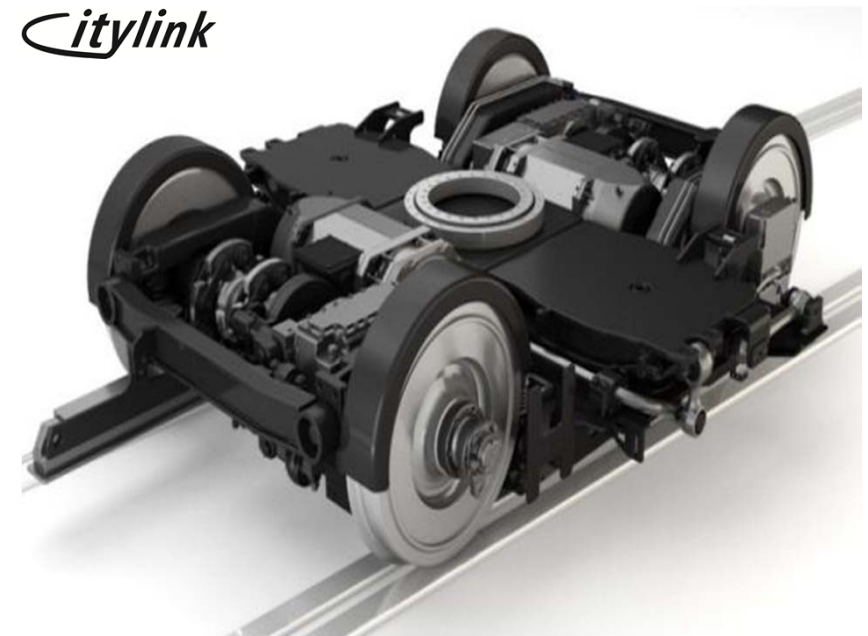
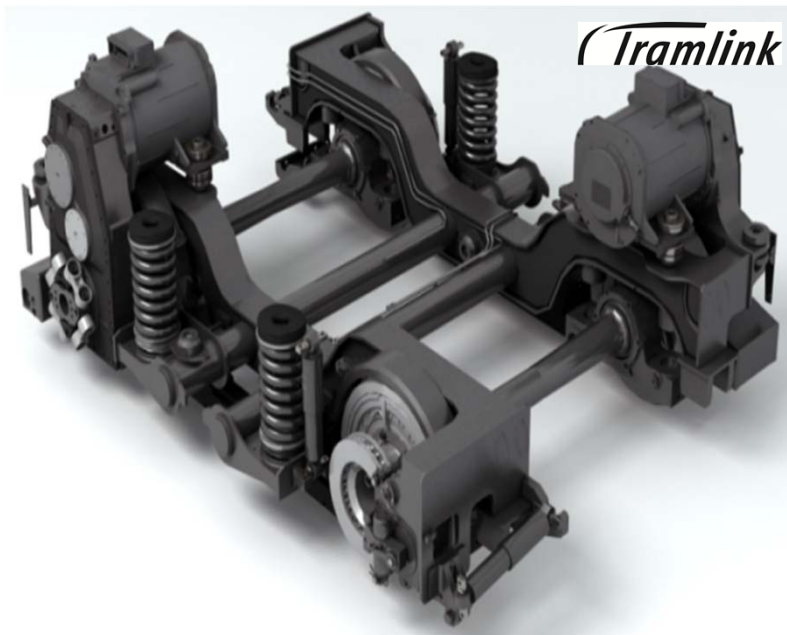
- TramLink is for urban environments , ~ 70km/h ➔ *Tramway / Streetcar application*
- CityLink covers from tramway applications up to a full railway operations at ~100km/h ➔ *Regional / LRT*
- The key of the success of both families lies in:
 - The innovative concept of TramLink bogie and CitiLink bogie
 - Full integration bogie-carbody on both vehicles
 - Optimised HS steel structure.
 - Easy adaptation to customers´ needs.
- Main differences are:
 - Overall Performances
 - Dynamic envelope and curve inscription
 - Lower parts clearance
 - Running comfort at high speeds
 - Seat arrangement (capacity vs. seating comfort)
 - Low floor and platform accessibility
 - Crash safety resistance
 - Weight in tare and weight per axle

CityLink covers wider range of operational modes than TramLink.

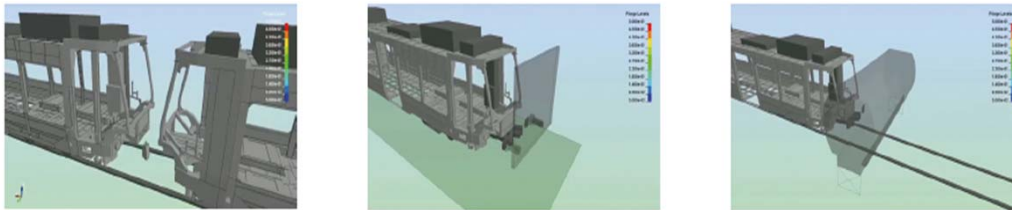


TramLink and CityLink crosscheck

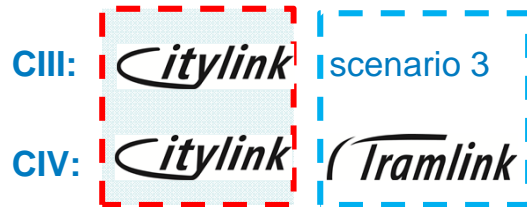
- CityLink keeps the 100mm requirement for lower parts track clearance (EBO requirement 80mm)
- TramLink respect only urban lower parts clearance of 60mm (BOStrab minimum requirement among others)
- Even in a 900mm track gauge TramLink bogie still allows full low floor configuration, CityLink architecture needs inner steps
- TramLink allows down to 17m radii inscription (std.), CityLink minimum curve negotiation is 22m (standard configuration)



TramLink and CityLink: Structure and crash concept



- Collision scenarios = EN 15227 – 4



- Static loads = EN 12663 - 5.2.3

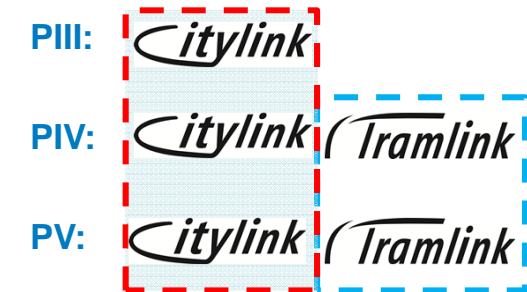


Table 2 — Collision scenarios and collision obsta

Design collision scenario	Collision obstacle	Operational characteristics of requirement	Collision Speed - km/h			
			C-I	C-II	C-III	C-IV
1	Identical train unit	All systems	36	25	25	15
2	80 t wagon	Mixed traffic with vehicles equipped with side buffers.	36	n.a.	25	n.a.
	129 t regional train	Mixed traffic with vehicles with a central coupler	n.a.	n.a.	10	n.a.
3	15 t deformable obstacle	TEN and similar operation with level crossings	$V_k - 50$ ≤ 110	n.a.	25	n.a.
	3 t rigid obstacle	Urban line not isolated from the road traffic	n.a.	n.a.	n.a.	25
4	Small, low obstacle	Obstacle deflector requirements to be achieved	See Table 3	n.a.	See Table 3	n.a.

Fuerzas de compresión en la zona de topes y/o gancho

Vagones de carga		Material de pasajeros					Fuerza en kN
Categoría F-I	Categoría F-II	Categoría P-I	Categoría P-II	Categoría P-III	Categoría P-IV	Categoría P-V	
2 000	1 200	2 000	1 500	800	400	200	
Carga máxima de operación							Carga en N
Vagones de carga		Material de pasajeros					
Categoría F-I	Categoría F-II	Categoría P-I	Categoría P-II	Categoría P-III	Categoría P-IV	Categoría P-V	
$1,95 \times g \times (m_1 + m_2)^a$		$1,3 \times g \times (m_1 + m_1)^b$			$1,2 \times g \times (m_1 + m_2)^b$		
Aceleraciones en la dirección x							Aceleración en m/s ²
Vagones de carga		Material de pasajeros					
Categoría F-I	Categoría F-II	Categoría P-I	Categoría P-II	Categoría P-III	Categoría P-IV	Categoría P-V	
$\pm 5 \times g$		$\pm 5 \times g^a$	mín. $\pm 3 \times g$	$\pm 3 \times g$		$\pm 2 \times g$	

TramLink and CityLink crosscheck

Both, CityLink and TramLink, are modular and scalable platforms fitting in all, new or old rail nets

citylink

Tramlink



Standard **TramLink**
32m x 2'65/2'4m



Standard **CityLink**
37m x 2'65m



TramLink, 7 coaches, 47m



CityLink, 4 coaches, 50m

CityLink Platform

- CityLink is the universal Tramway and Interurban LRV platform: Two systems in one train
- CityLink is modular, scalable and flexible. Barrier free, for urban & interurban operation
- CityLink LRV is within Stadler Rail Valencia portfolio the LRV with turning bogies (> 1'5° rotation)
- CityLink provides enhanced safety even at 110 km/h and in unpredictable urban environments



CityLink Platform – History of success



...becoming European leader manufacturer of TT with references in Spain, Germany, UK and Mexico with almost **125 units** sold:

- **Metric gauge Tram Trains to different Spanish customers:**



- **Citylink NET 2012 for Karlsruhe: 75 units sold**



- **Hybrid Citylink for Chemnitz**



- **1st. Tram Train in UK**



- **1st. Tram Train in Latin America**



CityLink Platform – Two systems in one train

Citylink



CityLink Platform – Two systems in one train

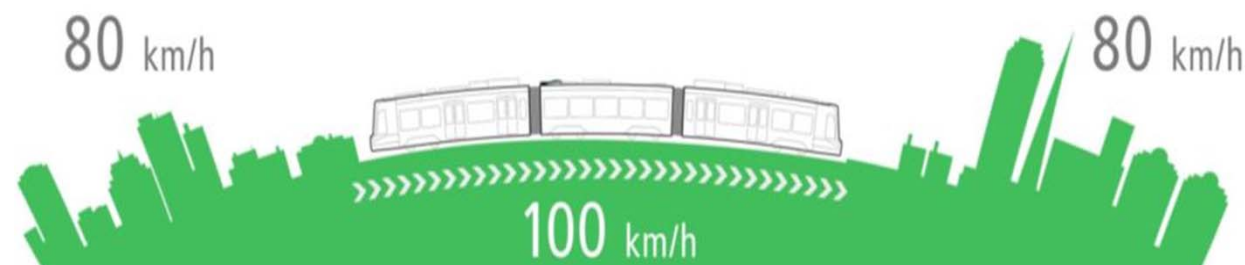
- CityLink is a LRV with **turning bogies** able to operate not only as a tramway
- Providing a **very high comfort** at urban operational conditions and main line infrastructure
- Compliance with C-III and C-IV EN15227 together with visibility DIN 5566-3 (1200mm @300m)
- Certified according **BOStrab** and **EBO**.

Tramway characteristics

- Impressive visibility from driver's cab
- Powerful brake system (effective hydraulic brakes)
- high acceleration
- Easy access from street platforms
- Barrier free low floor LRV
- Ready to cope with small curve radii and driving on sight

Railway characteristics

- Excellent running dynamics
- High comfort as in a regional train
- Up to 110 km/h
- Secondary pneumatic suspension
- Heavy rail crash-energy management system
- Enhanced car body structure ready to deal with freight wagons and regional trains



CityLink Platform – Vehicle architecture

Modularity and customization: Adapted to network requirements and customer's needs

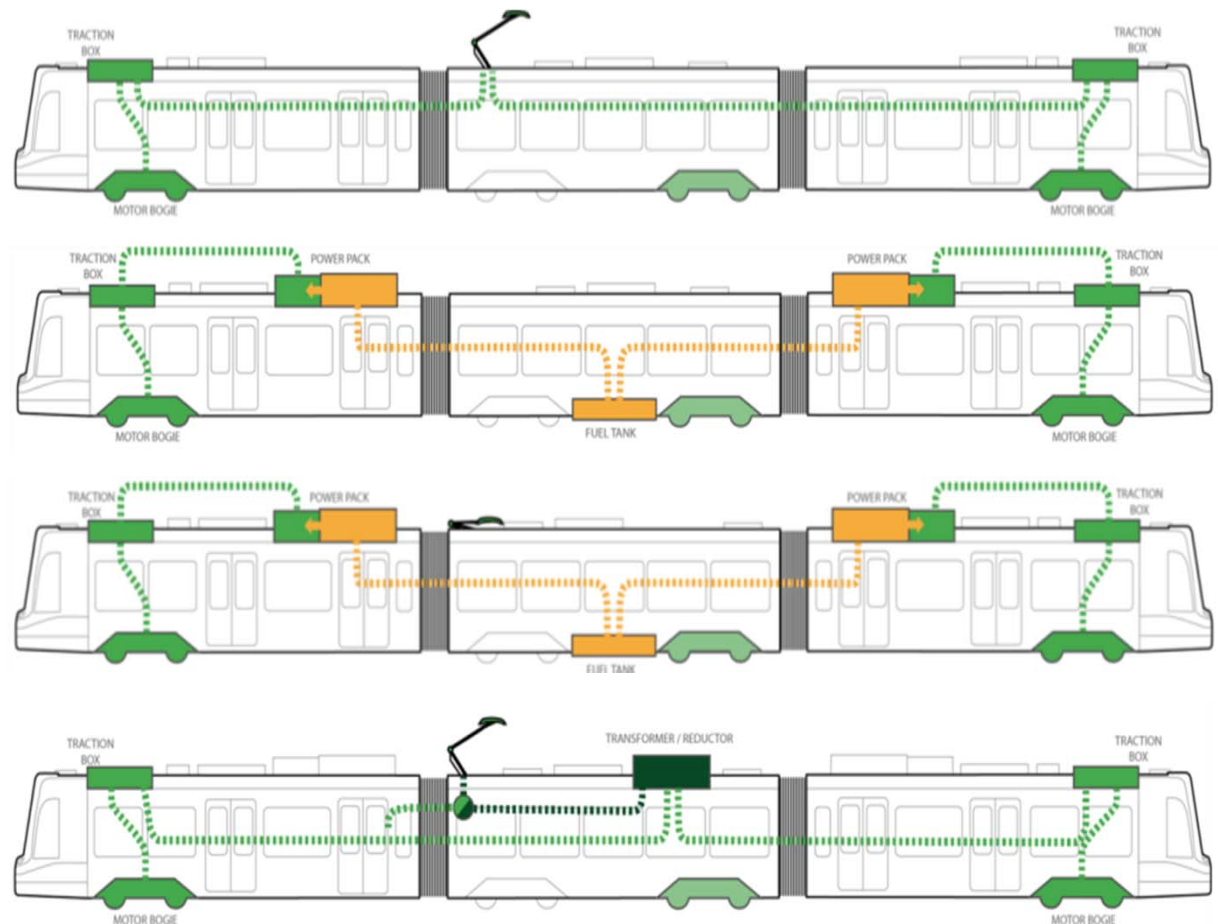
Power supply configurations:

- **750Vdc or 1500Vdc**
 - Alicante, Spain (metric)
 - Mallorca, Spain (metric)
 - Karlsruhe, Germany (int.)

- **Diesel**
 - FEVE, Spain (metric)
 - Puebla, Mexico (int.)

- **Diesel + 750Vdc (Hybrid)**
 - Chemnitz, Germany (int.)

- **750Vdc + 25KV_a (Dual)**
 - Sheffield, UK (int.)

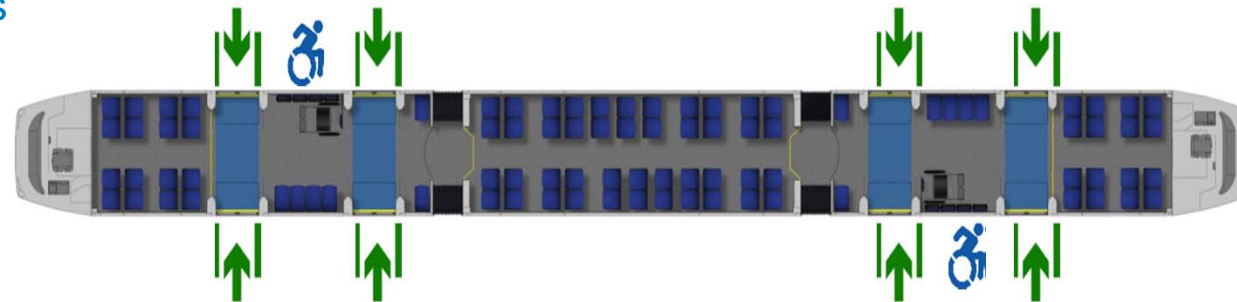


CityLink Platform – Vehicle architecture

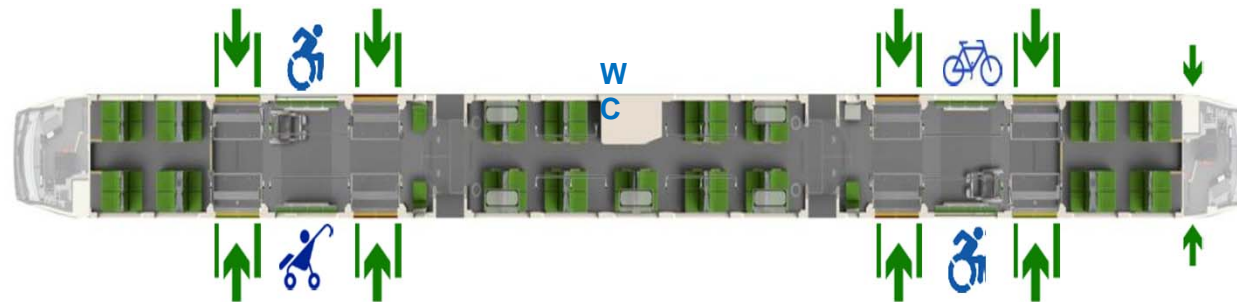
Modularity and customization: Adapted to network requirements and customer's needs

With the lowest access from its class, directly from platforms of 340mm up to 550mm. Allowing the use of existing infrastructures

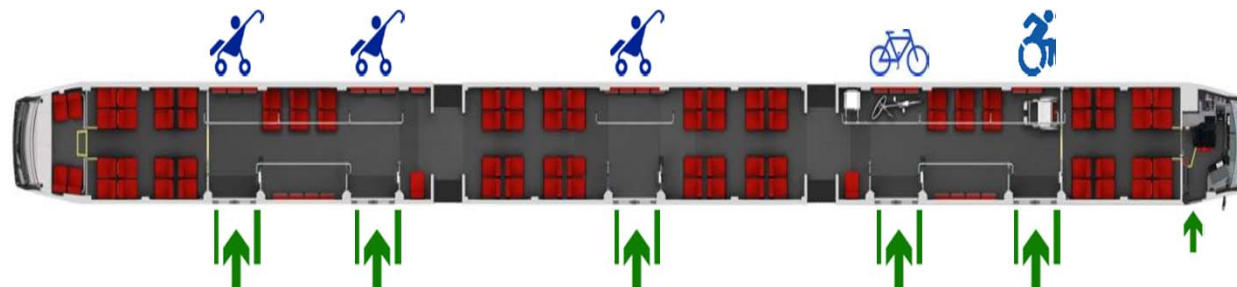
- **Sheffield**
235 pax



- **Chemnitz**
228 pax



- **Karlsruhe**
240 pax



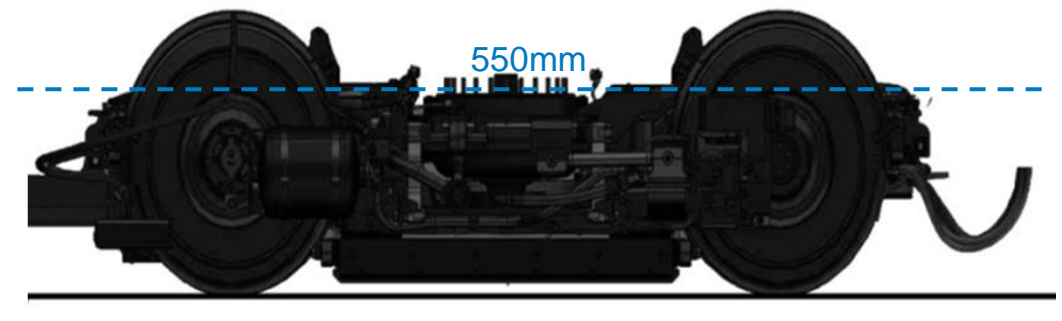
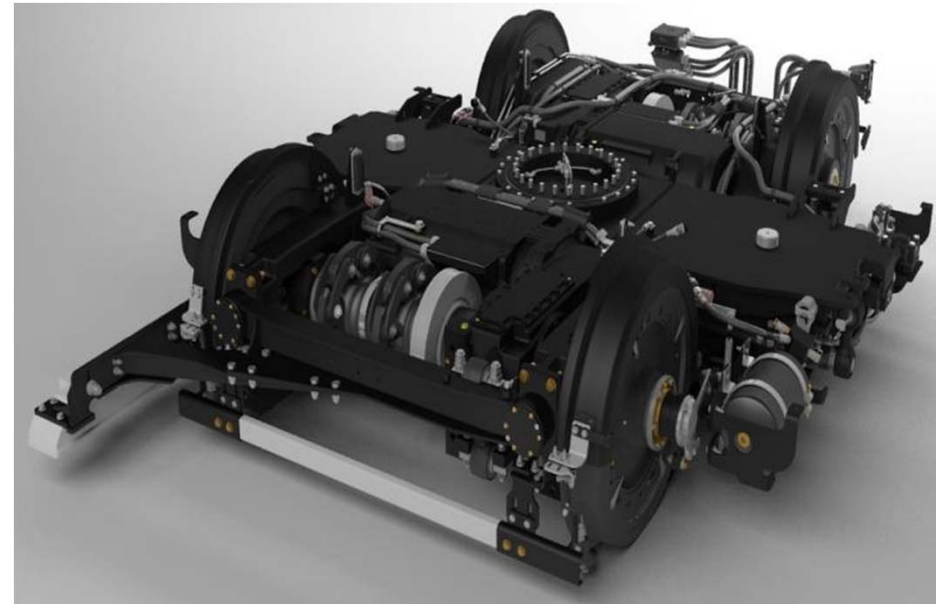
CityLink Platform – Barrier free

CityLink standard track gauge allows **low floor from the front to the back door with very smooth gentle longitudinal ramps <6%**



CityLink Platform – Bogie architecture

- **Main line bogie features in a tramway bogie size**
 - **Turning bogie** with real-axle or **conventional wheelset**
 - up to **720mm diameter wheels**
 - Horizontal curve inscription down to **22m radii**
 - Lower parts **100mm clearance**
 - Transversal motors
 - H frame structure
 - Resilient wheels
 - **Secondary air suspension**
 - **Slewing ring steering**
 - **Fully suspended transmission**
- CityLink bogie architecture is **the lowest “conventional” truck of its class designed to provide good comfort values even up to 110km/h**
- **EBO & BOStrab fully compliance**
- **UK certified also**
- **Low carbody interface**



CityLink Platform – HS duplex steel

- Duplex stainless steel mix best properties from austenitic and ferritic stainless steel
- Provides the **best strength and protection with the lowest weight**
- Thanks to its high content in Chrome and Nitrogen, and the presence of Molybdenum, these steels provide **very good protection against corrosion**
- **Good protection against pitting and crevice corrosion and good resistance against abrasion and erosion**
- Micro-structure of duplex steels provide **high mechanical strength** and high strength against corrosion under stress and cracking
- Due to these advantages using duplex steels **design is optimized for strength, maintainability, durability** and long term cost efficiency, and reduce the life cycle cost
- High energy absorption with low thermal expansion and good welding properties

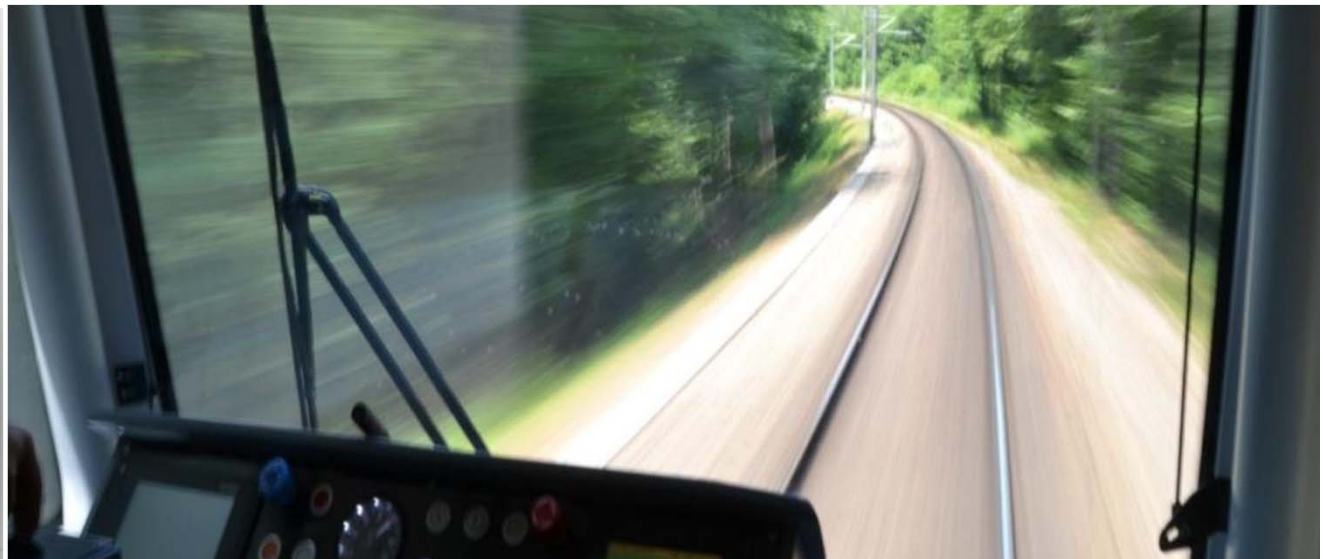


CityLink Platform – Enhanced safety

Crash management and visibility requirements in a low floor lightweight structure

Enhanced safety with passive measures and active equipment:

- Energy Absorbing crash elements,
- Anti-climbers,
- Powerful and quick reaction hydraulic brakes,
- Modular cab structure design,
- Survival area within driver's seat, etc...



CityLink Platform – Principal characteristics

- **Typical configuration** 37m length in 2'65m width and around 220/250 pax @4ppm
- Capable of running on **urban networks** as well as on **railway lines**.
- **Allowing the use of existing infrastructures** → reduced infrastructure investments
- For speeds up to 110km/h with high acceleration and effective hydraulic brakes
- **Enhance safety**: Energy Absorbing crash elements, Anti-climbers, Powerful and quick reaction hydraulic brakes, Modular cab structure design, Survival area within driver's seat, etc.
- **Compliance with C-III and C-IV EN15227** together with visibility DIN 5566-3 (1200mm @300m)
- **Maintenance free structure**, full made of duplex high strength stainless steel
- **Real turning bogie with slewing ring bolster and secondary air suspension**
- CityLink has **low floor from back to front doors** with very smooth gentle longitudinal ramps <6%
- **Conventional wheel-set up to 720mm diameter wheels**
- With the **lowest access from its class**, directly from platforms of 340mm up to 550mm.
- **Mono / Dual / Hybrid / Diesel configurations**



Stadler TramLink *ALL ABOUT COMFORT*

Tramlink

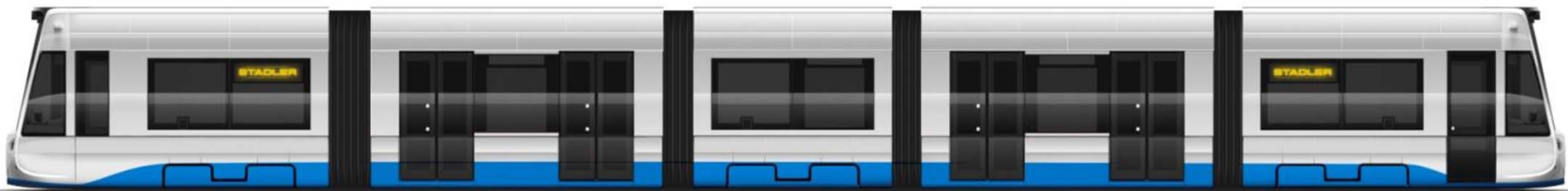
TramLink is the modular, scalable and flexible, full low floor, barrier free, multi-articulated tramway family



TramLink platform - Principal characteristics



Tramlink

- **Multi-articulated rail lightweight vehicle, 100% low floor, full barrier free (<6% ramps)**
- **Direct access** from platforms from 240mm up to 350mm
- **Best running dynamics and comfort** thanks to a **conventional turning bogie with real axle and big wheels diameter**
- Top capacity of its class with **up to 16 seats over running parts without steps or ramps**
- **Maintenance free structure**, full made of duplex high strength stainless steel
- Compliance with C-IV EN15227 (& CIII-3 15T tank lorry @ 25km/h) and visibility DIN 5566-3 (1200mm @300mm)
- Updated to the new fire and smoke EN 45545
- Modular bogie concept (from 1435mm down to 900mm) same architecture for trailer and motor
- Designed for catenary wireless operation on demand



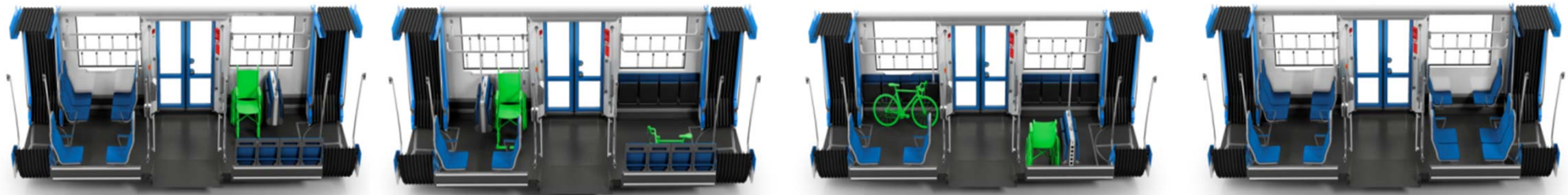
TramLink platform - Modularity

- Fits to all and every customer needs
- Length range from 18'5m up to 47'5m full low floor without any step from back to front
- Carbody widths from 2'3 up to 2'65m (including Rostock special one being 2'65 with 2'3 only for lower parts)
- Configurable door and seat arrangement . Interior modular concept

	Passengers	Lenght (min/max)	Doors (min/max)
	115 / 135	18,5 / 23 m	4 / 8
	200 / 215	28 / 35,2 m	6 / 12
	255 / 300	37,8 / 47,5 m	8 / 16

TramLink platform - Modularity

- The interior of the TramLink has been designed based on modularity, **for manufacturing and for our customers**
- The **Halfen profiles** on the wall allow for **multiple seat configurations** without major changes on the interior lining
- Seat configurations can be varied not only in our plant but also in our customer's depots throughout the vehicle life
- TramLink will always be able to fulfill our customer's needs, no matter if they vary during the lifetime of the vehicle



TramLink platform - Modularity

Tramlink

ROSTOCK



3 Bogies (5 Cars)

SANTOS



4 Bogies (7 Cars)

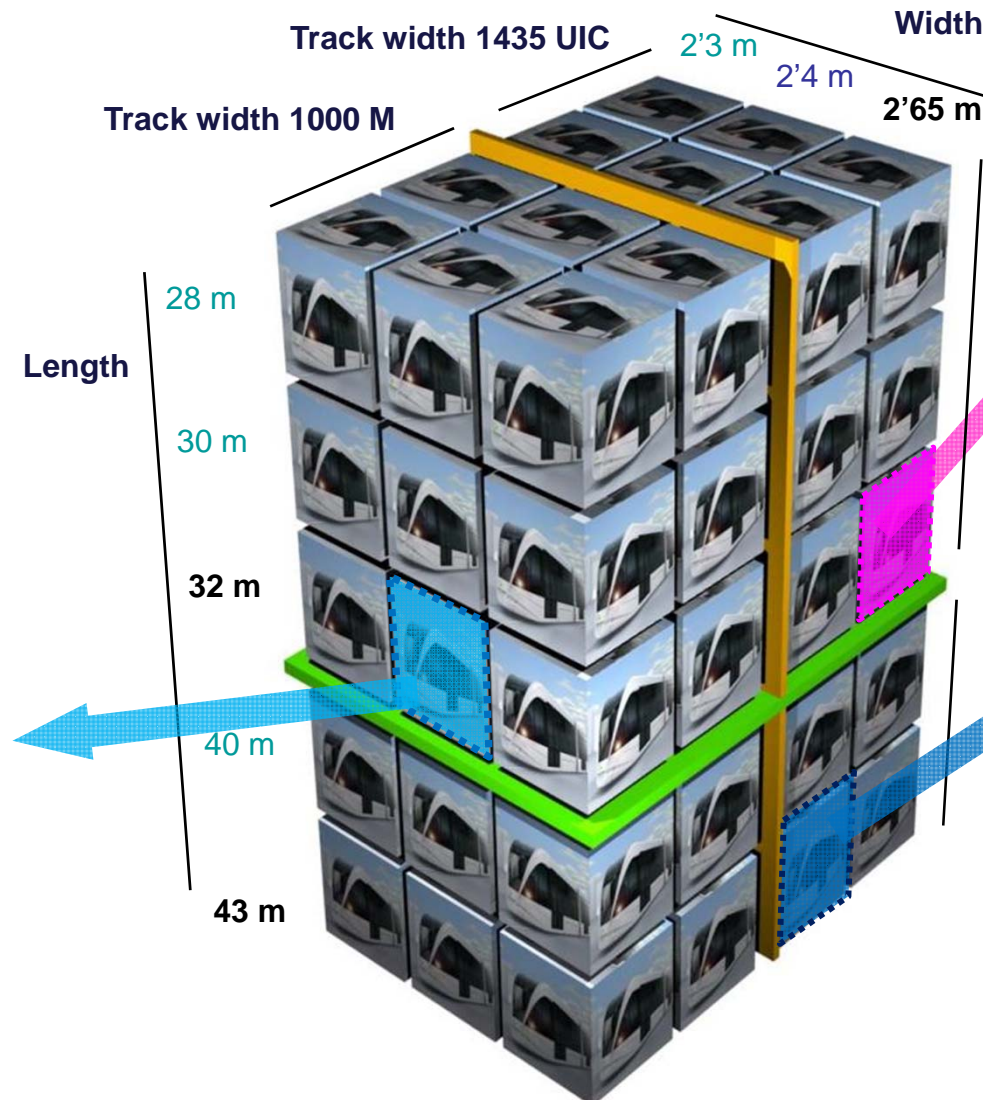


GMUNDEN



VALENCIA

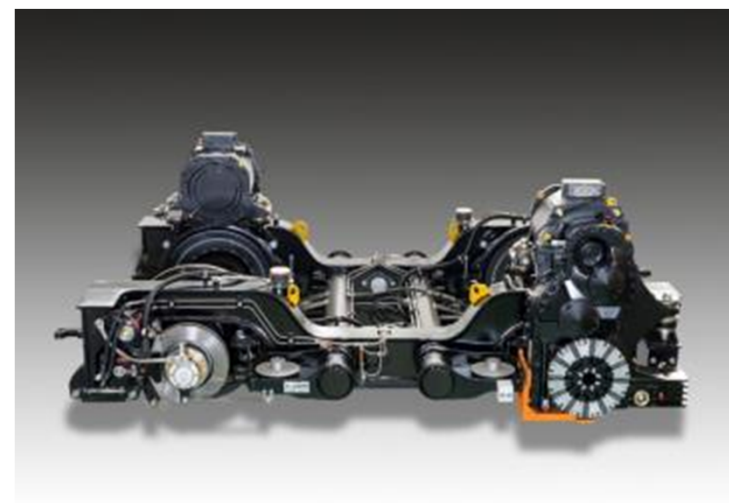
3 Bogies (5 Cars)



Tramlink platform - Bogie concept

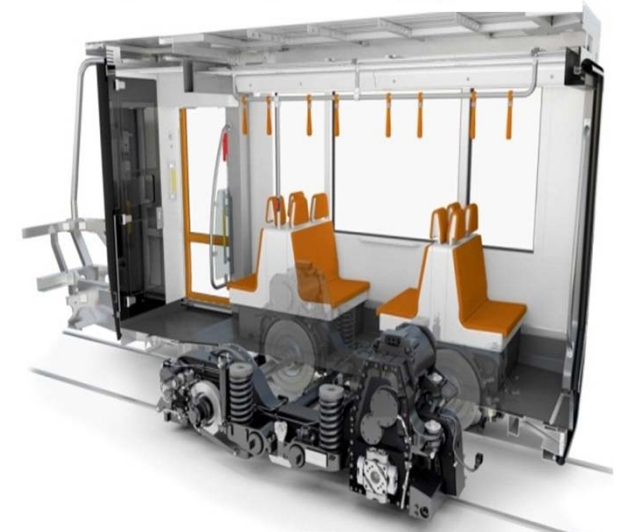
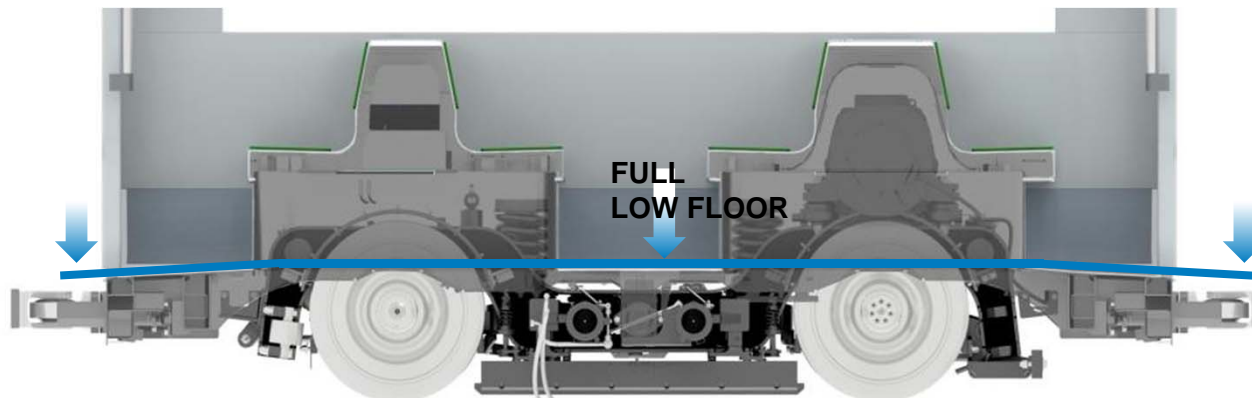
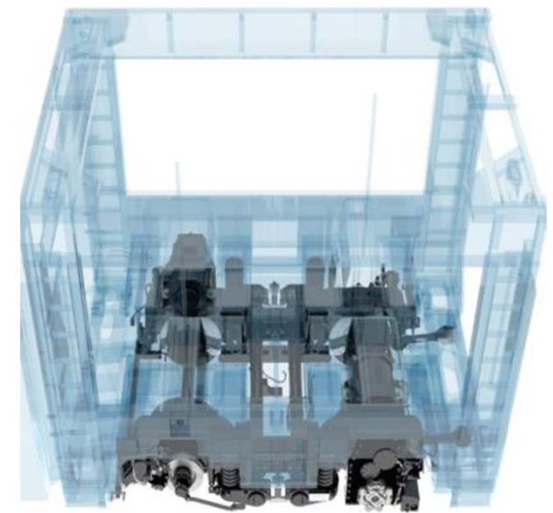
Tramlink

- Most of benefits and advantages of the TramLink, are possible because of the new bogie concept.
- The patented bogie design architecture consists on a **turning bogie with real axle wheelset, transversal motors, H frame structure and resilient wheels**.
- Conventional axle provides **better curve guidance, strength and state-of-the-art proven solution** easy to be homologated in all national normative frames.
- The suspension system is designed to provide **good comfort** values even up to 80km/h
- **Modular bogie concept**, even with different track gauge, same architecture, concept and solutions
- Low floor TramLink bogie fulfills all **BOStrab** criteria including 60mm clearance



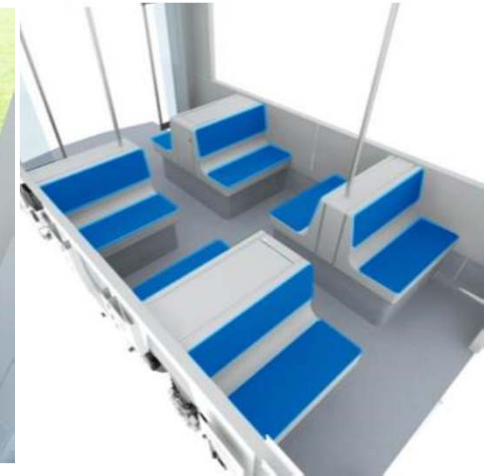
Tramlink platform - Bogie integration

- **Bogie and carbody were designed at the same time, with the same targets and requirements, etc.**
- → **Highly integrated design**, achieving a very low floor level entrance and allowing gently pass over axle mounting big diameter wheels.
- With the **maximum seat capacity** and comfort up to 16 seats per bogie area
- **Ready for direct access from very low platforms**, with a floor level over axle of 450mm achieved only with short 6% longitudinal ramps
- **Big elastic ring wheels with 600mm diameter** in a conventional axle wheelset



Treamlink platform - Bogie integration

- TramLink stand out from others thanks to its bogie-vehicle symbiosis allowing a very high capacity achieving up to 16 (4x4) comfort seats over bogie areas **without any step or transversal ramp**
- **All 16 seats with the same comfort!!**



Solutions of other tram manufacturers with steps, ramps or lower number of seats



Tramlink platform – Enhanced safety

Structure and crash concept

- Maintenance-free structure.
- The structure is basically made of DUPLEX® stainless steel and in certain areas also other steel grades are used.
- Structural requirements: EN12663 PIV & PV
- Reduction of the unfilled risk
- Absorption of the collision energy in a controlled manner
- Preservation of the residual space and vehicle structure where passengers and the driver can stay
- Crashworthiness requirements: EN 15227 C-IV & C-III scenario 3



Tramlink platform – Enhanced safety

Tramlink

Driver cab and exterior design.

- Impressive **visibility**
- **Maintenance** improved. Beams regulation could be made without dismantling any assembly.
- Easy-open mechanism to access the coupler.
- **Multi-mirror cams** installation is prepared.
- Full heated windows are possible.
- Lateral interior lining integrated in the exterior assembly increasing the quality of the finishing.



TramLink and CityLink - summary

CityLink:

- **Better comfort**, specially at higher speeds
- Designed for mix **urban and rail operation** (crash, coupling, signaling, etc.)
- More seats and room per seat
- Low floor from door to door
- Worst dynamic envelope



TramLink:

- **100% low floor** for any track gauge
- Designed for **urban operation** (or segregated tracks)
- Ready for **urban lower height platforms**
- Ready for **small curves negotiations** (twisted nets)



Thank you very much for your attention
Vielen Dank für Ihre Aufmerksamkeit

