Large MDC M1 Program

The City of Steel

3500 High Density Racks (11 kW/rack) 60 Megawatt Armoured steel

Introduction -
The mid sized global data centre

Imagine a growing city of steel.

A futuristic vision, reaching far beyond the enormous but conventional global data centres of today. This presentation is an introduction to something different - the Large MDC M1 program.

The key incentive, is scalability - less need for venture capital, especially at the early stage of the project.

Still, the server farm can be doubled in size, it can be tripled and so forth - in a theoretically infinite pattern - one gigantic city of steel, growing almost organically, constituted by smaller cells.

This presentation is focused on the facts - what can be achieved today, rather than a vague tomorrow. This presentation offers a turn key solution for a 60 Megawatt data centre.

We are already in production for a pilot project. The blueprints are ready. We are deploying the first live units in December 2011, as a solid proof of concept. The last 24 months has been spent on meticulous attention to every single little detail.

This makes it possible to move to the next step.

The deployment of a mid sized global data centre, designed for 3500 high density racks, 40 Megawatt of pure server power (60 Megawatt in total), and unprecedented security, not matched by any other such large scale server farm in the world.

This goal can be achieved within 16 - 24 months from "go ahead" - by using standardized industrial production lines. Here we rely on established channels for serial mass production, already present by our strong partnership within the industrial group of Swedish Steel.

The investment and venture capital needed will still be substantially less than the recent ordered Facebook installation in Sweden (FB estimated at 300 - 500 million Euro).

Furthermore, the installation capabilities are ground breaking in many other ways than minimizing just the financial risk. The design and functionality surpass all other major global server farms on the horizon.
The goal is to make a true global landmark, that stands out from other facilities, and still to be able to do that in a extremely cost efficient and scalable way.

All this can be achieved by innovation, design and a new way of building large scale modular server farms!

American Forbes Magazine, August 2011.

About us:

The MDC M1 Program is designed and developed by an industrial consortium and strategic partnership between *Modular Data Centers Stockholm AB* and *Swedish Steel (SSAB)* and the internet and telecom provider *Bahnhof AB*.

Modular Data Centers Stockholm AB is founded by some of Sweden's Internet pioneers with a solid track record of building data centres, and innovative new models for Internet infrastructure. MDC is behind the concept in this presentation - and responsible for the first deployment of M1 units just outside Stockholm in Kista Science City.

SSAB (Swedish Steel AB) is one of the worlds leading steel manufactures, specialising in metallurgy for advanced applications at the hardest possible levels. One of those patented alloys are "Armox 500T", designed to operate under combat conditions in armoured tanks. SSAB has strong muscles regarding production line, and are present at 2500 offices world wide. The ability to mass produce 100:s of modules is there.

Bahnhof AB has about 10 percent of the Swedish Internet traffic and is a major broadband and fibre operator in the Nordic region. Bahnhof operates several data centres, among them "Pionen White Mountain", a former nuclear bunker redesigned as a ultra secure data centre. Bahnhof is soon to be operating the first deployed MDC M1 modules for live customers in Kista Science City, right outside Stockholm.

Other suppliers:

The M1 Program cooperates with a number of strong subcontractors and providers for different details in the project. Estimation of cost regarding power supplies (in this presentation) is built around real pricing quotes.

A critical part of the installation will be the need for cost efficient power distribution solutions. Here we are forming an alliance with MTU (diesel engines), Schneider Electric, Eaton and Vattenfall (Vattenfall with core markets in Sweden, Germany and the Netherlands, and main product electricity).

The M1 Module

The concept is in many ways ground breaking in terms of design (inspired by science fiction) cooling techniques and by deploying larger data modules than anything else existing today on the world market.

MDC moves far away from all containerized solutions, providing a new uniquely designed unit - the M1.

The large module is designed for strictly outdoor placement. The smallest cellular body in the Large MDC M1 Program is one single M1 module.

One single module contains a total of **35 high density server racks**, and a full working space of **72 square meters**. Allowance for staff and flexible server environment (different server types) is a number one priority. Actually, the facility is designed with demand for Co-location - this makes the installation ideal to work in for maintenance and staff.

The first 3 modules (105 racks) are now under deployment in *Kista Science City*, right outside Stockholm, and will be operative during the first months of 2012. The first installation will be installed in December 2011.

The project has early on been internationally recognized in American *Forbes Magazine* and several IT-magazines. The project is nominated by "*Data Centre Dynamics*", for the 2011 data centres award in London in December.

The MDC M1 Module has been under development for more than 24 months, with helpful support from Invest Sweden, Stockholm Business Region and the Royal Institute of Technology in Stockholm.

The Large MDC M1 Program

What are the key benefits, compared to a conventional server farm?

1.) Scalability

Don't pay for empty space!

The investment for a complete solution will not only be substantially lower than any large scaled conventional server farm, it will be possible to growth module by module in a seamless organic way, that makes the need for initial capital investment low. In fact one can increase, or decrease, deployment of new modules at any given time.

2.) Cooling

Don't pay for cooling of space not in use!

You never cool areas that are not in use. This can often be the case in a regular conventional server farm.

The M1 Program takes full advantage of a new cooling technique based on active heat removing (AHRS). This system makes it possible to close down or open individual servers, racks and modules to a constant air flow, using the outdoor temperature to cool the servers.

At high density load with 11,5 kW per rack, and 22 centigrade temperature outside, 13 cubic meters per second of air will blow through the advanced filter system into the M1 modules. The racks are specially designed by MDC, allowing air to flow between the racks.

The PUE value during high density load will be slightly lower than 1.2 given 22 centigrades outdoor temperature. However - placement in cool climate (even greater Stockholm area has only 6 centigrade average temperature) will substantially lower the PUE, towards 1.1 and even less.

The MDC M1 Program is designed for climatological endurance, and even follows *100 centigrade standard* (operational ability between 50 centigrades plus and minus). The outdoor paint is based on a patented anti-heat repellent colour.

Precaution is taken against condensation, sand, humidity and practically all possible threats. At high outdoor temperature, active and conventional cooling will replace the AHRS cooling system automatically.

3.) Security

Don't put all your eggs in one basket!

The difference between the large MDC M1 Program and a conventional server farm is the individual M1. This installation is constituted by smaller totally independent "cells", all connecting to each other. This gives unprecedented redundancy.

If something unforeseen happens in one small single "house", it will minimize the risk for wide spread effects. In a gigantic conventional server farm, an unforeseen event, can in one single blow, strike out the entire business.

The M1 constructions are made in armoured steel, normally used in military applications (Armox 500T), which are hard to penetrate.

Each batch of plates goes through extensive ballistic testing, to meet stringent international criteria. Armox 500T is presentley operative in the most modern models of tanks and armoured vehicles, now deployed in Afghanistan.

On the inside, each unit is covered in a special anti melting material, and a condensation protection plate. The latter makes placement in either Arctic or desert conditions hassle free.

The M1 doors weight is 750 kilo. (They have for the design been inspired by "Space: 1999" retro science fiction, and are for security reasons pneumatically opened).

Every single M1 module is designed to be a natural "**Faraday Cage"**, built in armoured steel. The installation is practically immune to either solar flairs or **EMP**. This is a great difference from conventional server farms, which can be vulnerable to even smaller solar activities.

The interconnection between the modules is based on a climate zone (design resembling the domes of a potential space station on Mars). The practical reason for this is to make it possible to connect the entire installation to a indoor whether- proof environment, for staff and maintenance.

The "domes" in the Large MDC M1 Program will be existing hangar solutions, built by the same manufacturer that provides circular domes for smaller installations. In this mid sized global data centre, the type will be the hangars that are used for the Swedish air force (containing the fighter jet "*Griffin*").

Turn-key-solution - Specification of The Large MDC M1 Program

Target: Mid sized global data centre (server farm).

The estimation in this presentation is based on full scale, but the actual installation can be of different size. This makes it possible to seamless invest only in the actual needed size, at any given moment. You don´t pay for empty space - and can adjust size after business success.

Number of racks: 3500 high density racks.

Each rack powered by 11 kW power and containing 42 height units. The racks are a fully integrated part of the cooling system (with an embedded AHRS for cooling) and fully included in the installation and price estimations.

Power: 60 Megawatt.

40 Megawatt for servers, with additional possible 20 Megawatt for backup redundancy (and active cooling at temperatures exceeding 28 centigrade outdoor). Central power distribution will be performed with major energy firms (preliminary "Vattenfall").

Number of servers: 147.000 servers.

A typical installation could consist of a total of 147.000 servers of 1 unit height. However, the M1 Module allows for great flexibility. Blade servers, or any type of servers can be installed with great flexibility. The number 147.000 servers is just a benchmark for a possible installation.

Placement: MDC M1 can be placed anywhere in the world.

The target is the international market. However, recommendations are placement in cold climate - this will greatly decrease cooling costs.

Suggested placement in Sweden: Greater Stockholm area.

Greater Stockholm area would give excellent access to infrastructure, know-how and power supply - plus cold temperature (average 6 centigrades yearly). Stockholm placement will be a clear advantage for generating interest and business.

Remote wilderness localisation in the north may save some cooling money, but lessen business opportunities (and interest from the public sector). The market is located in major urban areas. This will be an upper hand.

Space needed for total installation: 25.000 square meters (including fencing area).

The space will make room for a total number of 100 (one hundred) MDC M1 modules of armoured steel, interconnected with 20 command modules (hangars) in inflatable format. For cooling purposes in this scale, the space has a calculated factor x 2 distance between the units, to increase cooling efficiency.

Specification of the M1 Module: M1 comes in four types.

1.) MDC M1 (35 racks, 72 square meters)
2.) MDC M1-C (fully integrated cooling module with MDC M1).
3.) MDC M1-COM (command module interconnecting several modules, allowing indoor monitoring and staff facilities).
4.) MDC M1-P (including built in power supply, MTU MeccAllte, Eaton UPS and batteries).

In this presentation the MDC M1, MDC M1-C (cooling) and MDC M1-COM (command module) is referred to as just **"M1 Module".**

The powering will be solved in a more centralized way for such a large installation, therefore the MDC M1-P will not be in use for this particular server farm.

Each M1 unit is designed for high density servers (blade model) with 400 kW effect for servers in one single module, and an additional 200 kW as redundancy for active cooling and backup.

Co-location: The M1 Module is built for co-location.

On one hand it allows a major global single player to take care of everything, and manage their own equipment. It can in this sense be used as a conventional single entry farm, in large scale.

But the flexible design also allows full co-location functionality. There are plenty of working space in each module. The space is designed from a ergonomic perspective, there for easy and flexible to work in.

This also means that the server farm can be opened for other players. It can be opened for different subcontractors, maintenance staff, and even other firms to operate and access the modules, with their own solutions.

Everything is managed by a fully integrated security system for personalized access. Monitoring all aspects of client and maintenance access.

The vision is to be able to offer the entire installation as a open and new arena for other business players, willing to take part of the benefits of being present at a large installation. This opens a new possibility for revenue streams not present at other similar server farms.

Management needed after installation: 15 people full size installation.

The M1 Module is fully automated and can be manned with a minimum of maintenance staff. The MDC M1 Program is a standardized concept, so it will be smooth and hassle free to keep maintenance at very cost efficient - but professional - levels.

Turn-key-solution

The solution provided in this presentation is a turn key solution including full height density racks, interior design, switches, internal IP-network, lights, pneumatically opened 750 kilo security doors, etc.

Armox 500T is cut out for the M1, SSAB factory (June 2011)

Command Module M1-C under production, Oswestry, England. September 2011

Deployment:

Stage 1:

Signing of letter of intent to finalization of contract. Acquisition of land.

Discussion of exact details and roll out plans for the facility. Localisation of suitable space for placement. Estimation of cost and presentation for public and commercial investors.

Presentation of business model for the server farm for other business interests.

Securing alliance partners, subcontractors and land owners. The goal for stage 1 should be a finalized contract and a "go ahead" road map for the installations - with land to build on.

Project leading will be performed in close cooperation with the clients legal and operational parties.

Estimation of time: 3 months

Stage 2:

Ground works at the site.

The work will follow a pre set design, where individual concrete slabs will be laid out in a pattern that covers the full installation for a total of 100 M1 Modules. All locally needed channelization for fibre and power (within the area connecting each module) will be performed at this initial time.

This could be done in a scalable way, by performing lesser installation work than initially required. However, that will later on increase construction cost, and consequently not be the most desired solution.

The ground works at stage 2 are focused to prepare the land for a full deployment for the total area, even if there will be a smaller amount to begin with.

Establishment of power installations, and power grid connectivity.

Estimation of time: 9 months:

Stage 3:

Deployment of MDC M1 Modules in batches of minimum 10 (ten) units each time. The first 3 batches (total 30 M1 Modules) could be fully deployed 12 months after starting of ground works (in stage 2).

This means that a fully operational data centre of 1050 high density racks, with place for at least 44.000 servers, could be operational within 12 months of finalization of contract.

The modules are put in place by transporting them from the factory, and assembled quickly on the site. This work is for the first 3 batches (if so required) done simultaneous as the ground works, and major power installations. Individual M1 components will be placed by crane.

Estimation of time: 3 months after finalization of ground works.

Stage 4:

Deployment of additional batches of M1 are made upon client request. This makes the facility fully scalable to client needs. It will be possible to adjust scale on demand, business models and financial means.

The Large MDC M1 Program allows great flexibility. Even single M1 unit can be rolled out upon request. The area is in any case fully prepared to install a total of 100 modules, for a 60 Megawatt server farm, with a total of 3500 high density racks.

Deliverance time for each 10 unit batch, from ordering to installation, is 3 months. Production and manufacturing resources are designed for serial production in large scale. But even so, one must be realistic, and allow 3 months of time between the batches.

A estimation of time up to full size installation (a total of 100 modules) will take 30 months after contract signing. The calculation is based on 3 months production time per batch (70 modules in 7 batches in total, for completion of stage 4).

Full size global data centre: 30 months after "go ahead"*.

Please note: Production time is based on existing production resources. A future enhancement of serial production capabilities, may greatly increase speed for deployment of later batches.

Estimation of investments

Stage 1:

Project management: 125.000 Euro

Signing of letter of intent for the project. Project planning, customization of plans to exact needs, negotiating with sub-contractors, real-estate owners, commercial- and public interests. Legal structure for contract and presentation of the material. Whether simulations for calculation of cooling. Application for building permits or similar. Negotiations with city.

Acquisition of 25.000 square meters of land: 3000 000 Euro.

Based on current real estate prices for industrial land, based on current pricing in greater Stockholm area (November 2011).

Total cost in stage 1: 3125 000 Euro
Accumulated cost: 3125 000 Euro

Stage 2:

Project management: 125.000 Euro.

The MDC consortium will provide project planning and management throughout this phase.

Ground installations: 2.500 000 Euro

The price is based on existing offers from constructing entrepreneurs, and calculated from a needed space of 25.000 square meeters.

Fibre installation (several separate physical fibre ways): 500.000 Euro (5000 Euro per M1).

Based on full installation of fibre and full connectivity within the local area, connecting all 100 modules with redundant fibre network.

Local power distribution: 750.000 Euro (7500 Euro per M1)

Complete 400 volts connections to all modules from a central power distribution point within the facility.

External power distribution, dimension, 60 Megawatt: 7.500 000 Euro

The external power distribution requires a central access point, containing a fenced security area, separate high voltage transformers, switch gears and electrical equipment. This installation will be done by leading sub-contractors on this field, and in close cooperation with the power supplier.

Note: A smaller scale operation with less power, if so required, can be estimated. There is of course a possibility to start with a smaller installation, and then upgrade. However in this presentation we want to give the full picture of the total cost at a high density facility, based on existing prices and offers.

Power backup electricity: 7.500 000 Euro full size installation.

This price will be scalable depending of deployment of M1 Modules.

The diesel engines will be a total of 30 units of MTU, MeccAllte, providing 2 MW each in backup power. The total installation of 30 units will provide 60 Megawatt backup power. The installation will be performed in conventional containers, where the diesel engines will be delivered installed in frames in a turn-key-solution.

UPS Power backup: 7000.000 Euro full size installation (3500 racks).

This price will be scalable depending of deployment of M1 Modules. Equipment including batteries and UPS from Eaton. The price per M1 unit is 70.000 Euro.

Double fencing of area: 180.000 Euro

High density guard fencing of 25.000 square meters (750 meter x 2 = 1500 meter of high density guard fencing. Two separate security zones provides maximum security. (Surveillance and passing system are already included in each M1 Module.)

Total cost in stage 2: 26 055 000 Euro
Accumulated cost: 29.180.000 Euro

Stage 3:

Project management: 125.000 Euro.

The MDC consortium will provide project planning and management throughout this phase.

Deployment of 30 units of M1 Modules: 18.000 000 Euro (600.000 Euro per M1)

Deployment of M1 Modules in three batches of a total of 30 units of M1. Providing space for 1050 high-density racks, and 44.100 servers. The deployment includes a turn-key solution, containing both the cooling Module and the data centre M1 Modules, and all infrastructural equipment needed internally (IP-network, switches, internal fibre ducts, security systems, cameras, etc.)

Power needed in this first installation is approximately 20 Megawatt. The power output need, in stage 2 can therefore be scaled, to a lower value if this is requested.

Interconnecting Command Modules: 250.000 euro

Deployment of 5 (five) command modules interconnecting the M1 Modules.

Total cost in stage 3: 18.375 000 Euro
Accumulated cost: 47.555 000 Euro

Stage 4:

Project management: 125.000 Euro

The MDC consortium will provide project planning and management throughout this phase.

Stage 4 is a scalable way of growing the installation, minimizing need for financial exposure, until the space is needed.

It will be possible, in batches of even single M1:s, to expand the facility up to a maximum of 100 units - a medium sized global data centre of 60 Megawatts power, and a total of 147.000 servers (or other types of servers). Allow 3 months of time for batches of 10 M1 units to be installed.

Full size deployment of 70 additional M1 units: 38.500 000 Euro

Each unit is in stage 4 estimated at 550.000 Euro per full M1 installation. When all is completed in stage 4, 100 M1 units in total will be deployed.

Interconnecting Command Modules: 750.000 Euro

Deployment of 15 (fifteen) command modules interconnecting the remaining M1 modules, making it a full installation.

Total cost in stage 4: 39 375 000 Euro (given that all 70 M1 units are deployed in this stage).
Accumulated cost: 86 930 000 Euro
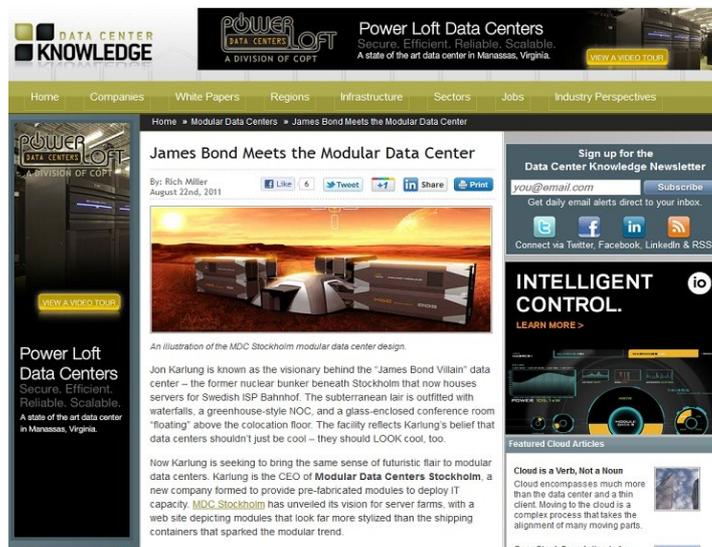
Great interest from people within the business

Cost of full turn-key installation:

Turn-key-solution for 60 Megawatt high density global data centre, according to the general specifications and details in this presentation.

A complete case study based on the large MDC M1 Program, and finalized in a contract, with specified details for a 60 Megawatt high-density server farm in armoured steel, and constructed in modular form, can be different.

Nevertheless, the goal has been to give the most accurate possible picture of the functionality, deployment and cost. The benefit of calculating a large data centre in modular form is to visualize the cost of individual modules and production time, making it possible to expand that in grander scale.

It is difficult to give exact estimates for ground installations, and power suppliers at this high voltage effect. Still, the calculation is done at professional level from people with extensive experience of the business. We have know-how, and we have made calculations to give a realistic picture of the final price tag.

Total cost -
Large MDC M1 Program (60 Megawatt)

Price: *86 930 000 Euro*
Cost per high density rack: 24.800 Euro
Complete deployment time from order: 30 months
Scalable: Yes. The concept is based on maximum scalability.
Pioneer factor and looks: Yes!

Price comparison Facebook (120 Megawatt)

Price: *350 000 000 Euro.*
Cost per rack: Unknown but the power 120 Megawatt is the limit.
Deployment time from order: 36 months
Scalable: No (or the facility will be divided in 3 centres, it might be possible to pull the plug after one single 40 Megawatt installation at 116.000 000 Euro).
Pioneer factor and looks: No!

Cost not included in presentation:
Financial costs, interest rates, etc.
Servers (can be 147.000 of 1 unit height, or just about any type of server).
Other possible data equipment connected to servers.
Routers and major network equipment for IP-network. This will be the scope of the client, rather than the provider of the data centre.

Additional information:

The material in this presentation and memorandum is confidential - further details and blueprints, hands on and specifications will be disclosed to potential investors and clients.

Contracts and specific details in this presentation are subject to change.

Local hands of the M1 Module, with a full presentation can be given at the installation site, and / or the factory where the M1 Modules are presentley under production.

Come and visit us!

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All modules are built in military **Armox 500T** provided by SSAB.COM

For spectacular information about this material check:
http://www.ssab.com/en/Brands/Armox/Armox-Web-TV