

M21 - a telematics-based mobility service for commuter traffic

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The State of Baden-Württemberg, DaimlerChrysler AG and other partner companies have been developing and testing new telematics-supported mobility services in the Stuttgart region to ease road congestion due to commuter traffic since 1998. The 'M21' project is a public-private partnership which set out to field test a package of mobility services in order to achieve optimal technical and organisational efficiency for a market launch. The core of the 'M21' package is the flexible, substantially au-

tomated and up-to-date brokering of car pooling opportunities in commuter traffic. The service is supplemented by the car-navigation-system 'Tele-Shuttle', up-to-date traffic information, short-term vehicle rental and 'Tele-Shopping' services.

In the first stage of the 'M21' project, the new mobility services are being tested using personnel at the Mercedes-Benz Technology Center in Sindelfingen near Stuttgart. An expansion of this trial to other companies and organizations in the

Stuttgart region is envisaged as of 2001.

Following completion of the project in December 2001, 'M21' is to be fully privatized with the aim of offering the new mobility services in other densely populated regions. The total costs of the pilot project amounting to approximately 10 million Euro, are being borne with a one-third share each by the State of Baden-Württemberg, DaimlerChrysler AG and partner companies which include the future private-sector service provider.

FIELD TRIAL - REASONS AND OBJECTIVES

In view of an increasingly overloaded traffic infrastructure there is now a general social consensus that the existing demand for transport should be handled with the greatest possible efficiency and environmental compatibility. One very promising approach is to use cars more efficiently for commuter traffic, particularly during peak periods. Despite a well-structured local public transport network, two-thirds of all commuters in the Stuttgart region currently use an automobile to travel to work. According to the available forecasts in the General Transport Plan of Baden-Württemberg and the Regional Transport Plan for Stuttgart Region, this situation is unlikely to change significantly in the future. For economic reasons it is seldom possible to offer attractive bus or rail links to service residential areas and work-places which lie outside the main transport arteries.

In addition, regular automobile commuters are nowadays confronted not only with bottlenecks in the road network, but increasingly often also with limited parking facilities at the workplace. In view of this, car pooling schemes for commuter traffic are becoming more and more important. Flexible working hours and increasingly varied working procedures among employees hamper the organization of 'classic' car pooling schemes with fixed partners at fixed times, however. In this respect the use of telematics provides the opportunity to make car pooling attractive for a larger circle of commuters by virtue of new technologies and organizational forms.

As part of the pilot project 'M21 - new telematics-based mobility services in traffic' the opportunities being opened up by telematics are being utilized for the flexible and favor-

ably priced brokering and administration of car pooling schemes. In addition, telematics-based supplementary services are tested with the intention to make participation in flexible car pooling schemes more attractive and therefore more economical. If these 'M21' services are well utilized, there can also be positive effects on the economy in the form of less congestion in commuter traffic, a reduction in fuel consumption and lower costs for the provision of employee parking spaces at the workplace.

A newly developed approach is designed to improve the market prospects of the newly-conceived 'M21' package of mobility services still further. The future customers and operators are already involved in the development and optimization of the mobility services as part of the field trials. The accompanying scientific research is designed to ensure that during the test phase, interim results can already be used to improve the service. It has also been possible to utilize the experience gained from earlier public-private-partnership projects relating to the use of telematics in the Stuttgart region (including the STORM field trial for regional traffic management in the Stuttgart region, 1991-1995).

Five mobility services have been developed in the project 'M21'. These are currently being examined and tested.

Dynamic-Car-Pooling service - 'M21-FahrPLUS'

'M21-FahrPLUS' is the core component within the mobility services to be tested in the project 'M21'. Unlike conventional car pooling schemes, it allows a high degree of flexibility when organising car pooling at the departure times required by the participants. Requests by passengers and offers by drivers can be logged and brokered on an updated daily basis via the Intranet company-intern or Internet by a sub-

stantially automated, inexpensively operated Mobility-Service-Center. Long-term bookings and standing arrangements can also be made. By virtue of its flexibility, the Dynamic-Car-Pooling service is particularly suitable for the growing number of employees with flexible working hours.

During the current pilot operation, the automated Mobility-Service-Center compiles the optimum car pooling arrangements and their routes at 2pm. The automated matching service takes into account the fact that customer will usually only accept a detour amounting to at most 10% of the journey or a time loss of 5 minutes. To increase the flexibility of the car pooling service, the matching operation will take place each afternoon on an hourly basis from January 2001, using the bookings logged at the time. To improve the brokering results in regions with fewer participants, defined and well-marked meeting points en route will be included. In Baden-Württemberg, the 'Parken & Mitnehmen' car parks at motorway junctions already provided by the road transport authorities have proved to be particularly favorable meeting points for such car pooling arrangements.

The names of car pooling participants, meeting points, departure times and routes are made available to customers by email, fax, SMS mobile phone message or telephone. During the pilot operation phase, the participants arrange payment of the proportional vehicle operating costs per

journey amongst themselves. The Mobility-Service-Center only gives the participants a recommendation concerning a reasonable share of the operating costs per kilometer travelled. The cost-effectiveness of a WAP link for the 'M21' service is currently being examined.

The so-called Mobility Guarantee for the home journey in the evening has proved to be a major factor for the acceptance of M21-FahrPLUS among test customers. Should the Mobility-Service-Center be unable to find a suitable sharing arrangement on any occasion during the present pilot operation, the customer is able to use a vehicle from the available, company-owned car fleet or – if this is justifiable in terms of travelling time – travel home by public transport using a transferable environment card. When this pilot operation is later expanded to include other companies, there are plans to organize the Mobility Guarantee in a similar manner.

M21-Tele-Shuttle

The M21-Tele-Shuttle is a technologically enhanced telematic variant of the Dynamic-Car-Pooling service. It enables even larger groups of participants to be flexibly organized without impairing quality. Via a mobile phone link, the Mobility-Service-Center provides the driver with an up-to-date route recommendation and he or she is guided to the home addresses of the passengers or the final destination by the on-board navigation system. Another advantage of the Tele-Shuttle technology is that groups of sharers travelling to work can be matched at a much later stage, and the names and addresses of passengers can be transmitted directly to the driver while he or she is already on the route. To avoid unnecessary delays when picking up passengers, the latter are briefly informed of the vehicle's impending arrival at home by telephone.

The service is designed so that in the final development stage the passengers are able to book the service at any time and join the relevant vehicle at a location of their choice. Unlike the Dynamic-Car-Pooling scheme, the information technology link between the Mobility-Service-Center and the vehicles in the case of the Tele-Shuttle principle is effected via a communication terminal with route guidance and an on-board computer which is integrated into the M21-Tele-Shuttle vehicle. For the ongoing demonstration phase, a Mercedes-Benz V-Class has been equipped with a telephone, on-board computer and satellite-based navigation system. Test customers for M21-FahrPLUS are available as drivers. At a later stage, there are also plans to equip the private vehicles of 'M21' participants with the necessary telematic equipment on request.

Additional services are offered to render the Dynamic-Car-Pooling service more attractive:

M21-Traffic Information

As an additional service, up-to-date traffic information is offered to 'M21' drivers via the 'M21' homepage in the Intranet/Internet. 'M21' customers are also able to order SMS-based, route-specific mobile phone information concerning the traffic situation at the required time of day.

The traffic information is automatically obtained from the available data sources by the Mobility-Service-Center, processed if required and made available to the 'M21' customers. During the current pilot operation the up-to-date, route-related road traffic information generated by the State of Baden-Württemberg coordinating center is transmitted to the participants by radio in the form of RDS/TMC messages. In addition, the 'M21' homepage provides direct access to the electronic public transport timetable information system provided by e.g. the State of Baden-Württemberg, Electronic Timetable

Figure 1: Range of services within the telematics-based 'M21' mobility package.

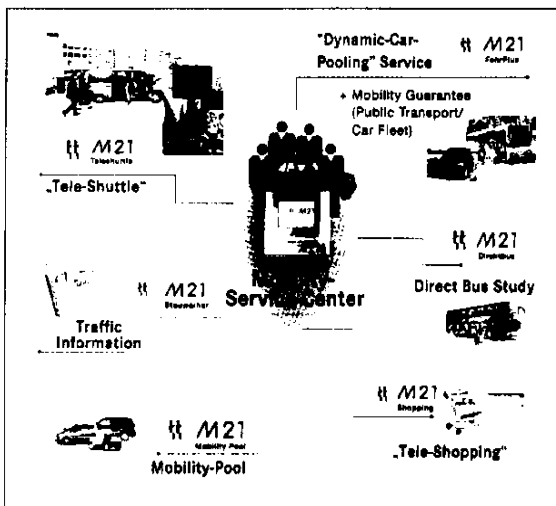
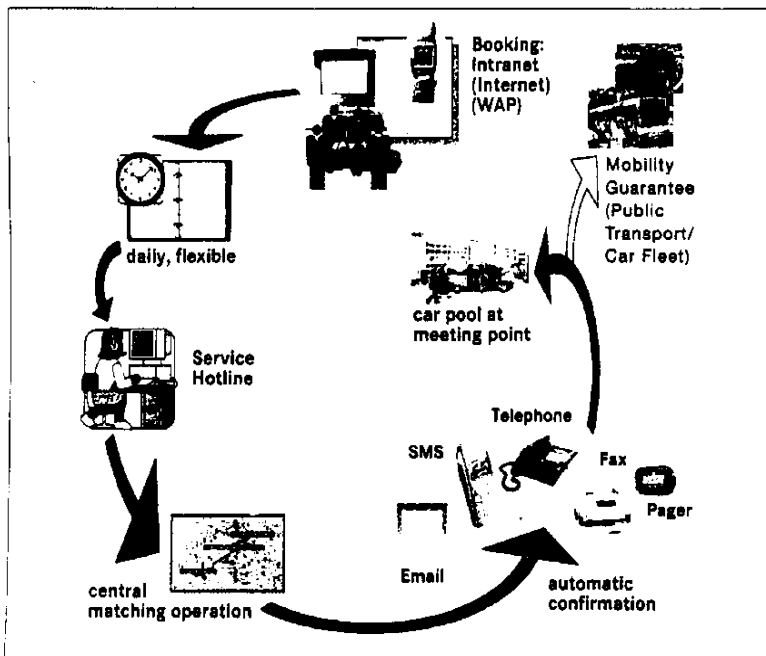


Figure 2: Brokering procedure for Dynamic-Car-Pooling groups in 'M21-FahrPLUS'.



Information 'EFA Baden-Württemberg', the German railways, Stuttgart airport and other mobility services. The option of receiving traffic data from a planned mobility information network for Baden-Württemberg is also available.

Use of vehicle pools – M21-Mobility Pool

Another additional service for 'M21' participants to make the 'M21' service package more comfortable is the short-term rental of private vehicles and commercially operated fleet vehicles via the Mobility-Service-Center. This enables 'M21' customers to satisfy their varied mobility requirements at low cost and while conserving resources even in their leisure time.

As a first stage during the current pilot operation, vehicles are available on short-term rental for specific transport tasks which cannot be carried out with the customer's own, everyday vehicle. Under the product name M21-Mobility Pool, the short-term rental of a Mercedes V-Class for transporting bulky items, a Mercedes A-Class multi-purpose vehicle and two smart convertibles as 'fun-cars' have been available from the smart Center in Leonberg since May 2000. 'M21' participants can book these vehicles by telephone or fax.

In a second stage, private vehicles which are not used for commuting to work for private or professional reasons are also to be brokered for short-term rental via the M21-Mobility-Service-Center (especially vehicles owned by passengers in Dynamic-Car-Pooling schemes). This improves the utilization level of private vehicles and reduces the individual operating costs. If this service becomes widespread, automated booking via the M21-Mobility-Service-Center could ensure a high level of vehicle availability and short travelling distances to vehicle drop-off points.

In a third stage, research will establish whether pool vehicles rented out by owners – preferably smaller vehicles – could also be deposited at nodal points in the local public transport system (e.g. train stations), which would involve the public transport system and render it more attractive.

M21-Tele-Shopping

As a further additional service in the 'M21' mobility package is workplace-based Tele-Shopping for day-to-day commodities. Using the telematics-based Mobility-Service-Center, participants in Dynamic-Car-Pooling schemes can order the goods they require from the Internet catalogue of the 'M21' supplier during their lunch break at the workplace, then collect them on-site before the journey back home at the parking-space. This avoids detours for daily purchases and separate shopping trips.

Starting as a first pilot test in January 2001, the first trial operation of an online shopping service took place in cooperation with an established supplier of food products. In a first stage, the ordered goods were delivered to a car parking place adjacent to the office-area of the Mercedes-Benz Technology Center in Sindelfingen. Later if it makes sense, the goods will be deposited in refrigerated, lockable compartments to make collection possible without time constraints.

M21-DIRECT BUS STUDY

An accompanying study will examine the market feasibility of direct connections using buses which are equipped with special information and communication facilities for commuters. This is to establish whether secure mobile telephone and Intranet/Internet connections in the bus will enable work to be carried out while on the daily journey to the workplace, thereby rendering travel by this means more attractive. Earlier research on the activity structures of salaried employees has shown that beyond the availability of com-

munication media, a wide range of professional tasks requires no particular infrastructures. In addition, the available communication facilities could be used for a wide range of entertainment offers.

TECHNICAL REALISATION

Logging and coordinating the incoming transport offers and passenger requests to form dynamic, flexible daily car pooling arrangements requires a central unit. The administration of these tasks is assured by the development of a Mobility-Service-Center. The concept of this Mobility-Service-Center takes into account the development of increasingly flexible working hours and is primarily based on the expected requirements of later users of the core service M21-FahrPLUS. The main emphasis is on the needs of potential participants in flexitime models. M21-FahrPLUS must meet the requirements of daily changes in departure times, participation as a driver or passenger according to choice and bookings at short notice. In addition to a high level of convenience and reliability by easy access to the system when 'reporting' and 'booking', rapid confirmation and the constant accessibility of the Mobility Service-Center, ensuring a guaranteed home journey and favorable pricing of the service are of decisive



Figure 3: Transfer of up-to-date traffic information by SMS.

Figure 4: Schematic of Tele-shopping for 'M21' members.

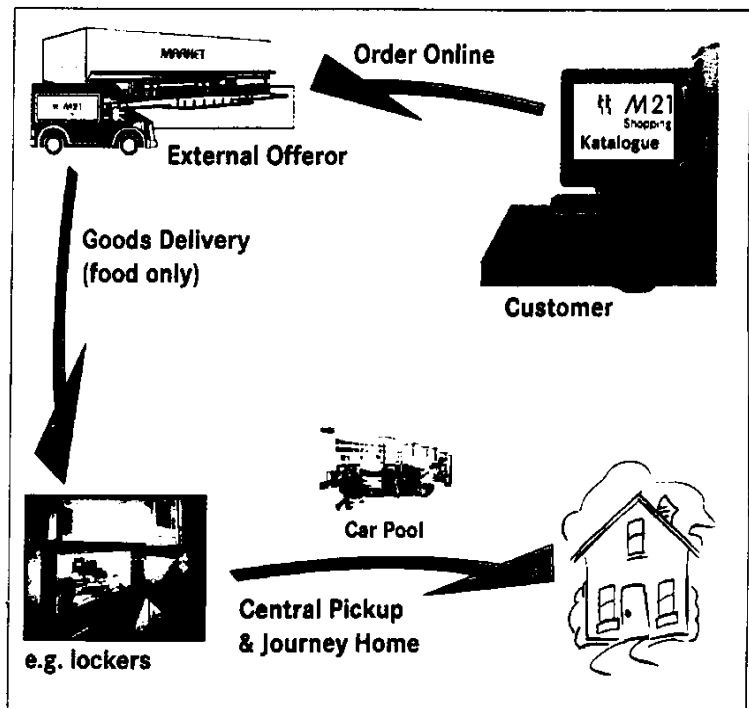


Figure 5:
The 'Teleshuttle'
vehicle in front of
the 'M21'
mobility service
centre.



importance.

Meeting the above requirements was part of the development of the M21-Mobility-Service-Center as a basis for M21-FahrPLUS and all the other mobility services to be integrated. At present the computer-based center provides participants with access via the DaimlerChrysler-Intranet and personal contact with an operator who may be reached 5 days a week between 8 a.m. and 6 p.m., and who will both register bookings and deal with queries and suggestions in exceptional cases. Users may use this Intranet access to select the functions of 'reporting', 'booking', 'cancellation' and 'amendment' of individual or standing arrangements. Until 2 p.m., it is possible to place passenger requests and driver offers for a return home-journey on the same day and/or for the journey from home to the workplace on the next working day. Current offers by other participants can also be shown, and one's own successfully matched journey displayed after the automatic, daily scheduling operation at 2 p.m. After matching, all the participants are sent an automatically generated confirmation via their individually configured communication medium (Email, SMS, fax, telephone).

The car pooling arrangements are made using a scheduling program which has been specifically tailored to the requirements of M21-FahrPLUS. The two decisive parameters are the detour factor, which describes a driver's maximum detour expressed in time, and the departure time difference, which describes the maximum time difference between the booked and actual departure times for both drivers and passengers.

In technical terms, the center is structured as follows: A server makes the access pages available via an Intranet server, organises the administration of participants using a database and administers the communication between participants and the center. A scheduling computer actually brokers the car pooling arrangements, administers the journey offers and requests as well as the routes, and communicates data between the center and the M21-Tele-Shuttle vehicles. The two computers communicate with each other via a pipe-client link.

Based on the experience gained from the pilot operation, the functionalities of the Mobility-Service-Center will be improved and expanded by the end of 2000 so that the M21-FahrPLUS service can be developed further into a second, user-oriented stage. By the end of 2001 the transfer of 'M21' operations to an operator in the private sector is planned in order to pave the way for commercial operation of the 'M21' services. The conditions for ongoing operation beyond the trial phase will be created by relocating the 'Mobility-Service-Center' to a computer center. To facilitate the integration of other companies, the system will be designed for client compatibility and for use in the Internet and in various Intranets. The fault-prone 'pipe-client link' will be replaced by a uniform database with access by both the server for participant and journey request administration and the scheduling computer for brokering of car pooling arrangements and the ad-

ministration of tour data. The concept permits consistent data storage. The present division of information transfer between the participants and the Mobility-Service-Center, which is carried out by two computers, will be consolidated into a single communication module.

In order to automate the brokering process, the scheduling program will be adapted as follows: in order to match up as many drivers and passengers as possible, the booking categories 'driver offer' and 'passenger request' will be supplemented by 'driver with option of passenger'. The latter will be automatically matched as either 'drivers' or 'passengers' depending on the current demand. An optimized distribution of passengers over as many vehicles as possible provides the highest matching rate.

In order to avoid large detours with long journey times, a percentage-based detour factor and an absolute upper limit for the extra time required are taken into account. Unattractive car pooling arrangements over short distances are avoided by the introduction of a minimum shared journey by drivers and passengers. Greater use of car pooling will also be achieved by greater brokering flexibility. Instead of once-only matching for the daily return journey with a booking deadline of 2 pm, scheduling will take place on an hourly basis in future, with booking possible up to one hour before the desired time of departure.

Since the initial impression of the service on first contact and daily use is of decisive importance for its acceptance, registration and booking will be made even more convenient: The participant will be offered optimized default settings with respect to departure point and destination, date, time and means of communication. The number of free seats and the luggage capacity can be individually configured for each booking. A preferred partner can also be nominated.

FIELD TRIAL EXPERIENCE TO DATE

The first phase of the 'M21' field trial at the Mercedes-Benz Technology Center (MTC) in Sindelfingen near Stuttgart commenced in September 1999. Here the M21 Mobility-Service-Center with the services so far realized is available to approximately 6000 employees via the Intranet. Up to July 2000, approximately 320 employees had registered as users of the Dynamic-Car-Pooling service M21-FahrPLUS, and a gradual increase in the number of participants to approximately 500 - i.e. almost 10% of the total MTC workforce - is expected.

Although the brokering process for flexible car pooling is a mainly automated routine, it has been found that individual online customer service in the case of queries and for solving unforeseen problems is an indispensable quality attribute of the 'M21' service package. For this purpose, a team of four employees is available at the Mobility-Service-Center by hotline or Email from 8 am. to 6 pm. every day. This high level of service was positively received by the users during surveys accompanying the project. It also enables customer requests to be registered immediately and the 'M21' package to be continuously improved in close contact with the test customers and subsequent end users.

The test experience to date particularly shows that marketing and advertising play a very important role. Firstly, they address potential new customers; secondly, the users are motivated to make bookings by continuous information, e.g. in information bulletins. It has been found that the number of new registrations and bookings increases following advertising measures such as flyers or articles in the employee newspaper. For 'M21' customers who are mainly interested in fixed car pooling arrangements, there are

plans to attach an electronic 'bulletin board' to the Mobility Service-Center. Only very few fixed car pooling groups have been formed among the present members. Sometimes these fixed groups also register and offer any vacant seats to passengers at M21-FahrPLUS.

Many of those interested in Dynamic-Car-Pooling live in more thinly populated areas on the outskirts of the Stuttgart region. With the present number of members, this can lead to major detours when collecting passengers. Acceptance of these detours varies – even detours amounting to 5% of the journey time are seen as unacceptable if the detour is against the direction of travel. Brief detours which eg involve leaving the motorway for a short period are also not accepted if the total journey time is more than 30 minutes. The meeting points at Park and Ride-sites along the motorways which have been established as an alternative are viewed positively at present, however they are only intended as an interim solution. Collection from the home address remains the desired norm, as it is only in this way that the private vehicles left at home by passengers can be made available to other members of the household or possibly for short-term rental to third parties.

One of the particular advantages of M21-FahrPLUS mentioned by test participants to date has been that it is the flexible alternative to inadequate public service connections between their homes and the workplace. In the case of passengers, one major motivation is the availability of the family car for other household members. Getting to know other colleagues was also emphasized as a positive effect.

ACCOMPANYING SCIENTIFIC RESEARCH

In order to assess the traffic-related effects of a planned general introduction of the 'M21' mobility package and to ensure customer-related and profitable development of the product, the project partners decided to have extensive accompanying scientific research carried out by a consortium of institutes at the Technical University of Stuttgart. The future operators of the services package are involved in these studies.

The accompanying scientific research is concentrated on the following aspects:

- Establishing the customer benefits by examination of acceptance behavior and its changes during the course of the pilot operation, as well as making recommendations for customer-related optimization of the products.
- Providing evidence for the commercial cost-effectiveness of 'M21' mobility services.
- Assessment of the traffic-related (general economic) benefits, including ecological effects.

A survey of 132 registered users carried out in June 2000 is an example of the in-teractive procedure during the course of accompanying scientific research. These were asked about various performance characteristics of the M21-FahrPlus service, among other aspects. The object of this study was to identify the strengths and weaknesses of the current service from the customer's point of view. This resulted in suggested measures by which the service could be made even more attractive, and by which further participants could be specifically attracted.

An assessment of 12 performance characteristics by a group of irregular users showed that it is particularly the specific features of M21-FahrPLUS – convenient booking at short notice, fair cost-sharing and assured homeward journeys by virtue of the so-called Mobility Guarantee – which are of outstanding importance to the customer. Responses to the question of what could be improved included the ex-

pansion of the service with more participants and more areas, as well as more conveniently located meeting points. This indicates that the attractiveness of the service will increase further following the planned expansion to other locations and companies. Moreover, the participants appreciate the flexibility and convenience of the M21-FahrPLUS system, as well as the cost and distance savings. Initial studies have shown that the users perceive car pooling journeys as less tedious.

INITIAL EVALUATION AND OUTLOOK

After one year of trial operation of the core module M21-FahrPlus, the theoretical approach of a telematics-based, Dynamic-Car-Pooling system has proved its worth in practice. Despite the high requirements of the test customers in terms of flexibility and convenience, the technical effort for automated brokering was realized at a very reasonable cost. However, it also became clear that a considerable marketing effort is required to attract and retain the demanding clientele. To date, the trial operation has indicated that subsequent marketing of the product M21-FahrPLUS offers good prospects, especially in larger companies and their surroundings. In the case of salaried employees with flexible working hours and long traveling distances to the workplace, the number of persons interested in flexible car pooling was more than tripled versus self-organized, fixed car pooling arrangements. This already indicates that an appreciable relief of the burden on the road infrastructure during peak periods is possible when the 'M21' services are offered on a general basis at a later stage. Scientifically established findings concerning the overall economic effects will however only become available following completion of the project.

In the course of further project stages, the 'M21' services package is gradually being expanded to include other DaimlerChrysler AG departments and other companies in the Stuttgart region. The experience gained to date strongly indicates that by completion of the pilot phase in December 2001, it will be possible to develop the telematics-based 'M21' products further into a profitable service for further operation on a purely commercial basis.

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